Three Essays on Inequality Across Space

DISSERTATION

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Abstract

This research is aimed at analyzing spatial differences in term of site characteristics and local policies and how they affect local/regional responses to wages, the return to schooling, and income inequality.

The first essay analyzes how important are both firms and households in shaping spatial wage differences in Chile, a developing country with a particular geography. The results indicate that amenities perform a key role in explaining spatial wage differentials in Chile. Because of its heterogeneous geography, natural endowments contribute significantly to the spatial wage patterns. However, man-made amenities also emerge as a strong force. The results also indicate that both firms and household preferences play a significant role in explaining spatial wage differences in Chile. Attractive regions for firms have higher average wage but these regions do not represent amenable places for households, with both productivity and amenity components pushing average wages up. Finally, it appears that most Chilean firms derive benefits from natural resource endowments and the associated concentration of economic activity in particular sectors

In the second study, spatial differences in the return to schooling are analyzed. The fact that more attractive places for workers may display a lower return to schooling, has been a great concern for both labor and urban/regional literatures. In this essay their

theoretical predictions are examined along with providing empirical evidence for Chile. The results suggest that those amenities related to firms seem to be the most important in affecting regional labor markets, in fact, the bias that affects the return to schooling estimate when site characteristics are omitted, seems to be highly influenced by differences in firms' productivity across space. However, the second set of empirical results show that both amenities related to firms (density) and to households (diversity and temperature) are significant, which confirms how important man-made amenities would be in order to understand the spatial pattern of the return to schooling in Chile.

Finally, the third study examines the effect of local government employment on income inequality across U.S counties. Particular attention has been paid to local governments in the United States since their past counter-cyclical responses to economic recessions. However, this behavior has not characterized the role of local governments in the last Great Recession. This study examines their effect on one of the most important population well-being indicators, which is income inequality. The results indicate that metropolitan and nonmetropolitan counties are affected differently by government employments. While for metropolitan areas local government employment enhances population well-being by reducing income inequality, nonmetropolitan counties are mainly affected by federal government employment. Also, the results suggest that bias is a serious issue when analyzing the impact of government on population well-being, hiding the real impact of government employment on well-being indicators.

To Susana and my mother

Con amor

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Chapter 1: Amenity decomposition: the role played by firms and workers in explaining spatial wage differences in Chile.

1. Introduction

Wage differences across regions can represent an equilibrium outcome when regions differ in the quality and quantity of amenities. Because amenities affect both firms' productivity and households' utility, regional wages vary to compensate workers and firms for those differences (Beeson and Eberts 1989). Accordingly, spatial equilibrium across regions is reached as a result of interactions between firms and workers, where amenities might represent valuable characteristics for both groups in every local labor market in a given environment.

Amenities, in general, can be defined as those site characteristics that affect both the household willingness to live in a region and firms' location decisions. Man-made amenities are the result of interactions between workers and firms i.e. agglomeration economies (Marshall, 1890). By contrast, natural amenities are site attributes such as mild temperature, landscape, and access to sea. The literature has devoted a significant effort in empirically testing the role played by amenities in affecting location decisions, in explaining spatial wage differences (Partridge et al. 2013), and analyzing city attractiveness for firms and consumers (Gabriel and Rosenthal 2004). However, for developing countries, the literature is scant. Furthermore, how important are either firms or workers in explaining wage differences across space seems to be absent from the literature. This lack of previous work is even more critical when it is recognized that, the higher income per capita, the more significant the effect of natural amenities on location decision when they are normal goods (Partridge 2010), and this increase on income is even more important for some developing economies.

Chile, as a developing country, presents several interesting features that place it as a noteworthy case. First, it is characterized by a particular geography, unlike most countries, Chile is a long and narrow country (4,400 kilometers long and, on average, 180 kilometers wide), and basically people can migrate only in two directions: north and south because the Pacific Ocean is in the west and the Andes Mountains are in the east. As Figure 1 shows, because all Chilean regions are located at different latitude, they are rather heterogeneous in terms of natural amenities e.g. temperature, precipitation, and natural resources.

Second, Chilean economic geography is also very interesting. Maps in Figure 1 show that both wages and housing rents display a similar pattern across space. Furthermore, urban development inherited a high concentration of population and firms in and around Metropolitan Region that includes Santiago[1] (M.R.) (Geisse and Valdivia 1978). This persistent urban agglomeration in M.R. is still developing, where man-made amenities such as infrastructure related to agglomeration economies definitely represent among the most valuable characteristics for both firms and workers, for the remaining regions, natural

[1] M.R accounts for 2% of total territory, 50% of production activity and 40% of population (Echeverria and Gopinath, 2007).

resources exploitation represent their most valuable characteristics[2]. This fact might be observed by looking at location quotients (LQ) computed for three economy activities displayed on the last three maps on Figure 1.

Because amenities are considered as normal/luxury goods, income is important because amenities are critical when workers make their location decisions only when they reach a specific income level (Partridge 2010). Chile was classified by the World Bank as a high income country in 2013, which means that the gross national income per capita is $12,616 or more[3]. One may expect that amenities are not playing a secondary role in Chile, and they represent a valuable component to understand the spatial wage distribution across its particular geography.

In this vein, the aim of this essay is to analyze the role played by both firms and workers in explaining spatial wage differences for a developing country with a particular geography and economic features, where both natural amenities and man-made amenities configure a unique environment to be studied. The data set spans from 2000-2011, and contains information about wages, housing rents, and both housing and workers characteristics. Also, some amenity variables that come from National Statistics Institute (INE) are used. This study performs a wage change decomposition into the amenity and productivity components, proposed by Beeson and Eberts (1989) for five points in time.

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[2] For 2008-2013, mining accounts for, on average, 15% of GDP, followed by industry with 12%. Central Bank of Chile http://www.bcentral.cl. Also, in 2012, minerals exports represented 62% of total exports. Monthly Report of International Trade. http://www.aduana.cl.

[3] For more information see http://data.worldbank.org/news/new-country-classifications.

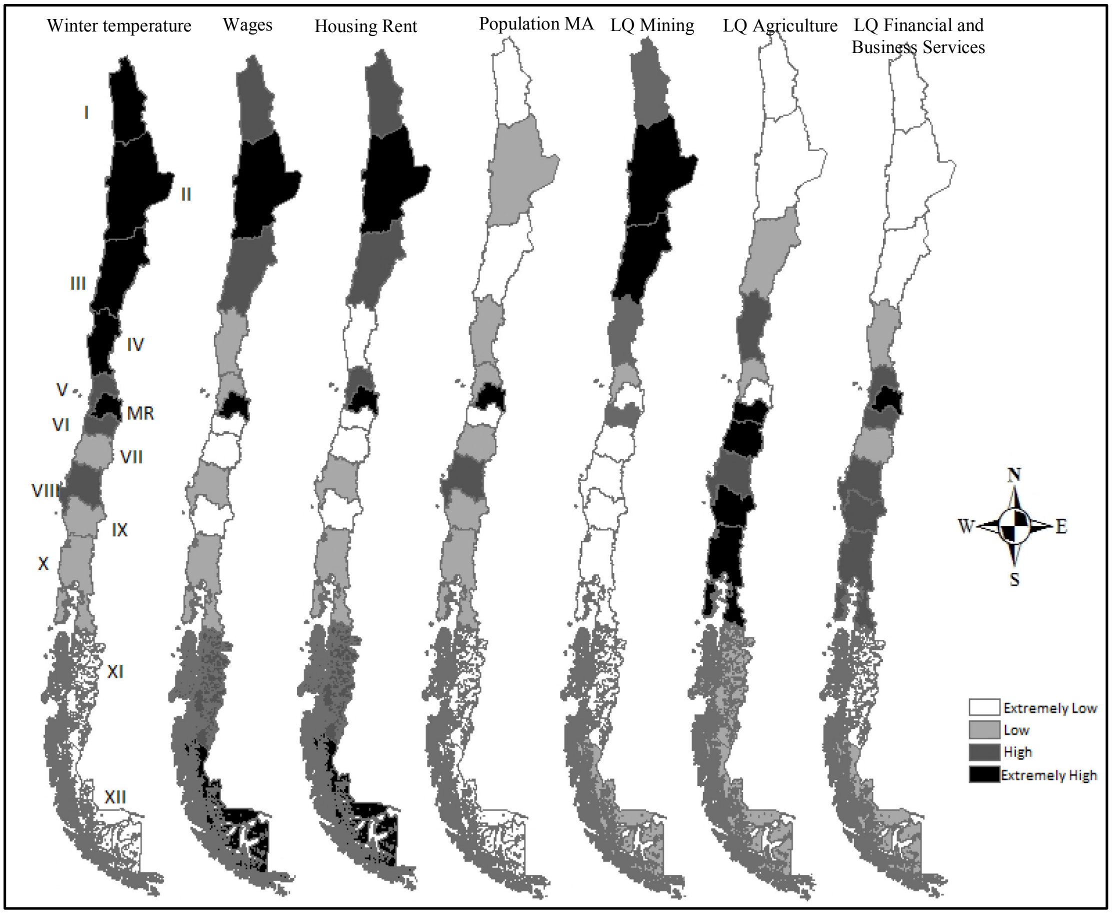

Figure 1. Economic Geography of Chile 2011.

After, it focuses on specific site characteristics to explain spatial differences on both productivity and amenity components for the Chilean regions. Among main results, it is found that both firms and workers play a significant role in explaining spatial wage differences in Chile. Also, workers seem to be more sensitive to natural amenities and more diverse places relative to economic structure in making migration decision, while firms are getting more benefits derived from agglomeration economies.

The rest of this chapter is organized as follows. Next section shows the theoretical framework and the wage change decomposition methodology. Section 3 outlines the data and econometric strategy along with some critical issues related to empirical estimation. Results are presented in Section 4. A robustness analysis is performed in Section 5. Section 6 concludes.

2. Theoretical Framework

This section will briefly summarize the SEM model of Roback (1982) and extensions made by Beeson and Eberts (1989). In a SEM framework, different amenities among cities affect both households' utility and firms' productivity. In this context, the representative household may be studied by using indirect utility function $V(.)$:

$$V(w, r; s) = V_0, \tag{1}$$

where $V(.)$ is function of wages, land rents and amenities denoted by w, r and s respectively. Utility, in equilibrium, has to be equal across regions, since workers can migrate without constraints across space.

The representative firm produces a composite commodity according to a constant-returns-to–scale production function. Assuming commodity price equals 1, in equilibrium, unit costs represented by a function $C(.)$ must be equal across regions and equal to price:

$$C(w, r; s) = 1 \tag{2}$$

The equilibrium condition involves the interaction between firms (labor demand) and households (labor supply) which determines both equilibrium wage and rent. In other words, both amenity (household) and productivity (firm) components are involved. In assuming linear isoutility and isocost curves, the slopes of the curves are (Beeson and Eberts 1989):

$$(dw/ds)^C/(dr/ds)^C = l^h \tag{3}$$

$$(dw/ds)^V/(dr/ds)^V = -L^P/N^P, \tag{4}$$

where l^h is the residential land, L^P and N^P are the land and labor used in production. As Partridge et al. (2010) state, the slope of each curve is determined by the movement on the other curve. This implies that the slope of isoutility is defined in terms of isocost curve, and analogously for the isocost curve. The total change in wages can be expressed as:

$$ds/dw = l^h\,(dr/ds)^C - (L^P/N^P)(dr/ds)^V \tag{5}$$

Finally the amenity component is obtained by using equation (5) and the change in rents for isocost and isoutility functions:

$$(d\log w/ds)^V = [(rL^P/wN^P)/(rL/wN)] * \big((d\log w/ds) - (k_h d\log p_h/ds)\big) \tag{6}$$

In equation (6), the housing price p_h reflects variations in land rents, thus it can be used to replace land rent (r) and k_h represents the share of a household's budget spent on housing. In addition, assuming that the total labor and total land represent the labor and land used in production, the term (rL^P/wN^P) may be expressed as $(rL/wN - k_l)$ where the last term represents the budget share of land (Beeson and Eberts 1989). Therefore, equation (6) allows for computing the amenity component of the total wage change, while the productivity component is calculated by subtracting the amenity component from the total wage change.

Figure 2 shows amenity decomposition. The upward sloping curves represent indirect utility functions $V(.)$ as function of wage (w), rent (r) and amenities (s). Likewise, unit costs function $C(.)$ for firm depends on the same arguments. Equilibrium 1 is reached in a city with s_1 level of amenities, while w_1 and r_1 represent equilibrium wage and rent respectively in that city. Equilibrium 2 is reached in a less attractive region for workers but a more attractive place (a positive net effect on productivity) for firms. Accordingly average wage is higher in the latter case because workers require a compensation and firms are able to pay a higher wage. According to Beeson and Eberts' (1989) methodology, total wage change from w_1 to w_2 can be decomposed into productivity and amenity components as Figure 2 indicates. While the first component is related to net effect on firms' productivity, the second one is related to workers' utility and then how they determine the final equilibrium wage in every region.

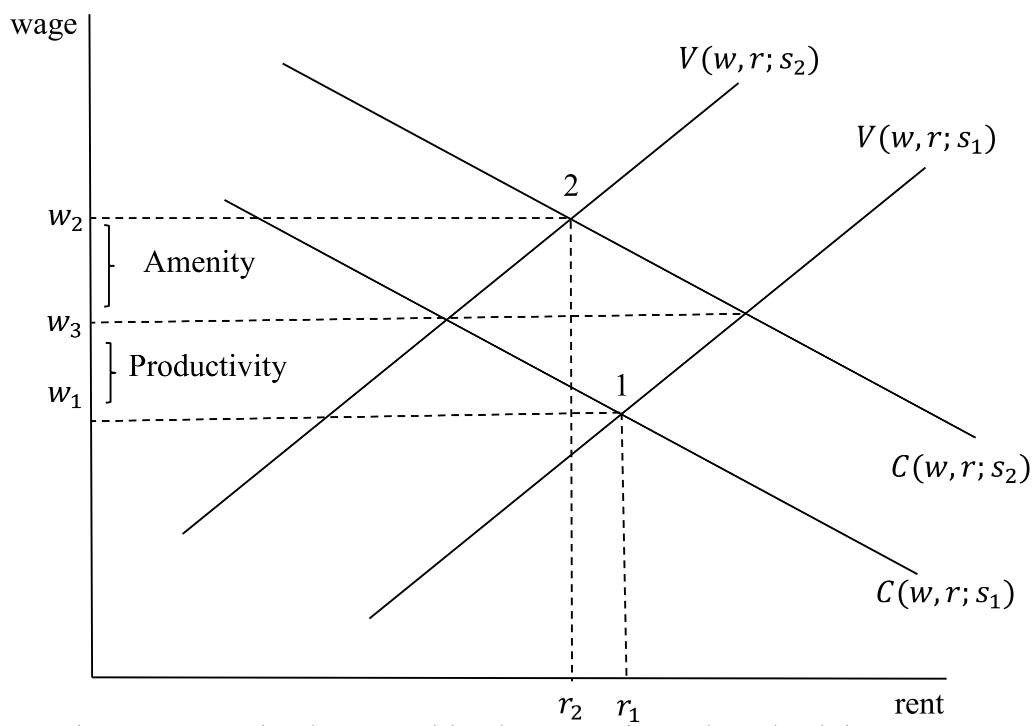

Figure 2. Amenity decomposition into amenity and productivity components

3. Data and Econometric Strategy

The main data sets are obtained from the Socio-Economic Characterization National Survey (CASEN) for 2000, 2003, 2006, 2009, and 2011. This survey contains individual information about wages and housing rents along with human capital and housing characteristics. Both full time and part-time workers are included, between the ages of 15 and 65 years old. With respect to housing characteristics, they are represented by the number of bedrooms, number of bathrooms, and quality indexes. More specifically, high wall quality index are those built from either cement or wood. Similarly, high quality indexes of floor and roof represents those built from cement. High quality housing represents a key housing characteristic that affects its value. Also, natural amenity variables such as precipitation and temperature (average and difference) are used. Man-made amenities are captured by employment density and diversity. Specific local advantages are represent by location quotient variables for mining, agricultural, and fishing activities. Table 1 shows more details about the set of variables.

Variable	Definition	Source
Log hourly wage	Hourly wage earned	CASEN
Human Capital variables		
Education	Years of education	CASEN
Experience	Age-years of education- 6	Computed
Marital status	Dichotomous variable=1 if individual is married, 0 otherwise	CASEN
Gender	Dichotomous variable=1 if individual is female, 0 otherwise	CASEN

Table 1. Variables, definition and data source (continued)
(2000-2003-2006-2009 and 2011)

Table 1 continued

Race	Dichotomous variable=1 if individual self-identifies as in one the eight indigenous groups: aymará, rapa-nui, quechua, mapuche, atacameño, coya, kawaskar, and yagán, 0 otherwise	CASEN
Rural	Dichotomous variable=1 if individual works in a rural area, 0 otherwise	CASEN
Occupation	Dichotomous variable for nine occupational categories	CASEN
Industry	Dichotomous variable for nine industrial classifications	CASEN
Rent and Housing attributes		
Log rent	Monthly housing rent	CASEN
Bedrooms	Number of bedrooms	CASEN
Bathrooms	Number of bathrooms	CASEN
Wall quality	Dichotomous variable=1 if wall is high quality, 0 otherwise	CASEN
Floor quality	Dichotomous variable=1 if floor is high quality, 0 otherwise	CASEN
Roof quality	Dichotomous variable=1 if roof is high quality, 0 otherwise	CASEN
Regional Amenities		
Precipitation	Total annual precipitation (mm)	INE
Average temperature	Average annual temperature (°C)	INE
Temperature difference	Difference between maximum and minimum average temperatures (°C)	INE
Employment Density	Regional employment density per square kilometer	Computed
Diversity	Inverse of Herfindahl index. $Diversity = 1/\sum_k s_{kj}^2$. Where s_{kj} is GDP share for industry k in region j.	Computed
Location quotients	$LQ = \frac{GDP_{kj}/GDP_j}{GDP_{kc}/GDP_c}$, where subscript c is country.	Computed

The econometric strategy involves two stages. First, it performs amenity decomposition for every period of analysis. In doing so, spatial wage differences in Chile might be characterized and analyze them through time. Second, it uses amenity variables to get some insight about the main reasons behind the specific amenity components for the whole time span.

3.1. First stage

The first step is to obtain quality adjusted measures for regional wages and housing rents, therefore both hedonic wage and rent equations need to be estimated[4]:

$$ln\, w_{ij} = \alpha^w + X_{ij}\beta^w + \varepsilon_{ij}^w \quad (7)$$

$$ln\, r_{lj} = \alpha^r + H_{lj}\beta^r + \varepsilon_{li}^r \quad (8)$$

For equation (7) the dependent variable is the natural logarithm of hourly wage[5] for individual i in region j ($j = 1, \dots, 13$), while the vector X includes years of schooling, experience, square of experience, gender, marital status, race, rural, occupation, and industrial sector. In equation (8) the dependent variable is the natural logarithm of monthly housing rent l in region j, vector H contains housing characteristics such as number of bedrooms, number of bathrooms, and quality index for roof, wall, and floor. Both equations are estimated for every year of the time span (2000, 2003, 2006, 2009 and 2011).

The quality adjusted values for both regional wages and rents are computed by subtracting the predicted values from the actual values. After that, quality adjusted average

[4] Equation 7 was also estimated by dropping the outliers using the studentized residuals and excluding those observations located at the tails of the distribution (below and above -2.5 and 2.5 respectively). Estimated coefficients only presented slight changes, therefore the whole sample is used in the analysis.

[5] The log specification follows the traditional literature of labor economics derived from Mincer (1974).

values are computed for every region[6]. Finally, total wage change can be decomposed into amenity and productivity components by computing Equation (6). To estimate equation (6), it is needed to compute first $(rL^P/wN^P)/(rL/wN)$. The ratio of income to land (rL) can be approximated by using the World Bank[7] data set for Chile which gives a value of 0.181. The ratio of income to labor (wN) is approximately 0.6 (Fuentes et al., 2006). Therefore, the ratio (rL/wN) equals 0.3017. Finally, the numerator (rL^P/wN^P) can be estimated by using the expression $(rL/wN - k_l)$, where k_l is about 0.066 (Sagner, 2009). Thus, the total expression $(rL^P/wN^P)/(rL/wN)$ is then 0.2357.

There are some empirical issues that need special attention. First, in estimating quality adjusted measures, it relies on the fact that these measures only contain information related to amenities. Because workers' characteristics estimates are subtracted from actual values from the wage equation and likewise, housing attribute information is subtracted from actual rent. However, it is not possible to control for every workers' characteristics, therefore the quality adjusted wage may be affected by omitted variables. The same caveat is relevant for housing rent quality adjusted measures, since there are some housing characteristics (year house built, number of floors, among others) omitted from the analysis. To deal with this issue, some robustness checks are performed to make sure that the amenity decomposition is reliable enough.

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[6] This study did not consider using spatial fixed effects as first step and then regress them on the amenity measures as in Clark et al. (2003) because we just have 13 regions.

[7] This data set corresponds to statistics for natural resources rents (% of GDP) http://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS.

Second, wage change decomposition uses several fixed ratios to compute amenity components. Specifically, it uses the share of a household's budget spent on housing (k_h), income to land ratio (rL), income to labor ratio (wN), and the budget share of land (k_l). In Chile, there are not specific measures for these ratios, hence they have to be taken either from other papers $(wN \text{ and } k_l)$ or secondary data sets $(k_h \text{ and } rL)$. Because of these limitations, it is strictly necessary to perform a sensitivity analysis to show the results are robust enough to several values of these ratios.

As a general issue, it is important to keep in mind the sorting process behind spatial equilibrium. Individuals display different preferences (types) for amenities, those individuals with high amenity valuations locate in regions with high amenities and accept lower wages (Graves, 2012). However, as regression analysis is conducted where all individuals' types are included, estimates represent a sort of average for those various groups (Roback, 1982).

3.2. The Second stage

The second stage focuses directly on regional amenity variables and how they can help us to understand the reason behind spatial configuration of the amenity decomposition in Chile. Specifically, amenity components previously estimated are used to estimate the following models:

$$(productivity)_j = \alpha + A_j\theta + \gamma_t + \varepsilon_j \tag{9}$$

$$(amenity)_j = \alpha + A_j\theta + \gamma_t + \varepsilon_j \tag{10}$$

In equations (9) and (10), dependent variables represent both productivity and amenity components estimated for every region j ($j = 1, \dots, 13$) and for every year ($t = 2000, 2003, 2006, 2009, 2011$). Therefore, there are 65 (13x5) productivity and amenity components. Vector (A_j) contains precipitation, temperature (average and difference), employment density, diversity and, locations quotients, and finally (γ_t) is a time fixed effect. These equations are aimed at finding out the reasons behind amenity components in Chile. Nevertheless, there are some empirical concerns that need to be addressed.

One of the main issues when a large set of site characteristics are incorporated into analysis is the close relationship they display which is reflected in the degree of multicollinearity between them. Because of this, this study only focuses in some specific amenity variables rather than a large list of them. Coupled with multicollinearity, endogeneity issues arise as well. This problem is particularly important for man-made amenities. For instance, Chile displays only one large urban agglomeration in and around Santiago in the M.R. The chosen agglomeration measures (e.g., density) are meant to be closely associated to other man-made amenities, such as crime rates and recreational activities. In order to avoid multicollinearity, the economic strategy just focuses on some specific agglomeration variables such as employment density and diversity, though omitted variable bias may arise if these are imperfect proxies. In sum, there is a tradeoff, and instrumental variables will be used to address possible endogeneity.

The three natural amenity variables, precipitation and temperature (average and difference) might be treated as exogenous. Since geography of Chile is rather heterogeneous, it is expected these site characteristics to play an important role for both firms and workers. Also, location quotients for mining, agricultural, and fishing activities are incorporated, to capture the variability across space related to specific natural endowments (localization economies) that represent the main economic activities across Chilean regions.

Finally, as mentioned, man-made amenities are proxied by two measures, employment density and diversity. The former is aimed at reflecting the net effect of urban agglomeration (benefits and congestion costs) because firms located in and around the M.R. are able to take advantage of denser input-output linkages, thick labor markets, and technological spillovers (Marshall, 1890). Also, urban agglomeration might display important benefits for consumers called consumption amenities (Glaeser et al. 2001) but there might be also congestion costs derived from denser regions. Therefore, either a positive or negative sign on the estimated parameter is expected. As stressed by Glaeser et al. (1992) some benefits of agglomeration come from areas highly industrially diversified (Jacob's externality). Accordingly, the second measure is the diversity of economic activity in every region.

As mentioned, it cannot be assumed that the man-amenity measures are orthogonal to the error term. To address any potential endogeneity, this section follows partially the approach proposed by Combes et al. (2008). It uses lagged employment densities for Chilean regions as instruments to incorporate historical features of agglomeration from 1907, 1920, and 1930. The main aim will be to reduce the potential bias, though the performance of the instruments will be tested.

4. Results

The estimates from Equations (7) and (8) are shown in Tables 14 and 15 respectively (see Appendix). In both wage and rent models, the estimates show the expected signs and they are all statistically significant. This is followed by the calculation of the quality adjusted measures for regional wages and rents, which are the base to perform the wage change decomposition into amenity (workers) and productivity (firms) components for every period.

As shown in Figures 3 to 7, the wage change components are rather stable over years except some slight changes. In Chile, higher average wage regions (I, II, M.R, XI and XII regions) are attractive places for firms, and relative to other regions, less amenable regions for workers. Therefore, both amenity and productivity components push wages upward. As can be seen, both workers and firms are affected differently by site characteristics, these differences are related to the fact these regions present several valuable characteristics from the productivity side, that is, important sources of natural resources and advantages relative to quality of infrastructure that characterizes major urban agglomerations (M.R). However, from the household perspective, these regions display unattractive climate conditions coupled with the fact that those regions are located in isolated geographical zones, except the Metropolitan region, where consumption amenities do not seem to be strong enough to classify the M.R as a high amenity regions for households.

On one hand, while M.R., the most populated Chilean region, is positively related to firm productivity, it is an unattractive regions for households, suggesting that urban consumption amenities do not appear to offset congestion costs. The M.R. is not characterized by key natural amenities, rather, man-made amenities related to populated places is the most relevant feature for both firms and consumers. On the other hand, regions I, II, XI and XII are endowed with significant natural amenities. While in northern regions mining activity represents the main economic activity, fishing activity represents the main economic engine in regions XI and XII. Nevertheless, attractiveness of these places for firms does not apply to the households. They are all very isolated regions with the Atacama Desert in the North and the south of Chile where fishing is prevalent, very low temperatures are common. The other regions present mixed results. There are only two regions (VIII and IX) that represent more desirable places for households but less attractive for firms, and consequently have lower averages wages. It is interesting to notice that in Chile, there are no attractive regions for *both* workers and firms. In other words, firms are located in those places that are not amenable places for consumers and vice versa. Undoubtedly, this fact has a major relevance in explaining spatial wage patterns across Chilean regions.

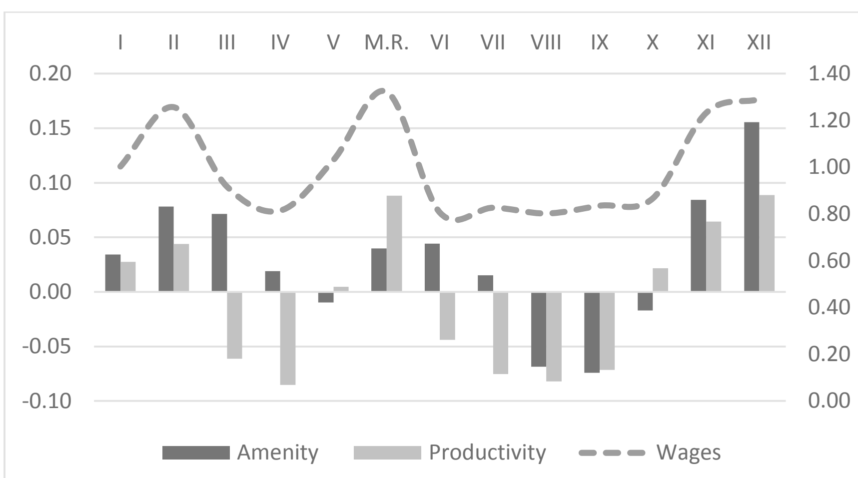


Figure 3. Amenity decomposition for Chilean regions: 2000

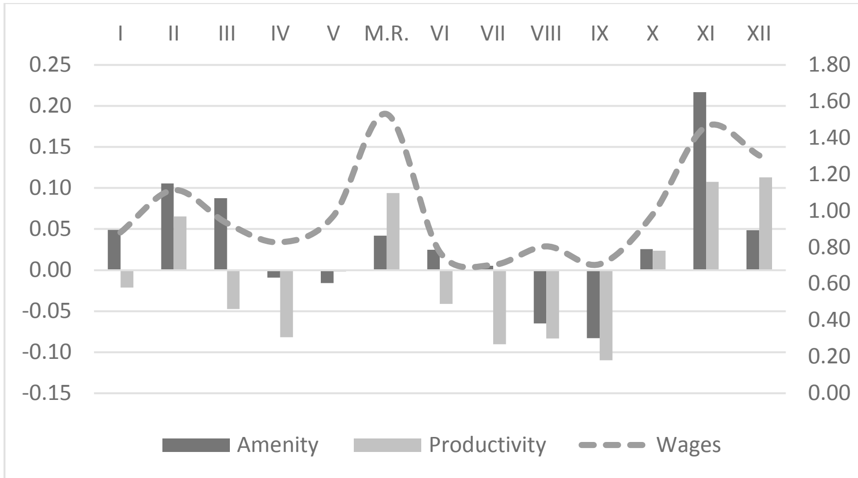


Figure 4. Amenity decomposition for Chilean regions: 2003

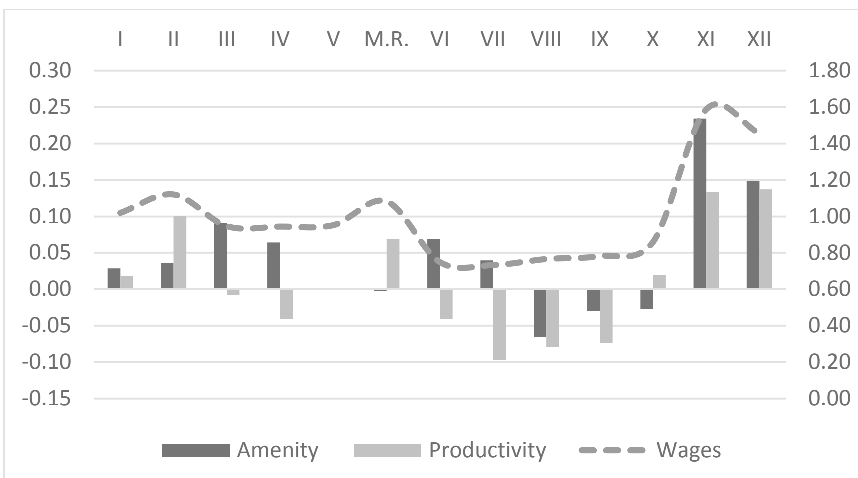


Figure 5. Amenity decomposition for Chilean regions: 2006

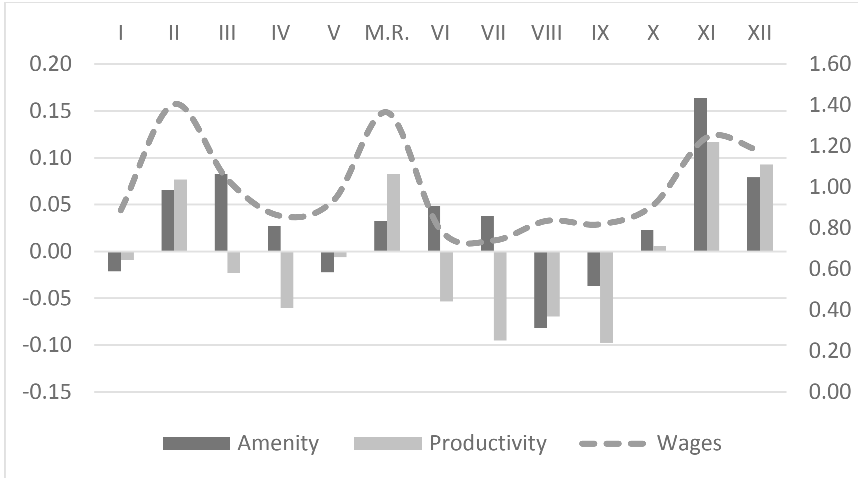


Figure 6. Amenity decomposition for Chilean regions: 2009

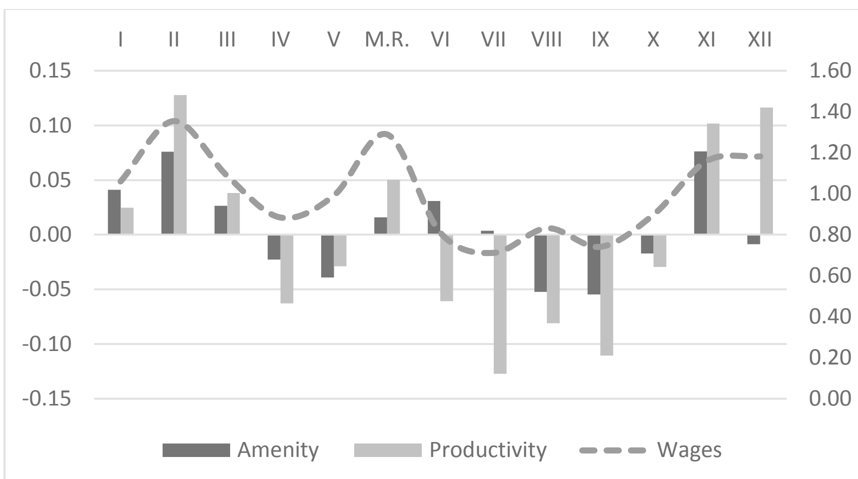


Figure 7. Amenity decomposition for Chilean regions: 2011

Table 2 shows OLS and 2SLS estimated coefficients from Equations (9) and (10). As mentioned, after controlling for both housing and human capital characteristics, regional average wage differences represent both amenity and productivity differences across regions, therefore this stage is aimed at finding those site characteristics that may explain this heterogeneity across space. For workers (amenity component), regions with higher levels of precipitation represent more amenable places. In fact, it is the unique natural amenity that is statistically significant. The positive sign for LQ fishing activity might be reflecting the fact that this activity takes place in very isolated regions, because of that a positive compensation in required to attract a workforce. Both the amenity measures - density and diversity - display negative relationships with amenity component suggesting that consumption amenities are valuable enough to make households accept a lower wage. However, a potential bias may be affecting those estimates.

Firms present a slightly different scenario with the productivity component being significantly related to precipitation and average temperature. Both of these coefficients are negative, suggesting a link to firm productivity. In terms of man-made amenities, it can be seen that both employment and diversity are significantly related to firm productivity. However, they display opposite signs. While employment density is positively related to firm productivity, diversity display a negative sign, indicating that a heterogeneous set of industries does not have a positive effect on productivity. On the other hand, productivity is positively associated with fishing activity, however agriculture displays a negative association. These results suggest how important localization economies are in the Chilean context, though endogeneity may play a role, which will be addressed on the next econometric stage.

Variables	OLS		2SLS	
	Amenity (workers)	Productivity (firms)	Amenity (workers)	Productivity (firms)
Precipitation	-0.0875***	-0.0574***	-0.0898***	-0.0737***
	(-5.18)	(-3.10)	(-5.68)	(-3.94)
Average temperature	-0.0009	-0.0134***	-0.0023	-0.024***
	(-0.23)	(-3.08)	(-0.51)	(-4.38)
Temperature difference	0.0025	-0.0017	0.0022	-0.0039*
	(1.22)	(-0.75)	(1.13)	(-1.69)
Employment density	-0.0142*	0.0167*	-0.0105	0.0429***
	(-1.76)	(1.88)	(-1.02)	(3.53)
Diversity	-0.0487*	-0.0834***	-0.0508**	-0.0985***
	(-1.77)	(-2.76)	(-2.03)	(-3.33)
LQ Mining	-0.0078	0.0007	-0.0058	0.0150*
	(-1.13)	(0.09)	(-0.79)	(1.72)
LQ Agriculture	0.0061	-0.0165**	0.0072	-0.0083
	(1.02)	(-2.51)	(1.24)	(-1.21)
LQ Fishing	0.0094***	0.0087***	0.0099***	0.0124***
	(4.62)	(3.91)	(4.74)	(5.01)
Constant	0.172**	0.355***	0.186**	0.454***
	(2.08)	(3.92)	(2.36)	(4.86)
N	65	65	65	65
R-sq.	0.664	0.690	0.662	0.637
Note: t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01. All regressions include year fixed effects. For 2SLS estimates, First stage F is around 16 and adjusted partial R-sq. for employment density is 0.3527, p-value of Hausman test is 0.0025 for firms' productivity model.				

Table 2. Amenity and productivity components regressions: Equations (9) and (10)

The last two columns in Table 2 report the 2SLS estimates in which employment density is treated as endogenous. For households (amenity component), there is no significant difference between the OLS and 2SLS estimates with the estimated parameters being very stable, except density, which is not significant anymore. Diversity remains statistically significant and it is actually larger, suggesting that it represents an amenity for households, and they would be willing to move to more diverse places accepting a lower wage. This result may be related to two facts, first more diverse places can offer more consumption amenities to households and second, in places that display a more heterogeneous industrial composition, households increase their opportunities to find a job, which may represent a valuable amenity, and they are willing to accept a lower wage.

The most interesting results are for the productivity component. All significant coefficients are now larger (in absolute terms) compared with the OLS estimates. Natural amenities (precipitation, temperature) are negatively related to firm productivity. In terms of man-made amenities, employment density shows a large positive effect on productivity, indicating that endogeneity represented a serious concern on the OLS estimates. While the diversity coefficient is also larger than OLS estimates, it is also negatively related to firms' productivity and the coefficients for the LQ for fishing and mining activities are positive. These set of results strongly suggest that Chilean firms receive benefits related to specialization rather than diversity.

5. Robustness analysis

A robustness analysis is performed to ensure that the results are stable. First, the wage decomposition uses several fixed ratios to compute the amenity components. Specifically, it uses the share of a household's budget spent on housing (k_h), income to land ratio (rL), income to labor ratio (wN), and the budget share of land (k_l).

Region	Base analysis		Change in k_h +10%		Change in k_h -10%	
	Amenity	Product.	Amenity	Product.	Amenity	Product.
I	0.024	0.017	0.021	0.020	0.027	0.014
II	0.064	0.100	0.042	0.121	0.085	0.079
III	0.063	-0.011	0.071	-0.019	0.056	-0.004
IV	0.017	-0.067	0.036	-0.085	-0.001	-0.048
V	-0.015	-0.006	-0.015	-0.006	-0.016	-0.005
VI	0.050	-0.049	0.067	-0.066	0.034	-0.033
VII	0.027	-0.101	0.055	-0.130	-0.001	-0.073
VIII	-0.063	-0.084	-0.046	-0.101	-0.080	-0.067
IX	-0.052	-0.099	-0.030	-0.121	-0.074	-0.077
X	0.002	0.004	0.002	0.004	0.003	0.003
XI	0.128	0.110	0.108	0.130	0.147	0.091
XII	0.061	0.116	0.035	0.142	0.086	0.090
M.R.	0.023	0.084	0.003	0.104	0.043	0.063

Table 3. Sensitive analysis for share of household budget (k_h)

There are no official Chilean measures for these ratios, hence they have to be taken either from other papers (wN and k_l) or secondary data (k_h and rL). Because of these limitations, it is strictly necessary to perform a sensitivity analysis to show whether the results are robust to changes in these ratios.

As Table 3 shows, it just focuses on one specific ratio and, the values for both amenity and productivity are robust to an increase in k_h. It is clear that the reported values change when k_h is modified, but the change is very small. Thus, there are no significant differences between the base analysis and alternative values for k_h.

It is also assessed whether the amenity decomposition is robust to alternative ways of defining the site characteristics. This is a critical issue because the wage change decomposition methodology does not explicitly define the specific measures of amenities such as crime rate, temperature, or access to sea, but rather it relies on error terms from both wage and housing rent estimates to compute the amenity components (adjusted quality measures). Consequently, a quite simple way to perform this assessment is to examine the regional fixed effects in a manner proposed by Gabriel and Rosenthal (1999). Figures 8 and 9 show the comparison between regional fixed effects and the results with the quality adjusted measures derived from Beeson and Ebert's methodology. Though the results do not perfectly correspond, they do suggest that both procedures produce very similar patterns.

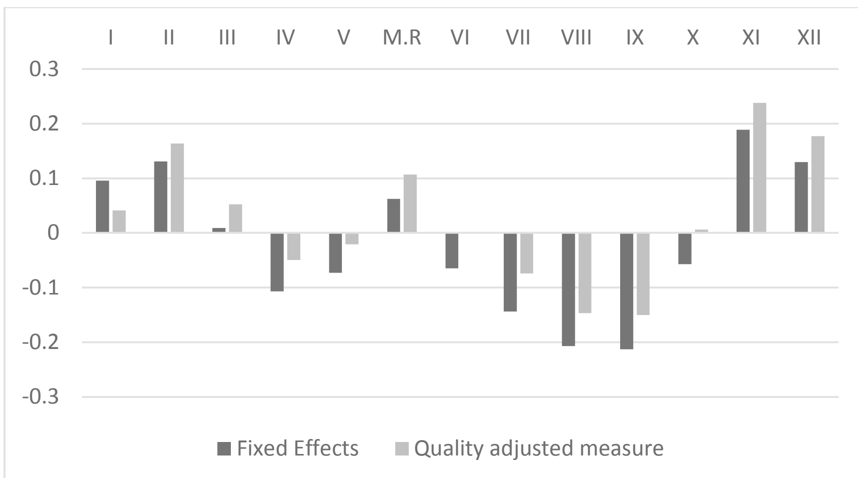


Figure 8. Regional Fixed Effects and Quality adjusted measures: Wages 2000-2011

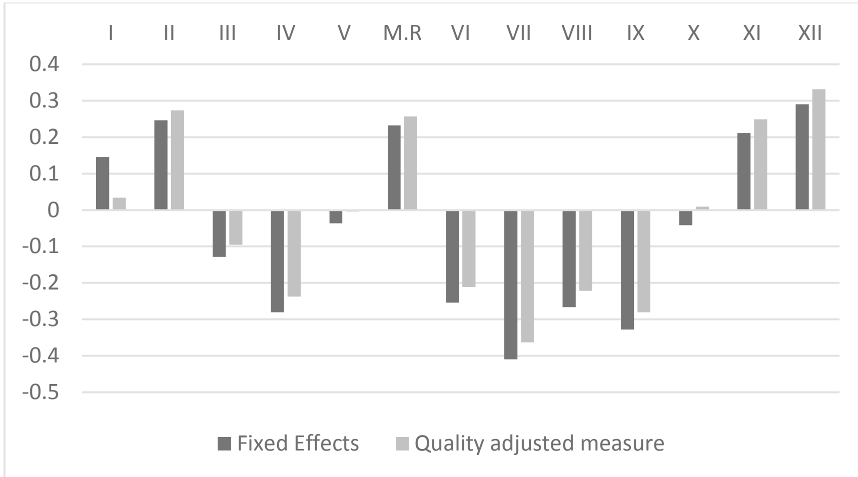


Figure 9. Regional Fixed Effects and Quality adjusted measures: Rents 2000-2011

6. Conclusion

This study concludes that amenities perform a key role in explaining spatial wage differentials in Chile. Because of its heterogeneous geography, natural endowments contribute significantly to the spatial wage patterns. However, man-made amenities also emerge as a strong force for explaining regional wage differences. More specifically, high wage regions II, XI and XII all have natural endowments as their main economic engine that are less desirable regions for households. The M.R. surrounding Santiago has one of the highest average wages in Chile as it is a high amenity place for firms and low amenity region for households. The results also indicate that both firms and household preferences play a significant role in explaining spatial wage differences in Chile. Attractive regions for firms have higher average wage but these regions do not represent amenable places for households with both productivity and amenity components pushing average wages up.

Finally, it appears that most Chilean firms derive benefits from natural resource endowments and the associated concentration of economic activity in particular sectors.

Despite the fact that Chile is not a developed country, empirical evidence shows that both workers and firms pay attention to amenities to make their location decisions. Moreover, SEM performs as an appropriate theoretical framework to represent and understand spatial configuration in a developing country like Chile with growing income level. Additionally, the wage change decomposition emerges as a useful methodological tool to disentangle how important both firms and households are in shaping spatial differences in wages for both developed and developing economies, providing valuable empirical evidence to several actors such us scholars, policy makers, and government agencies.

From a policy perspective, this study encompasses several points that deserve to be taken into account. Chile is a very centralized country, where the main public agencies and governments are located in Santiago (M.R). Also, Chile displays a higher income inequality that has been very persistent across time coupled with a high concentration of human capital in and around M.R. This study suggests that amenities seem to be more important for firms in making their location decisions, while households appear to place a large weight to the chances of getting a job. Currently, it seems that providing a better economic environment for firms (man-made amenities), would affect their location decisions by moving them to those more economic friendly places. In doing that, human capital would be able to move to those regions that now display lower average wages. Both facts would create a positive reinforcement to push those less developed regions forward where endogenous amenities (man-made amenities) play a primary role.

Chapter 2: Amenities and the return to schooling

1. Introduction

For many years the estimation of the return to schooling has been a main focus for labor economists and significant efforts have been made to deal with a specific source of bias: omitted ability (Angrist and Krueger 1991; Blackburn and Neumark 1995). More recently, attention has been paid to site characteristics attached to labor markets as another source of bias. In the labor economics literature it is found now that some scholars claim that ignoring local labor markets can cause a serious misunderstanding of the reasons behind the bias of the return to schooling when econometrics techniques such as instrumental variables are used and local characteristics are not directly incorporated into the analysis (Black et al. 2009).

Nevertheless, the importance of site characteristics has been present in urban/regional economics literature for a long time (Rosen 1979; Henderson 1982; Roback 1982, 1988; Blomquist et al. 1988). The fact that amenities are capitalized into wages and rents allows economists to understand spatial differences that characterize US local markets by recognizing that a spatial equilibrium is consistent with local differences on both wages and rents. In analyzing those differences, some have noticed a possible stylized fact that not only wages, but the return to worker characteristics are spatially heterogeneous in the United States (Graves 1999, 2014).

Undoubtedly, the return to schooling is relevant for several reasons. Systematically, both developed and developing countries allocate large amounts of public resources to enhance and extending educational opportunities to their population. Moreover, as an investment, education does not have only a direct effect on target population, but its benefits may extend beyond a private return to reach social returns (Moretti 2004). In developed countries, such as the United States, educational attainment seems to display a close relationship with amenities. The rising of per capita income has allowed people start looking at amenities as one factor in making migration decisions, therefore the supply of worker characteristics is far from being neutral, in fact, more educated people may place a larger weight on site characteristics in their migration decisions if they are normal or superior goods (Graves 1979, 1983; Rappaport 2007; Partridge 2010).

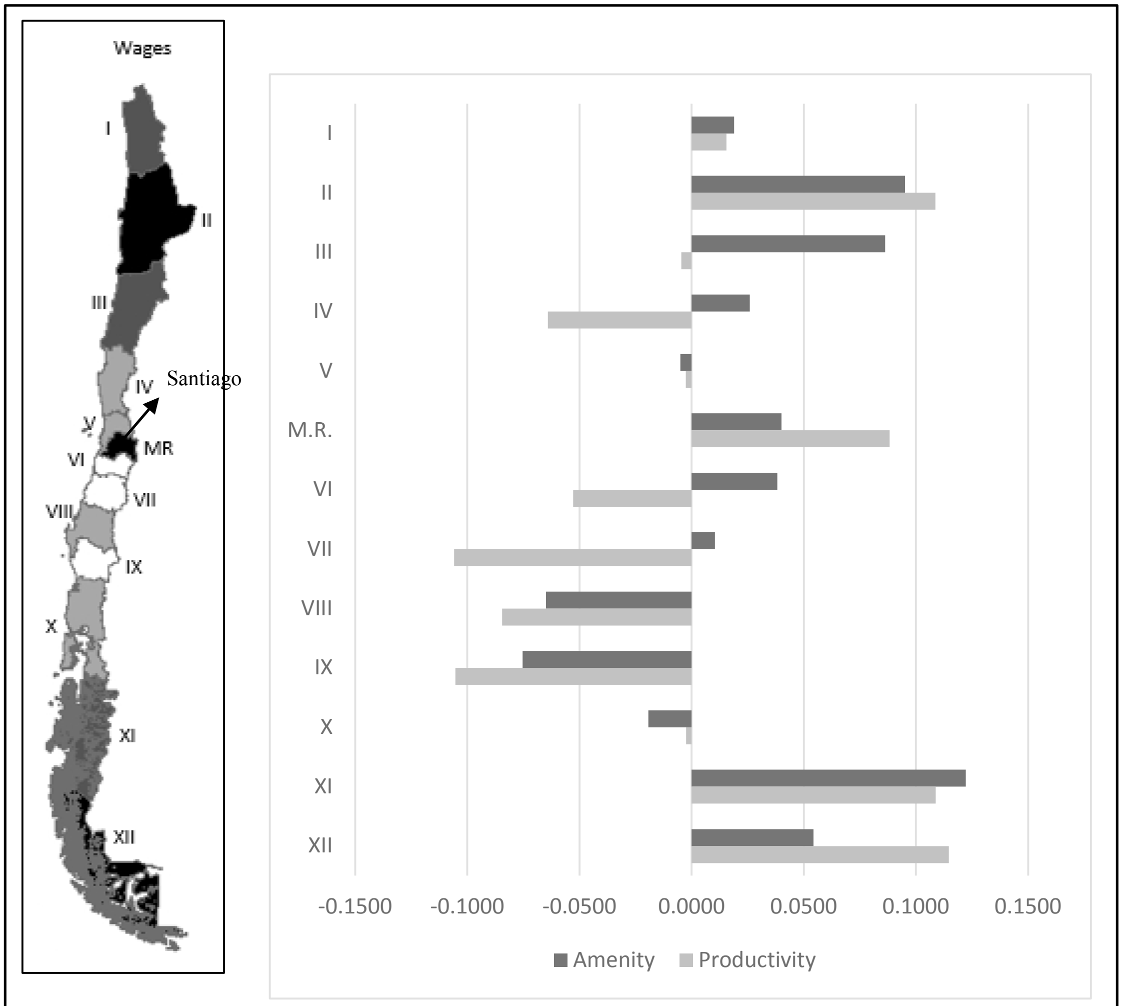
In this vein, education investment also plays an important role from a regional perspective. Workers may attain mixed benefits form their educational investment: pecuniary and nonpecuniary earnings, that is, higher return in form of wages as well as enjoying amenities attached to labor markets. Therefore, if more educated workers display a higher willingness to pay for amenities in term of foregone wages, they consequently would be willing to accept a lower return to schooling to live in more amenable places (Graves et al. 1999; Gabriel and Rosenthal 1999). However, it is important to notice that firms may also play a significant role because, for example, if a more amenable place for workers is also attractive for firms, a positive productivity shock can raise the return to schooling regardless of the migration inflow of more educated workers (Graves 2014).

Accordingly, the objective of this essay is first to review theoretical implications and predictions from the Spatial Equilibrium Model (SEM) related to the return to schooling coupled with a more a recent theoretical model from the labor economics literature. Also, empirical evidence will be provided by using Chilean data. The contributions to the literature are two. First, by showing how two branches of the literature: urban/regional and labor economics lead to the same theoretical predictions and second by providing empirical evidence to help fill a gap in the literature relative to interactions between education and site characteristics embedded in local labor markets, as noticed by Graves (2014).

Chile is an interesting environment to analyze returns to education. First, the SEM has shown to be the most appropriate theoretical framework to understand the Chilean spatial distribution of wages (Paredes 2013). Chile is a developing country, however with a medium per capita income[8], where site characteristics display a great importance in explaining regional wage differences (Paredes 2013; Iturra 2015). Second, the Chilean geography is very particular. Chile is a long line with two natural borders, in the east Andes Mountains and in the west Pacific Ocean. Because of that, workers can only migrate in two directions: north and south, and since every place is located at a different latitude, regions are rather heterogeneous, where both natural and man-made amenities create unique

[8] Chile was classified by the World Bank as a high income country in 2013, which means that the gross national income per capita is $12,616 or more.

environments. As Figure 10 shows, regional wages and amenity components[9] display a close relationship. For instance, Iturra (2015) finds that higher average wages (darker color in map) are found in those regions attractive for firms but not for workers (I, II, M.R, XI and XII).



Source: CASEN 2000, 2003, 2006, 2009 and 2011. Amenity components were estimated by Iturra (2015).

Figure 10. Wages and amenity components for Chilean regions: 2000-2011

[9] See Beeson and Eberts (1989) for an explanation of regional wage change decomposition. Also, Iturra (2015) as applied for the Chilean context.

This study uses micro data from the Socio-Economic Characterization National Survey (CASEN) for 6 years: 2000, 2003, 2006, 2009 and 2011. This data set contains detailed information of worker characteristics. Amenity variables come from Statistics National Institute (INE), among them there is regional information for climate conditions such as temperature and precipitation. Among the main results it is found that temperature display a significant role in affecting regional returns to schooling, while warmer places as seen as more amenable places, by contrast, places with higher temperature variations represent less attractive regions. Interestingly, man-made amenities are the most significant among amenity measures, while density affects positively regional returns to schooling, diversity displays a negative relationship.

2. Literature Review

2.1.The return to schooling in urban/regional context

In the SEM, amenity differences across cities are capitalized into local wages and rents. In equilibrium, neither firms nor workers have incentives to migrate since both unit cost and utility levels are equalized over space. Importantly, cost and utility convergence does not imply wage and rent convergence and spatial differences can exist in those prices as well as in the return to worker characteristics (Beeson 1991).

Some empirical implications of differences in worker characteristics were highlighted by Roback (1982). She noticed that in a given location, amenity preferences can vary significantly among workers, therefore estimates represent an average of those preferences. Roback (1988) formally addresses how differences on worker characteristics affect the wage-rent spatial equilibrium. Despite her claim that her model only focuses on how these differences affect productivity rather than demand for amenities, another important theoretical implication is that: If the income elasticity of demand for housing is less than one (necessity good) and more than one for amenities (luxury good), wages for more skilled workers relative to those with lower skills, will fall in more amenable places, hence the return to schooling will be lower in more attractive places.

Beeson (1991) extends Roback model and formally addresses how heterogeneity in worker supply affects demand for amenities over space. Her main motivation was to develop a model where differences in worker attributes can explain regional differences in the return to worker characteristics. In her model, workers are heterogeneous in term of their characteristics (e.g. years of schooling), whereas firms are homogeneous. Both utility and unit costs are function of wages, land rents and amenities. In equilibrium utility for each type of worker is equal across space.

$$\mathrm{V}\left(w_{ij}, r_j; s_j\right)=\bar{V}^i , \tag{11}$$

where V(.) is the indirect utility function and wages, land rents and amenities are denoted by w, r and s respectively. Subscript i indicates worker type and j is a specific location. The right-hand-side of equation (11) represents the national average level of utility. For firms:

$$\mathrm{C}(w_1, \ldots\ldots, w_n, \bar{p}_k; s)=1 \tag{12}$$

The representative firm produces a composite commodity with price equals 1 and it employs workers (from type 1 to n), $\bar{p}_k$ is the price of capital and *s* represents amenities. The price of one reflects that in spatial equilibrium, all firms have the same costs.

One of the main theoretical implications indicates that, in equilibrium, regional differences in average wages represent the difference between average value of amenities to households and firms. Since land rents reflect amenity values, if workers value amenities more than firms on average, the rents paid by workers are lower than their amenity valuation while firms pay more than their amenity value. Therefore, firms need to pay a lower average wage to be compensated by their rent payment above their valuation and to remain indifferent between locations. This reasoning explains why in high amenity places for workers, average wages should be lower relative to other cities, all else constant. Likewise, in high amenity places for firms (firm values amenities more than workers) a higher average wage is paid.

In focusing on the return to worker characteristics, Beeson (1991) analyzes the return in the form of differing wages for workers with different endowments of attributes. In this framework, the return to worker characteristics depends on several factors such as elasticities of demand for both housing and amenities, and the relative value of amenity to households and firms, however, it can be simplified as follows[10]:

$$\partial(d \log w/ds)/\partial z = z^{-1}\left[(p/w)\left(\eta_{h,z} - \eta_{s,z}\right)\right] \tag{13}$$

[10] Here, it is assumed that elasticity demand for housing ($\eta_{h,z}$) equals elasticity of demand for composite commodity ($\eta_{x,z}$).

Equation (13) represents the return to worker characteristic z (e.g. years of schooling) as a function of the ratio between monetized value of amenity and nominal wage (p/w), and the elasticity of demand for land ($\eta_{h,z}$) and amenities ($\eta_{s,z}$) with respect to characteristic z. If Eq. (13) is positive, then the wage change relative to the amenity is higher for the more educated workers, which means that the return to schooling would be higher in more amenable places. However, for this result to hold, the more years of schooling, the greater land consumption relative to the value of amenities ($\eta_{h,z} > \eta_{s,z}$). Likewise, by changing real income, Eq. (13) also implies that the return to schooling will be higher in more amenable places as long as the income elasticity of demand for land is larger than the income elasticity of demand for amenities (Beeson 1991). However, this is a very strong assumption since housing might perfectly represent a necessity and the amenity a luxury good as suggested by Roback (1988). In fact, the literature has shown that the income elasticity of demand for housing is around 0.7 (Rosen 1985; Harmon 1988).

Eq. (13) also indicates that the return to worker characteristic will be homogenous across space (a single parameter in a Mincer equation) when $\partial(d \log w/ds)/\partial z = 0$, this implies the income elasticity of demand for land and the income elasticity of demand for amenities are equal. However, this represents a very specific case when preferences are homothetic and income elasticity of demand for all goods equals 1 (Black et al. 2009).

2.2. From urban/regional economics to labor economics perspective: a complementary analysis.

In moving on to the labor economics literature, Black et al. (2009) address the impact of site characteristics in estimating the return to schooling. In their model, heterogeneous workers in educational attainment have to optimally choose their location that varies on amenities and their bundle consumption: a composite good and housing.

Their model relies on amenity differences are capitalized into housing rents as in Beeson (1991). This amenity heterogeneity can affect either firms' productivity or workers' willingness to migrate. They indicate that even assuming homothetic preferences, spatial fixed effects have to be incorporated to estimate Mincer equation because different distribution of capital human across space will lead to a biased estimate of the return to schooling when site-specific effects for locations are ignored.

In analyzing the interaction between amenities and the return to schooling, they show a very interesting theoretical prediction. If more educated workers display a higher willingness to pay for amenities (the amenity is a luxury good), in more amenable places the return to schooling will be lower compared to less attractive places. SEM framework may be used to explain the reasoning behind this prediction. Furthermore, it may also show how Beeson's model fits perfectly into the same framework, regardless her theoretical approach is different.

Figure 11 shows how spatial equilibrium is reached when human capital is divided into high and low educated workers. The upward sloping curves in each panel represent indirect utility functions $V(.)$ as function of wage (w), rent (r) and amenities (s). Likewise, unit costs function $C(.)$ for firm depends on the same arguments. Equilibrium 1 occurs in a relative unattractive region (e.g. a region with a high crime rate), with poor amenities (s_P). High educated workers earn a wage (w_P^H) while low educated workers earn (w_P^L) (where $w_P^H > w_P^L$).

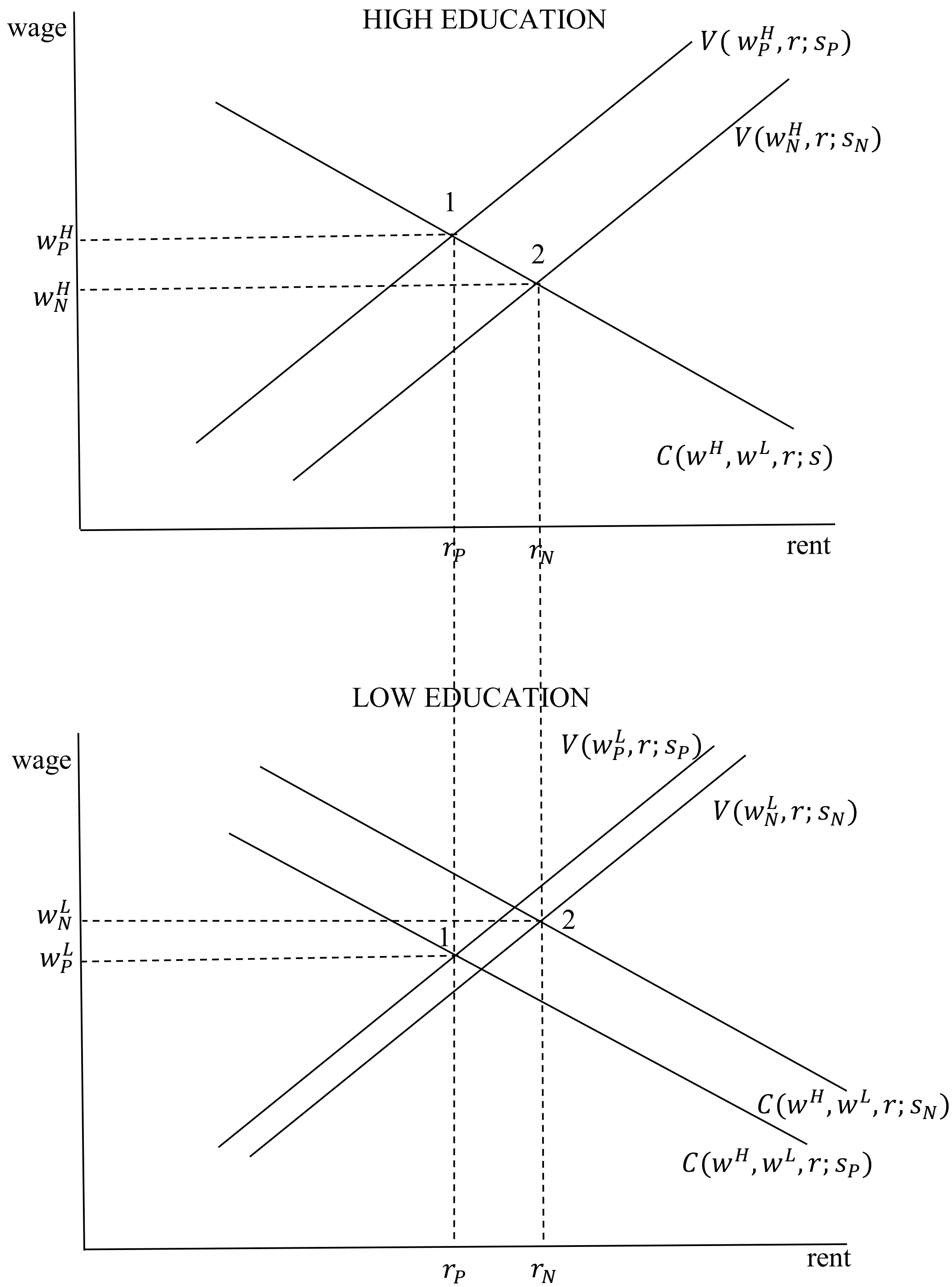


Figure 11. Spatial Equilibrium for high and low educated workers in a poor amenity place and a nice amenity place for workers

Because they both face the same housing market, the equilibrium rent for both group of workers is (r_P). Here, the ratio w_P^H/w_P^L represents the gross return to schooling.

Equilibrium 2 represents a more attractive region for workers as a nice amenity place (s_N) (e.g., a mild temperature region). Since highly educated workers display a high willingness to pay for amenities (a luxury good), they migrate to this region to enjoy those amenities and their isoutility curve shifts downward. In doing so, the wage for more educated workers is pushed downward (w_N^H) while rent is pushed upward(r_H).

Because low educated workers do not display preferences for amenities, they do not migrate unless they earn a higher wage to be compensated by a higher cost of living. Therefore, firms need to pay a higher wage to low educated workers[11] (w_N^L), therefore unit costs curve shifts upward, and consequently isoutility curve shifts downward when these workers migrate. Here, w_N^H/w_N^L represents the gross return to schooling for this more amenable place. It is easy to see that $w_P^H > w_N^H$ and $w_P^L < w_N^L$, hence $w_P^H/w_P^L > w_N^H/w_N^L$, that is, the return to schooling will be lower in more amenable places for workers.

The same prediction may be obtained by using Beeson's model[12]. On one hand, in equilibrium 2, high educated workers pay a higher rent, nevertheless, they pay less than their valuation of amenities, however, firms pay a higher rent than their valuation of region's amenities, and therefore spatial equilibrium requires that firms pay a lower wage to high educated workers to be compensated for the higher rent. On the other hand, low

[11] High and low educated workers are assumed to be complementary inputs as in Roback (1988).

[12] To see the exact opposite prediction, that is, high amenity places display a higher return to schooling see Beeson (1991). The key difference is she assumed income elasticity for housing is greater than the income elasticity for amenities.

educated workers pay a higher rent than their amenity value (amenities are not important for them), for that reason, they require to be compensated by earning a higher wage. As a result, more attractive places display a lower return to schooling.

In summary, despite the fact the reasoning behind these two models is different, they both are complementary and in fact, reach the same theoretical prediction: as long as the amenity is a luxury good and housing a necessity, in more amenable places the return to schooling will be lower compared to less attractive places for workers.

3. The role of firms in affecting the return to schooling

Site characteristics do not only affect workers, in fact, they are also relevant for firms in making their location decisions. Yet, as noticed by Beeson and Eberts (1989), the spatial equilibrium is reached as a result of the interaction between firms and workers. More specifically, in the previous analysis, firms have been omitted, however as Graves (1983; 2014) notes that amenities also affect firm' productivity, which might configure an interesting scenario regarding returns to schooling. For example, according the previous theoretical framework, a more amenable place for workers should lead the return to schooling to be lower compared to less amenable places. However, this might not be the final result when this place is also attractive for firms through a positive effect on their productivity that increases demand for workers and consequently increases wages and returns to schooling.

This is an empirical rather than a theoretical issue. Ceteris paribus, after controlling for amenities, the return to schooling should be lower, since part of the benefits of living in an attractive place is not pecuniary (amenity consumption). However, some empirical evidence for the United States shows the opposite result. This is because many attractive places for workers are also (and even more) desirable place for firms (Graves 1983, 2014) causing that the return to schooling to be higher after controlling by site characteristics.

Nevertheless, there is also evidence that firm and household preferences for cities also differ—i.e., while some places are attractive for firms they are less desirable cities for workers (Gabriel and Rosenthal 2004). Therefore, it is needed to remain agnostic until empirical evidence gives some insights regarding how important firms and households are in explaining spatial heterogeneity in the return to schooling across Chilean regions.

4. Data and econometric strategy

4.1. Data

The main data sets come from Socio-Economic Characterization National Survey (CASEN) for 6 years: 2000, 2003, 2006, 2009 and 2011. The sample is restricted to those workers between 18-65 years old. As Table 4 shows, it contains information about wages, years of schooling, potential experience (linear and quadratic), marital status and gender. Also, controls for race, rural, occupational activity and industrial sectors are used.

Table 4 also contains and define the amenity measures. It is important to notice that they might represent either natural or man-made amenities. The former might be taken as exogenous such as precipitation, and temperature (average and differences). The latter are highly endogenous (Combes et al., 2008), therefore special caution has to be taken in analyzing them. Furthermore, an exhaustive set of amenities might also greatly increase multicollinearity due to their high correlation with population. These empirical issues will be addressed below. As a measure of economies of agglomeration (Marshall, 1890), regional employment density is used because it encompasses both net benefits and costs (e.g. congestion costs) resulting from urban agglomeration. Therefore the overall effect on the return to schooling can be either positive or negative.

Variable	Definition	Source
Log hourly wage	Hourly wage earned	CASEN
Human Capital variables		
Education	Years of education	CASEN
Experience	Age-years of education- 6	Computed
Marital status	Dichotomous variable=1 if individual is married, 0 otherwise	CASEN
Gender	Dichotomous variable=1 if individual is female, 0 otherwise	CASEN
Race	Dichotomous variable=1 if individual self-identifies as in one the eight indigenous groups: aymará, rapa-nui, quechua, mapuche, atacameño, coya, kawaskar, and yagán, 0 otherwise	CASEN
Rural	Dichotomous variable=1 if individual works in a rural area, 0 otherwise	CASEN
Occupation	Dichotomous variable for nine occupational categories	CASEN
Industry	Dichotomous variable for nine industrial classifications	CASEN
Regional Amenities		
Precipitation	Total annual precipitation (mm)	INE
Average temperature	Average annual temperature (°C)	INE
Temperature difference	Difference between maximum and minimum average temperatures (°C)	INE
Employment Density	Regional employment per square kilometer	Computed

Table 4. Variables, definition and data sources (2000; 2003; 2006; 2009 and 2011) (continued)

Table 4 continued

Diversity	Inverse of Herfindahl index. $Diversity = 1/\sum_k s_{kj}^2$. Where s_{kj} is GDP share for industry k in region j.	Computed
Location quotients	$LQ = \frac{GDP_{kj}/GDP_j}{GDP_{kc}/GDP_c}$, where subscript c is country.	Computed

As stressed by Glaeser et al. (1992) some benefits of agglomeration are derived from the region's industrial diversification (Jacob's externality). Accordingly, the second measure is the diversity of economic activity in every region. Also, since Chile stills depends on natural resources that are located specifically in some regions (e.g. mining in the II region and fishing in X and XI regions). Consequently, there may some benefits derived from industrial concentration (localization economies) in those places such as lower costs on inputs or final products, specialized services and cooperation between firms (Parr, 2002). These agglomeration advantages derived from the concentration of particular sectors are expected to benefit primarily firms (positive productivity shocks) rather than households. This section also incorporates location quotients for agricultural, fishing and mining activities to account for the role played by localization economies.

4.2. Econometric strategy: Individual level analysis

The first empirical strategy uses repeated cross-section data sets to estimate the following empirical model:

$$\ln w_{ijt} = \alpha + X_{ijt}\beta + \gamma_t + \mu_j + \varepsilon_{ij}. \qquad (14)$$

In Eq. (14) w_{ijt} is the log the hourly wage earned by worker i in region j ($j = 1, \ldots, 13$) and time t. X is a vector that contains human capital characteristics, γ_t is a time fixed-effect, regional fixed effects μ_j capture location-specific attributes as well as regional differences in the cost of living (Beeson 1991, Gabriel and Rosenthal 1999, Clark et al. 2003), and finally ε is the error term.

This specification allows to explore the role played by site characteristics in affecting the return to schooling in two ways. First, by exploring the potential bias in the return to schooling when spatial fixed effects are omitted, an issue related with spatial labor sorting which is particular interesting for Chile as stressed by Chacon and Paredes (2015), and second, interacting amenity measures with years of schooling it specifically starts focusing on the nature of interactions between site characteristics and the returns to schooling (Beeson 1991; Graves 1999).

4.3. Econometric strategy: Regional models

The second empirical strategy focuses more directly on regional return to schooling measures. The first aim is to estimate regional returns to schooling for the thirteen Chilean regions by using the following empirical model:

$$ln\, w_{ij} = \alpha_j + X_{ij}\beta + Sch_{ij}\delta_j + \varepsilon_{ij} \tag{15}$$

Following Beeson (1991), in Eq. (15) educational attainment interacts with regions($Sch_{ij}\delta_j$) to allow the returns to schooling to vary across regions for every year of our sample. Additionally, instead of using the whole sample, this section estimates a second measure of regional returns to schooling by estimating the Mincer equation for every region separately, accordingly under the assumption that each region represents a specific local labor market. Finally, those regional returns to schooling are used as dependent variables to estimate the following empirical model:

$$\beta_j = \alpha + A_j\varphi + \gamma_t + \varepsilon_j, \tag{16}$$

In Eq. (16), regional returns to schooling (β_j) are function of a vector of amenities A_j. Because there are 5 cross section data sets, 65 observations represent the final data set for the whole period (13x5).

As mentioned, this stage addresses some empirical issues that might affect the quality of the estimates. First, in order to reduce problems derived from the degree of multicollinearity among amenities variables, the attention is restricted to specific measures of man-amenity measures. It is expected that employment density is able to capture most of those effects (positive or negative) related to urban agglomeration, therefore other measures of man-made amenities such as that crime rate and recreational activities are not used because they may just add another source of endogeneity, along with their high correlation with employment density. In addressing these econometrics issues, in the end this section uses two man-made amenities measures: employment density and diversity.

Second, it is required to deal with some endogeneity issues. This section follows partially Combes et al.'s (2008) approach to address the concern that the man-amenity measures are not orthogonal to the error term. This might be caused by both omitted variables bias or some shocks that affect return to schooling that are not accounted for. Thus, instruments are used to reduce any bias that may affect the estimates.

In this vein, deep lags of employment densities from 1907, 1920 and 1930 are used as instruments. The main aim will be to reduce the potential bias in employment density.

Despite the fact that the same task for diversity variable could not performed because information required to create deep lags is not available, the bias that may affect its estimated parameter is not as serious as for density measures (which is more of direct interest), therefore the statistical association may give us valuable insight relative its causal effect.

5. Results

Table 5 shows the estimates for Eq. (14). While in the first column no spatial fixed effects are used, the second column incorporates regional fixed effects. Finally the third column also displays estimates interacting education with the amenity measures listed in Table 4.

The results indicate that the return to schooling is upwardly biased when regional fixed effects are omitted. This result is related to two empirical issues. First, by omitting fixed effects, differences in human capital distribution across space are not taken into account, therefore this bias is reduced when controlling by spatial fixed effects. Second, a more interesting issue, this result reveals the importance of firms in affecting spatial returns to schooling. As explained by Graves (2014) and our theoretical section, since amenities are normal/superior goods that configure a non-pecuniary earning, the return to schooling should be downwardly biased when amenities are omitted from the wage regression. Nevertheless, as Table 5 indicates, this is not the case for Chile, suggesting that the role played by firms is relevant, resulting in a significant decline on the returns to schooling when fixed effects are incorporated.

Variables	Model 1	Model 2	Model 3*
Education	0.0623***	0.0598***	0.0692***
	(15.38)	(16.22)	(4.22)
Education interacted with:			
Precipitation			5.83E-06
			(1.68)
Average temperature			-0.0011
			(-1.34)
Temperature difference			0.0007*
			(2.03)
Employment density			0.0001**
			(2.29)
Diversity			8.03E-06
			(0.01)
LQ Mining			0.0003
			(0.23)
LQ Agriculture			-0.0039**
			(-2.65)
LQ Fishing			-0.0012**
			(-2.53)
Regional Fixed Effects	No	Yes	No
Sample size	389,117	389,117	389,117
R-sq.	0.412	0.427	0.4142

Note: t-statistics using cluster errors in parenthesis, * p<0.1, *** p<0.05 *** p<0.01. All regressions include all individual characteristics and year fixed effects. In Model 3 education is centered. * Model 3 was also estimated using regional fixed effects, employment density is not statistically significant anymore, but the rest of the interaction terms keep their significance.

Table 5. OLS estimates Equation (5): Individual level analysis, dependent variable: individual log of hourly wage

The third column displays results from interacting education with the amenity measures. In regards to natural amenities, only temperature difference is statistically significant with a positive sign, suggesting that it represents a disamenity from the consumer's perspective. Also, employment density is significant and it is also positively related to the return to schooling, this may represent either a productivity effect or disamenity related to congestion costs, or both. As expected, localization economies play a significant role in Chile, both agricultural and fishing activities display a negative relationship with the return to schooling, both activities are not characterized by paying high average wages in Chile, thus this may represent a negative productive effect rather than an amenity for households as we would expect employment concentrations to increase the risk of unemployment for households.

The second set of estimates focuses directly on regional returns to schooling. While models 1 and 3 show estimates by using regional returns to schooling derived from interacting years of schooling and regions, models 2 and 4 display estimates when returns to schooling are computed for every region separately.

Variables	**OLS**		**2SLS**	
	Model 1	**Model 2**	**Model 3**	**Model 4**
Precipitation	0.0012	-0.0017	0.0016	-0.0026
	(0.40)	(-0.61)	(0.59)	(-0.98)
Average temperature	-0.0008	-0.0022***	-0.0005	-0.0027***
	(-1.08)	(-3.32)	(-0.66)	(-3.78)
Temperature difference	0.0005	0.0006*	0.0005	0.0005
	(1.31)	(1.88)	(1.57)	(1.64)
Employment density	0.0031**	0.0038***	0.00240	0.0052***
	(2.14)	(2.84)	(1.41)	(3.24)
Diversity	0.0026	-0.0077*	0.0029	-0.0085**
	(0.52)	(-1.70)	(0.66)	(-2.05)

Table 6. OLS and 2SLS estimates Equation (6): Regional models, (continued)
dependent variable:regional return to schooling

Table 6 continued

LQ Mining	-0.0006	-0.0002	-0.0009	0.0005
	(-0.49)	(-0.19)	(-0.77)	(0.45)
LQ Agriculture	-0.0029***	-0.0029***	-0.0031***	-0.0025***
	(-2.72)	(-2.99)	(-3.06)	(-2.66)
LQ Fishing	-0.0001	0.0001	-0.0002	0.0003
	(-0.29)	(0.32)	(-0.56)	(0.89)
Constant	0.0623***	0.0953***	0.0597***	0.100***
	(4.23)	(6.99)	(4.32)	(7.77)
Sample size	65	65	65	65
R-sq.	0.645	0.667	0.643	0.660
Note: t-statistics in parenthesis, * p<0.1, ** p<0.05 *** p<0.01. All regressions include year fixed effects. First-stage F test for is rather higher than 15 and the partial R-sq. for employment density is 0.57 and p-value for Sargan test for model 4 is 0.4466.				

As first approach, it uses OLS to estimate Eq. (6) as columns 1 and 2 indicate. While in model 1 only employment density is significant, in the model 2 all amenity variables but precipitation are statistically significant. Their coefficients suggest that temperature plays an important role, with a lower return to schooling in warmer places and a higher value in those places with major temperature variability.

According to the theoretical framework, this result is consistent with the fact that the former represents an amenity while the latter acting as a disamenity for workers. In regards to man-made amenities, both density employment and diversity are significant, while density display a positive relationship with the dependent variables, diversity is negatively related to regional returns to schooling, with coefficients rather higher than those of the remaining variables. Finally, only location quotient for agricultural activity is significant and as expected it displays a negative relationship with the return to schooling.

Columns 3 and 4 show 2SLS estimates. The main focus is to reduce the bias that might be affecting employment density since this measure is meant to be highly endogenous because of both omitted variables (other measures of man-made amenities contained in the error term) and some contemporaneous shocks that are not independent from different levels of urban agglomeration across space. Lag of population density (1907, 1920 and 1930) are used as instruments for employment density. Conversely, diversity also must be treated as endogenous, nevertheless, there is not past information to use as an instrument and lag of population density did not perform well instrumenting diversity.

Both models (3 and 4) show differences in terms of the statistical significance of the coefficients, it is clear that separated regional returns to schooling estimates display a better performance (Model 4). Because of that, the focus of the analysis is on column 4 results, the preferred model. First, the results suggest that average temperature affect significantly regional returns to schooling. As previous results indicate average temperature seems to be the most important natural amenity, specifically, warmer places provide a valuable non-pecuniary return to workers, pushing downward the return to schooling.

Most importantly, employment density shows a larger positive effect on the return to schooling, when compared with result on column 2, suggesting a downward bias in the previous estimate. Along with this result, diversity also displays a significant role but its coefficient is negative. This result may be related to the fact that in more diverse regions, unemployment risk for more educated households is reduced, thus it represents an amenity.

These results suggest that firms play an important role in shaping spatial returns to schooling in Chile, however, households seem to be as important as well, where both temperature and diversity represent important amenities for them.

Overall, according the theoretical framework, more amenable places should display a lower return to schooling, however, the impact of firms through demand side might reverse this theoretical prediction. In one hand, firms through agglomeration effects bring about a positive effect on the return to schooling. On the other hand, the results also suggest that both temperature and diversity are important amenities for households, lowering the return to schooling. Despite the fact that according to the value of the significant estimates, man-made amenities (density and diversity) appear to be the most valuable site characteristics that affect regional returns to schooling, a simple exercise reveals interesting results: While an increase of one standard deviation of the regional average temperature and diversity would decrease the average regional return to schooling by 0.9% and 0.3% respectively. An increase of one standard deviation of employment density would increase the return to schooling by 0.9%. This exercise suggests that both natural and man-made amenities are equally important in explaining regional differences in the return to schooling in Chile.

6. Conclusion

Despite the fact that both urban/regional economic and labor economic use different approaches to focus on interactions between site characteristics and the return to schooling, they both reach same the theoretical predictions: more amenable places should display a lower return to schooling compared to those less attractive regions, all else constant. The fact that amenities represent normal/superior goods is the key issue to explain how local labor markets reach its equilibrium along with differences in human capital endowment in terms of schooling attainment, which affect their willingness to pay for amenities in terms of foregone wages.

In analyzing regional returns to schooling for Chile, the first results suggest that those amenities related to firms seem to be the most important in affecting regional labor markets, in fact, the bias that affects return to schooling estimate when site characteristics are omitted seems to be highly influenced by differences in firms' productivity across space. The second set of empirical results confirm that amenities related to firms (density and diversity) are important, however it also indicates that natural amenities (temperature) have a significant effect on the return to schooling.

Finally, it is important to notice that a lower regional average return to schooling in more amenable regions may be related to two theoretical facts that are observationally equivalent. High-educated households might be willing to accept a lower return to education in those places, but it also indicates that in those places less-educated workers require a higher compensation in term of wages because of higher housing rents, and then shortening the wage gap between high and low educated people and consequently displaying a lower return to schooling. However, the exact magnitude of this reduction depends on local characteristics of both labor and housing markets.

Chapter 3: Local government and income inequality across US counties

1. Introduction

Income inequality has been a great concern for a long time in the USA (Autor et al. 2008). In the literature, several explanations have emerged to understand the causes of rising income inequality. For instance, labor economics scholars have analyzed the effect of skill-biased technological change on labor demand for different skills (Autor et al. 2003, Juhn et al. 1993). Also, some researchers have studied the role played by institutional factors such as minimum wage and unionization. (Dinardo et al. 1996). More recently, Piketty et al. (2003) performed an interesting analysis by studying the top shares of incomes and wages across time in the USA.

These studies have considered individuals as units of analysis. However, there are some researchers that have analyzed income inequality by focusing on spatial unit characteristics, such as states, counties and metropolitan areas (Bartik 1994, Partridge et al. 1996, Topel 1994, Moller et al. 2009). This study follows this perspective and it analyzes US counties to assess the effect of local government employment on population well-being, specifically on income inequality. Despite the fact that the performance of local government is also closely related to other well-being measures such as poverty and median of household income, the high and persistent income inequality that has characterized the

USA coupled with a broad concern of its effect in terms of economic growth (Partridge 1997, 2007), and some political and social consequences (Glaeser et al. 2009), this topic deserves a special attention in the literature.

Because local governments across the USA have systematically increased their importance in promoting local development (Lobao and Kraybill 2005), it is expected the role played by them in affecting income inequality is far from being neutral. In this vein, the research question of this chapter is whether local governments are able to influence income inequality in US counties and if they are, does this reduce inequality among households in US counties?

It is critical to address this research question because local governments employ the highest proportion of public employment (64%), while state governments only account for 23% and federal government 12% (U.S. Bureau of the Census 2008). Also, there is a growing public concern due to the shrinkage of employment by local governments during the Great Recession of 2007-2009. While in the past, local government employment increased during recessions, according to the U.S. Bureau of Labor Statistics, from the latest recession started in December 2007 to December 2015, it has decreased by 2.19%. Moreover, since the recovery started in June 2009, it has decreased by 3% until December 2015.

In the literature there is some evidence of the effects of local governments on well-being among residents in the USA. For instance, Lobao and Hooks (2003), found positive impacts of government employment in reducing inequality but mixed effects on income growth across counties. Likewise, Lobao et al. (2012) analyzed the role of county government capacity in affecting well-being of local residents and, found that a strong county capacity (fiscal autonomy and centralization) is related to a lower poverty, but it is not related to median of household income.

The aim of this chapter is to assess the effect of local government employment on income inequality across US counties. This study spans from 2000-2012 and it uses data from several sources. In the American Community Survey (ACS) there is information relative to income inequality measures, Economic Modelling Specialist intelligence (EMSI) contains information for local, state and federal employment. Finally, most controls come from the 2000 US Population Census. A key econometric issue in this study is to deal with endogeneity that plague policy impact research (Lobao et al. 2012). A novel instrumental variables method is performed to identify the effect of local government employment on income inequality.

The contribution of this study to the existing literature is twofold. First, to the author’s knowledge, this is the first study that analyzes local government employment that explicitly takes into account endogeneity. Second, it also analyzes the direct effects of local governments on income inequality across US counties during the recession period 2007-2009. Moreover, it also focuses on the period of time right after the Great Recession to have a broader understanding of the effect of local government employment. While there is a long-running theoretical debate about the role of government on economic performance, this study provides empirical evidence that is important for several actors, such as scholars and policy makers in the United States.

The following section reviews the literature relative to the debate of the role of government on the economy. Section 3 addresses data sets used and the expected relationships. Econometric strategy is explained in Section 4. Section 5 presents the main results and Section 6 concludes.

2. Literature review

As assessment of the effects of governments (federal, state, and local) on the economic performance requires a focus on an old debate regarding the interactions between government and market.

In the international context, some scholars have studied why some developed countries have shown a significantly better performance, in terms of unemployment rate, wage levels, and income inequality, compared to the United States. Researchers have emphasized the importance of several factors, among them, institutional and political contexts arise as the key explanations. The literature has pointed out that OECD governments typically account for larger proportions of workers than the United States, which could be one of the factors explaining the difference in the performances of those economies (Blau and Kahn 2002).

Furthermore, the role of the state may be even more important because it acts in two dimensions. First, it directly affects the income distribution in a given spatial unit by providing employment that displays a more equal wage distribution (Moller et al. 2009). Second, it provides services aimed at enhancing well-being among residents (Lobao and Hooks 2003). Overall, the literature has noted that governments are important in affecting inequality, but in the USA, their role has weaken during the last years given funding shortfalls (local, state, and federal).

The view advocates public government interventions is supported by state-centered theory that claims the state does not necessarily hinder the economy, instead it may foster economic and social development. Besides, the state and market are not antagonistic forces. The state, in fact, provides key support for the performance of market functions (Hamm et al. 2012). The political economic view also provides more reasons in favor of the state as positively linked to economic performance. First, the state is more likely to achieve goals aimed at redistributing resources compared to the market. Second, both the state and market may work together, and finally by supporting more vulnerable people, the state is also supporting the broader economy (Lobao and Hook 2003).

On the other hand, as Lobao et al. (2012) point out, the either null or negative effect of government in the economic well-being is supported by two views. First, according to the neoliberal framework, government interventions are basically seen as having a negative effect on economic performance and its consequences are ineffective or even counterproductive on the economic well-being. Additionally, the state is seen as crowding out private sector activity (Hayek 1960). Second, according to the political economy view, government interventions create incentive for rent-seeking, which attracts firms that are frequently oriented to high income groups or the elite instead of focusing on more vulnerable populations (Lobao et al. 2012).

Overall, it is rather clear that among scholars, antagonist positions are held relative to the role of government. While in the literature, this debate still remains, this study provides empirical evidence regarding how local government employment in U.S. counties affects income distribution.

3. Data and expected relationships

3.1. Counties as unit of analysis

This study uses counties as unit of analysis. There are several advantages to using counties. First, they represent better spatial units to analyze outputs relative to the labor market process (Partridge and Rickman 2006). Second, counties consider both metropolitan and nonmetropolitan areas and data collection is uniform and relatively easy to access since it is performed by centralized agencies (Isserman et al. 2009; Moller et al. 2009). They also cover the entire US territory, therefore understanding the causes behind income inequality at county level provides insights into understanding inequality. Third, since counties are nested in states, the role of common factors such as institutional and political issues that affect counties belonging to different states can be assessed (Moller et al. 2009). Finally, county governments have been growing since the 1996 welfare-reform, therefore they enjoy a greater fiscal and functional autonomy (Benton 2002, 2005; Lobao and Kraybill 2005). Counties perform the majority of programs relative to social welfare and they usually coordinate development within local governments that belong to every county (Benton 2002, Craw 2006).

There are some shortcomings of using county-level data. Within county income inequality is only a component of total income inequality in the USA. Furthermore, economic interaction are not necessary embedded within a county, residents may have interactions that involves other counties, therefore within county inequality can be reflecting some consequences outside county boundaries (Moller et al. 2009). Despite this fact, counties seem to be the most suitable spatial units to analyze income inequality across space in the USA.

3.2. Data sets

As specified in Table 7, this study uses data from several different sources. Since the primary focus is the Great Recession of 2007-2009, it uses ACS to get information relative to income inequality measured by the Gini[13] coefficients (the dependent variable) that cover the recession period 2007-2009 and the beginning of the recovery period 2010-2012. Despite the fact there are other inequality measures that capture different characteristics of the income distribution (e.g. Atkinson and Theil indexes) those measures are not available at county level. Because of this, this study uses the Gini coefficient as dependent variable. However, income share ratios are also available at county level, hence, they will be used to test the robustness of the results, since they allow us to capture different portions of the income distribution. The five-year survey allows to analyze a longer time span (2008-2012). The three-year survey allows to split the analysis into two periods, however this survey contains information only for areas with population of 20,000 or more, while five-year contains data for all areas.

[13] See Levy and Murnane 1992 for an analysis of alternatives measures of income inequality.

The main independent variables come from EMSI (emsi.com). This data set contains information for sector employment at a very disaggregated level, where the government employment is divided into three categories: federal, state and local. Lagged variables (in 2001) are used to reduce endogeneity problems regarding reverse causality. Government employment may affect population well-being by at least two channels. First, a direct way, by employing local population and giving to them a source of stable income. Second as a measure of the services that a county can provide to its residents, including those related to education, health, and public services that directly affect the quality of life of their people.

Control variables for two economic sectors are also incorporated, specifically the proportion of workers in manufacturing and service sectors. Service is divided into FIRE category that contains workers employed in Financial, Insurance and Real Estate services and Service category that includes employment in Accommodation, Education, Arts and Health sectors. Manufacturing has a higher density of unions, while a structural shift to the service sector brings about a polarization between low and high wages among workers. Accordingly, counties with higher manufacturing employment experience lower inequality, while in counties with higher employment in services, inequality should be higher (Moller et al. 2009).

The literature suggests that employment growth can affect the income distribution. In fact, there is empirical evidence that employment growth benefits younger and less-skilled men. Also, employment growth may provide better opportunities to more vulnerable people, and therefore reduce income inequality. (Bartik 1994, Bartik 1996).

However, as Bartik (1994) suggests, employment growth can be endogenously determined with some changes on the income distribution, therefore it is not suitable to use directly employment growth as a control variable. Rather, industrial mix growth is computed as a proxy for local demand shocks (Partridge and Rickman 2008). This proxy measures local employment growth by industry sector relative to the national growth rate as if every local industry would have growth at the national employment growth. Similarly, the effect of economic growth on income distribution is expected to be negatively related, therefore this study should find that those counties with higher employment growth display lower income inequality.

It is important to control for the sociodemographic characteristics. This data set includes control for educational attainment by computing the proportion of population with college degree by county. The relationship between education and inequality is ambiguous (Partridge et al. 1996). On one hand, Lobao and Hooks (2003) state that higher educational attainment is related to a higher bargaining power, and consequently inequality will be reduced in the presence of a larger proportion of educated people. On the other hand, there could exist a polarization among people, in terms of education attainment in a county that has portion of educated people with a higher average income, while another portion of non-educated residents with a significant lower average wage. The result of this process will be consistent with counties with higher inequality (Moller et al. 2009).

Variable	Definition	Data Source
Gini 2008-2012	County Gini coefficients.	5 years ACS.
Gini 2007-2009	County Gini coefficients.	3 years ACS.
Gini 2010-2012	County Gini coefficients.	3 years ACS.
Federal employment	Federal employment 2001 (%).	EMSI
State employment	State employment 2001 (%).	EMSI
Local employment	Local government employment 2001 (%).	EMSI
Manufacturing employment	Manufacturing employment 2001 (%).	EMSI
FIRE employment	Finance, Insurance and Real Estate employment 2001 (%)	EMSI
Service employment	Accommodation and food services, educational, social and health services, Arts, entertainment and recreation employment 2001 (%)	EMSI
Industrial mix growth	Rate of employment growth all industries.	Computed
Children	Population < 18 years, 2000 (%).	US Census of Population.
Age 65+	Population > 65 years, 2000 (%).	US Census of Population.
College degree	Population with a college degree, 2000 (%).	US Census of Population.
African-American	African-American population, 2000 (%).	US Census of Population.
Hispanic	Hispanic population, 2000 (%).	US Census of Population.
Unemployment 2000	Unemployment rate 2000.	Bureau of Labor Statistics.
Women/labor force	Women 16+ years in labor force 2000 (%).	US Census of Population.
Median of Household income	Median of household income (log and Sq.)	American Community Survey
Population	County population 2000 (log)	US Census of Population.
Gini coefficient 1990	County Gini coefficient.	US Census of Population.

Table 7. Variables and data source

With respect to the shares of African-American and Hispanic population, literature has shown that both groups of population face serious disadvantages relative to wage and income. Therefore, a higher proportion of both African-American and Hispanic populations is related to higher income inequality (Moller et al. 2009).

In terms of age composition of population, a non-working group is represented by residents under 18 years old and over 65 years old. Because they do not participate in labor market, higher inequality is expected in those counties with higher proportion of non-working group (Lobao and Hooks 2003). However, there may be a negative relationship between inequality and the proportion of people over 65 years old. This is because social benefits such as social security allows them to enjoy higher incomes, thereby reducing income inequality (Nielsen and Anderson 1997).

The effect of unemployment on income inequality is also ambiguous (Lobao and Hooks 2003), because it is also related to specific institutional contexts. Therefore, this is an empirical question since it is possible to find either a positive or negative statistical association.

Women's participation in the labor market also needs to be incorporated into the analysis, however, its effect on income inequality is not clear (Lobao and Hooks 2003). Some researchers claim income inequality should be reduced since families now can enjoy another source of income that comes from woman's work, therefore moving low income families toward middle income households (Bradbury 1990; Nielsen and Anderson 1997, Moller et al. 2009). Nevertheless, there may also be a positive relationship if highly educated women marry high income men and start participating in the labor market

(Thurow 1987, Mulligan and Rubinstein 2008). Given these reasons, it is not clear whether the relationship between women labor participation and income inequality will be positive or negative.

According to Kuznets (1955), inverted U shape characterizes the relationship between inequality and development[14] and after some point development should be related to lower inequality (Partridge et al. 1998). Nevertheless, the Great U-turn suggests that development is related with higher inequality (Moller et al. 2009). Both the natural log of median of household income and its value squared are used as a development measures and it is expected to find negative and positive signs for their coefficients respectively.

Finally, it is also important to control for the level of urbanization. The relationship between population and income inequality may also be ambiguous. The effects of agglomeration economies may mainly benefit high-skilled workers and therefore widen income distribution (Garofalo and Fogarty 1979). However, as Levernier et al. (1998) indicate that places with higher density may also benefit low-skilled workers by providing better opportunities to find a job. It is expected that the relationship between population and income inequality may be either positive or negative.

Because the income distribution that characterizes a country, is a result of interactions between the market and state, that are not easily modified. The income inequality is a persistent social and economic phenomenon through time, therefore, it is required to control for past levels of inequality. However, it is also important to note that

[14] See also Williamson (1965) and Lindert and Williamson (1985).

local government e.g. county governments, provide services aimed at promoting economic development. Therefore contemporaneous inequality level and local government activities could be closely related (positive correlation). To avoid the contemporaneous correlation between local government employment and inequality, this study uses 1990's inequality levels rather than 2000's measures to control for past level of county inequality[15].

4. Econometric Strategy

One of the main challenges of the empirical strategy is to account for endogeneity that may affect the identification of the effect of local government employment on income inequality. This issue guides the econometric strategy where the following empirical model is estimated:

$$Ineq_{is(t)} = \alpha + \gamma Fed_{is0} + \delta Sta_{is0} + \theta Loc_{is0} + \beta X_{is0} + \rho_s + \varepsilon_{is0}, \tag{17}$$

where Ineq represents inequality at county *i* in the state *s* at time *t*. Fed, Sta and Loc represent shares of federal, state, and local government employment respectively at time 2000. β is a 2000's vector of controls listed in Table 13, and ρ are state fixed effects and, finally ε is the error term.

As discussed briefly, reverse causality between government employment and income inequality may be reduced by using lags of the control variables. The main independent variables as well as control variables correspond to either the 2000s or 2001s

[15] In order to test the robustness of the estimated coefficients, a sensitive analysis will be performed using the Gini in 2000.

years. While the dependent variables (Gini coefficients) represent measures from 2007 to 2012.

Also, state fixed effects are incorporated into the analysis to control for those common factors among counties that belong to the same state. As mentioned, there may be common institutional and political contexts that affect income inequality among those residents living in the same county, state fixed effects should be able to capture that omitted information and reduce any potential bias from the local government estimate.

Despite the fact that fixed effects are aimed at controlling for omitted information, local governments may display autonomy in their policy development, which as a consequence, creates omitted variable bias.

This study deals with this potential source of endogeneity by using instrumental variables approach. Specifically, it uses a technique called IVMATCH that follows Partridge et al. (2016), which includes using matching techniques to create the instrumental variables. This approach have been mostly used in international trade[16] and is still novel to for identifying issues in regional models.

This strategy entails finding, for every county, the most similar county in terms of key private sector shares identified in terms of a matching strategy, I then use the share of government employment of those counties as the instrument for the endogenous variables. More specifically, to find those matches, I use as covariates lagged (1995) shares of

[16] See Autor et al.(2013) for an example in studying the effect of Chinese import competition on US local labor markets in which they use Chinese trade patterns in other advanced economies to instrument for Chinese import shifts to the United States.

employment for 11 economic sectors[17]. Lagged shares of government employments (federal, state, and local) are also used as covariates in order to create the most suitable instrument. Furthermore, to limit spatial spillover, counties that are sufficiently distant from one another are picked up, and therefore their residual should be uncorrelated.

Furthermore, Mahalanobis matching is used to match each county belonging to a state with a county outside that state but located in the same Census Region. Mahalanobis distance (MD) between county i located in state s and county l located in state p is defined as:

$$MD = \left(x_i^s - x_l^p\right)' \widehat{C}^{-1} \left(x_i^s - x_l^p\right), \tag{18}$$

where x is a vector of covariates and $\widehat{\mathrm{C}}$ is the estimated covariance matrix. The covariates are the employment shares for 11 economic sectors. Even though the econometric strategy is aimed at reducing the potential bias in local government employment, the other two levels of government employment (federal and state) could be potentially endogenous. For this reason, when finding matches, the lagged level of every government employment are used separately. For instance, in order to create the instrument for local government employment, 11 economic sectors are used as covariates plus 1995 share of local government employment. The instruments for federal and state government employment are similarly created. Additionally, to avoid endogeneity due to spatial spillovers effects[18], matches have to be found at least 125 miles away from every county centroid.

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[17] Please see NAICS supersectors for more details: http://www.bls.gov/ces/cessuper.htm.

[18] See Rosenthal and Strange 2004 for geographical scope of spatial spillovers.

Similarly, the same matching technique is used to find the second nearest neighbor for every county. In doing this, there are two instruments for every endogenous variable, therefore the model is overidentified. Therefore, the instrument's strength can be tested in the first stage, and additionally, since there are more than one instrument for every endogenous variable, it is also possible to test whether the instruments are uncorrelated with the error term using an over-identification test.

5. Results

The sample is divided into metropolitan and nonmetropolitan counties. As Levernier et al. (1998) suggest, these two groups of counties are characterized by significant different levels of income inequality and different data generating processes, even after controlling for several counties' characteristics.

5.1. Metropolitan counties

Equation (17) is estimated, first using OLS and then using one instrument for every endogenous variable using the closest match for federal, state, and local government employments. These estimates are shown in Tables 8 and 9 respectively. Finally, Table 10 displays the preferred estimates, when two instruments are used for every endogenous variable and the model is overidentified.

Independent Variables	2008-2012	2007-2009	2010-2012
	Gini	Gini	Gini
Local Employment 2001	-0.0372**	-0.0819***	-0.0715***
	(-2.07)	(-3.44)	(-3.37)
State employment 2001	-0.0309**	-0.0091	-0.0125
	(-2.07)	(-0.56)	(-0.87)
Federal Employment 2001	-0.0392*	-0.0269	-0.0379*
	(-1.73)	(-1.09)	(-1.70)
Manufacturing 2001	-0.0006	0.0128	0.0270**
	(-0.05)	(0.80)	(1.97)
FIRE 2001	-0.0067	0.0157	0.0307
	(-0.19)	(0.43)	(0.92)
Services 2001	-0.0216*	0.0075	0.0220
	(-1.83)	(0.45)	(1.50)
Industrial mix growth	-0.0002	-0.0003	-0.0001
	(-1.02)	(-0.72)	(-0.40)
Children	-0.113***	-0.150***	-0.162***
	(-3.24)	(-3.81)	(-4.58)
Age 65+	0.0346	-0.0036	-0.0388
	(1.07)	(-0.10)	(-1.23)
College degree	0.148***	0.115***	0.119***
	(10.54)	(7.56)	(8.61)
African-American	0.0272***	0.0193***	0.0259***
	(4.02)	(2.60)	(3.85)
Hispanic	0.0228**	0.0155*	0.0207**
	(2.53)	(1.66)	(2.46)
Unemployment 2000	0.0255	0.0210	0.0675
	(0.34)	(0.26)	(0.92)
Women/labor force	0.0074	-0.0045	-0.03
	(0.29)	(-0.16)	(-1.20)
Median of Household income	-0.271	-0.185	0.407**
	(-1.30)	(-0.82)	(2.00)
Median of Household income (Sq.)	0.0101	0.007	-0.0205**
	(1.02)	(0.66)	(-2.14)
Population	0.0044***	0.0042***	0.0041***
	(6.01)	(4.77)	(5.10)

Table 8. OLS estimates, Metropolitan Counties (continued)

Table 8 continued

Gini coefficient 1990	0.473***	0.590***	0.537***
	(18.09)	(20.07)	(20.24)
State fixed effects	Yes	Yes	Yes
Sample of counties	1,164	978	985
R-sq.	0.739	0.782	0.799
t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01.			

Independent Variables	2008-2012	2007-2009	2010-2012
	Gini	Gini	Gini
Local Employment 2001	-0.0765	-0.178***	-0.239***
	(-1.52)	(-2.88)	(-4.33)
State employment 2001	-0.0219	-0.0117	-0.0407**
	(-0.99)	(-0.51)	(-1.96)
Federal Employment 2001	-0.0323	-0.0299	-0.0684**
	(-1.12)	(-0.97)	(-2.44)
Manufacturing 2001	-0.0073	-0.0016	-0.0164
	(-0.43)	(-0.09)	(-0.87)
FIRE 2001	-0.0072	-0.0025	-0.0207
	(-0.19)	(-0.06)	(-0.56)
Services 2001	-0.0266*	-0.0113	-0.0142
	(-1.71)	(-0.52)	(-0.77)
Industrial mix growth	-0.0003	-0.0001	-0.0003
	(-1.15)	(-0.40)	(-0.95)
Children	-0.0863**	-0.122***	-0.138***
	(-2.17)	(-2.94)	(-3.60)
Age 65+	0.0408	-0.0037	-0.0610*
	(1.19)	(-0.10)	(-1.83)
College degree	0.142***	0.103***	0.104***
	(9.75)	(6.35)	(7.02)
African-American	0.0241***	0.0171**	0.0258***
	(3.42)	(2.28)	(3.71)

Table 9. 2SLS estimates, one instrument for every endogenous variable, Metropolitan Counties (continued)

Table 9 continued

Hispanic	0.0192**	0.0116	0.0154*
	(2.00)	(1.24)	(1.79)
Unemployment 2000	0.0377	0.0301	0.0709
	(0.51)	(0.38)	(0.97)
Women/labor force	0.0046	-0.0117	-0.0484*
	(0.18)	(-0.43)	(-1.90)
Median of Household income	-0.325	-0.245	0.342*
	(-1.56)	(-1.10)	(1.66)
Median of Household income (Sq.)	0.0126	0.0098	-0.0176*
	(1.29)	(0.93)	(-1.82)
Population	0.0039***	0.003***	0.0018*
	(3.88)	(2.60)	(1.66)
Gini coefficient 1990	0.477***	0.586***	0.527***
	(18.40)	(20.10)	(19.63)
State fixed effects	Yes	Yes	Yes
Sample of counties	1,163	977	984
R-sq.	0.736	0.776	0.783
F- test First stage	>15	>15	>15
t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01. F-statistics for local, state and federal governments.			

The first set of results correspond to the metropolitan counties. While the OLS (Table 8) estimates indicate that only local government employment displays a significant negative correlation with income inequality for every period of analysis, both federal and state governments only show a significant association with the dependent variable in the whole period 2008-2012.

As previously mentioned, OLS estimated are potentially affected by the omitted variables bias. Accordingly, in the next step IVMATCH technique is performed to create the instruments. Table 9 shows 2SLS estimates by using one instrument for every endogenous variable. In absolute values, local government employment estimates are larger compared to the OLS estimate for both the recession and post-recession periods, suggesting that OLS estimate is downwardly biased. Nevertheless, for the whole period of analysis (2008-2012) local government estimates are no longer statistically significant. Both state and federal government employments only display significant associations with the dependent variable in the post-recession period. The F-statistics suggest the instruments are strong in the first stage using the rule of thumb of greater than 10.

Table 10 displays the whole set of IV estimates using two instruments for every endogenous variable. Results confirm that local government employment dampens inequality in both the recession and post-recession periods. Despite the fact that both estimates are smaller than previous ones, they remain statistically significant. The whole period does not display any significant statistical associations, however, this includes the Great recession, and thus this fact may explain why it is not possible to find any significant statistical association, because it undermines the quality of estimates. With respect to state and federal government employments, the results suggest they do not affect income inequality among households for any period of analysis.

In terms of the quality of the instruments, they show to be strong in the first stage, however, Sargan test suggests that they are only exogenous in the recession period (2007-2009). The null hypothesis that the instrument are uncorrelated with the error term is strongly rejected in the post-recession period (p-value 0.0101). This fact deserves special attention, because Sargan test remains agnostic about either all instruments or one of them are not valid. Since there are two instruments for every endogenous variable, testing them individually indicates that one of them performs better (according to F and Hausman tests), whose estimates are shown in Table 9. While in the recession period the instruments display a good performance, in the post–recession, adding a second instrument dampens the quality of the estimates, which may explain why the null hypothesis of exogeneity is rejected in the last period of analysis. Therefore, in the post-recession period, coefficients estimated using only one instrument for every endogenous variables are more reliable.

In summary, the results indicate that local government employment performs a role in reducing income inequality. While in both recession and post-recession periods, an increase of one standard deviation in the sample (0.05) in local government employment would decrease approximately the income inequality by 0.01 points. This effect is significantly smaller for federal and state governments that would reduce income inequality approximately by 0.002 in the post-recession period.

In regards to the control variables, these estimates are also very interesting. The results suggest that sociodemographic characteristics are more closely associated to county differences in the income distribution than economic variables. For every time spans, the three industry shares do not display any significant correlations with the dependent variable. Despite the fact, previous results displayed some statistical associations, they are not consistent across all estimates.

The opposite scenario is found by looking at sociodemographic estimates. The share of children consistently displays a negative relationship with income inequality. With respect to the population shares with a college degree, African-American and Hispanic, the expected relationships are confirmed. Counties with higher shares of college degree and minority populations show higher levels of income inequality. These results suggest that disadvantages faced by minorities and low educated people are still important and affect income distribution in their locale.

In terms of median household income, only the post-recession period shows a significant association. While the linear values are positively related to income inequality, the squared value shows a negative association, which is not consistent with the expected results according to the U-turn stated by the literature.

Agglomeration economies captured by population indicates that a higher population density benefits specific groups of population, most likely more educated people, and consequently denser counties are characterized by a more unequal income distribution. There are at least two reasons that may explain this result. First, counties with higher concentration of population may represent unattractive places for households, therefore high-educated people would require a higher compensation to live there, and therefore it represents an amenity effect. Second, if firms that employ a high proportion of high educated workers[19] are located in denser areas, they are more likely to benefit from agglomeration economies (Bluestone 1965).

Finally, as expected, current levels of income inequality are positively related to previous levels. For the whole time span, they are all statistically significant showing a positive correlation. As mentioned, a sensitivity analysis was performed using 2000 level of inequality. As expected, the estimated coefficients of local government employment are

[19] In fact, Glaeser et al. 2009 found that differences in human capital distribution play a significant role in explaining differences in the GINI coefficient across metropolitan areas in the USA.

lower in absolute terms, given the contemporaneous correlation, however they remain statistically significant, displaying the same causal effect.

Independent Variables	2008-2012	2007-2009	2010-2012
	Gini	Gini	Gini
Local Employment 2001	-0.0015	-0.151***	-0.159***
	(-0.04)	(-3.08)	(-3.59)
State employment 2001	-0.0063	-0.0063	-0.0216
	(-0.31)	(-0.30)	(-1.16)
Federal Employment 2001	-0.0053	-0.0207	-0.0398
	(-0.20)	(-0.74)	(-1.57)
Manufacturing 2001	0.0129	0.0037	0.0065
	(0.89)	(0.21)	(0.39)
FIRE 2001	0.0143	0.0059	0.0087
	(0.39)	(0.16)	(0.25)
Services 2001	-0.0092	-0.0041	0.0056
	(-0.67)	(-0.21)	(0.33)
Industrial mix growth	-0.0002	-0.0002	-0.0002
	(-0.90)	(-0.52)	(-0.71)
Children	-0.107***	-0.125***	-0.143***
	(-2.83)	(-3.10)	(-3.93)
Age 65+	0.0528	-0.0001	-0.0458
	(1.58)	(-0.00)	(-1.43)
College degree	0.146***	0.105***	0.109***
	(10.25)	(6.72)	(7.74)
African-American	0.0252***	0.0169**	0.0246***
	(3.66)	(2.29)	(3.66)
Hispanic	0.0244***	0.0123	0.0174**
	(2.65)	(1.35)	(2.09)
Unemployment 2000	0.0257	0.0288	0.0704
	(0.35)	(0.37)	(0.99)
Women/labor force	0.0117	-0.0094	-0.0390
	(0.46)	(-0.35)	(-1.58)

Table 10. 2SLS estimates, two instruments for every endogenous variable, Metropolitan Counties (continued)

Table 10 continued

Median of Household income	-0.263	-0.238	0.359*
	(-1.27)	(-1.08)	(1.79)
Median of Household income (Sq.)	0.0099	0.0095	-0.0183*
	(1.02)	(0.92)	(-1.94)
Population	0.005***	0.0034***	0.0029***
	(5.71)	(3.23)	(3.03)
Gini coefficient 1990	0.478***	0.589***	0.535***
	(18.56)	(20.45)	(20.54)
State fixed effects	Yes	Yes	Yes
Sample of counties	1,162	977	984
R-sq.	0.736	0.778	0.793
F- statistic	>15	>15	>15
Sargan test (p-value)	0.0148	0.8425	0.0101
t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01. F-statistics for local, state and federal governments.			

5.2. Nonmetropolitan counties

For nonmetropolitan counties, there are significant differences compared to metropolitan areas. Both OLS and 2SLS estimates show that federal government employment is negatively associated with income inequality. It is important to note that for metropolitan counties, the federal government only displays a significant statistical relationship with income inequality in the post-recession period, a quite different scenario compared to nonmetropolitan counties. Local government employment displays a significant association only in the post-recession period.

Independent Variables	2008-2012	2007-2009	2010-2012
	Gini	Gini	Gini
Local Employment 2001	0.0281**	-0.0259	-0.0360
	(2.35)	(-1.04)	(-1.49)
State employment 2001	-0.0202	-0.0200	-0.0004
	(-1.39)	(-0.84)	(-0.02)
Federal Employment 2001	-0.0680***	-0.0694*	-0.178***
	(-2.86)	(-1.94)	(-4.98)
Manufacturing 2001	0.0164*	-0.0194	-0.0162
	(1.71)	(-1.02)	(-0.90)
FIRE 2001	0.0201	-0.0403	-0.000974
	(0.44)	(-0.52)	(-0.01)
Services 2001	0.0291***	0.0086	0.0430**
	(2.63)	(0.41)	(2.08)
Industrial mix growth	0.0002	-0.0008**	-0.0005*
	(1.24)	(-2.18)	(-1.73)
Children	-0.0854***	-0.131**	-0.0958*
	(-3.01)	(-2.52)	(-1.86)
Age 65+	0.0051	-0.0179	-0.0811*
	(0.19)	(-0.38)	(-1.74)
College degree	0.142***	0.186***	0.144***
	(8.78)	(7.02)	(5.54)
African-American	0.0253***	0.0227**	0.0431***
	(3.67)	(2.28)	(4.39)
Hispanic	0.0152**	0.0278**	0.0238**
	(2.04)	(2.44)	(2.10)
Unemployment 2000	0.0075	0.178*	-0.0980
	(0.13)	(1.91)	(-1.06)
Women/labor force	-0.0245	-0.0204	-0.0736**
	(-1.29)	(-0.60)	(-2.22)

Table 11. OLS estimates, Nonmetropolitan Counties (continued)

Table 11 continued

Median of Household income	0.0560	-0.0667	0.0435
	(0.26)	(-0.19)	(0.12)
Median of Household income (Sq.)	-0.0059	0.00021	-0.0051
	(-0.56)	(0.01)	(-0.30)
Population	0.0059***	0.0032	0.0035*
	(6.86)	(1.49)	(1.66)
Gini coefficient 1990	0.253***	0.392***	0.277***
	(10.49)	(8.81)	(6.36)
State fixed effects	Yes	Yes	Yes
Sample of counties	1.968	843	859
R-sq.	0.520	0.630	0.605
t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01			

Independent Variables	2008-2012	2007-2009	2010-2012
	Gini	Gini	Gini
Local Employment 2001	0.0164	0.0152	-0.107*
	(0.68)	(0.27)	(-1.89)
State employment 2001	-0.0257	-0.0279	-0.0265
	(-1.13)	(-0.83)	(-0.78)
Federal Employment 2001	-0.124***	-0.0884**	-0.217***
	(-4.05)	(-2.13)	(-5.20)
Manufacturing 2001	0.0094	-0.0140	-0.0439*
	(0.83)	(-0.61)	(-1.77)
FIRE 2001	0.0044	-0.0357	-0.0527
	(0.09)	(-0.44)	(-0.65)
Services 2001	0.0238*	0.0159	0.0189
	(1.83)	(0.60)	(0.72)
Industrial mix growth	0.0002	-0.0008**	-0.0006**
	(1.14)	(-2.32)	(-2.13)

Table 12. 2SLS estimates, one instrument for every endogenous variable, Nonmetropolitan Counties (continued)

Table 12 continued

Children	-0.0790**	-0.145***	-0.105*
	(-2.41)	(-2.61)	(-1.89)
Age 65+	0.0011	-0.0325	-0.0973**
	(0.04)	(-0.67)	(-2.00)
College degree	0.146***	0.195***	0.142***
	(8.91)	(7.41)	(5.44)
African-American	0.0243***	0.0255**	0.0442***
	(3.40)	(2.57)	(4.51)
Hispanic	0.0130*	0.0303***	0.0215*
	(1.67)	(2.68)	(1.93)
Unemployment 2000	0.0274	0.161*	-0.0875
	(0.47)	(1.77)	(-0.97)
Women/labor force	-0.0229	-0.0242	-0.0679**
	(-1.21)	(-0.73)	(-2.09)
Median of Household income	0.0501	0.0306	-0.0265
	(0.23)	(0.09)	(-0.07)
Median of Household income (Sq.)	-0.0058	-0.0044	-0.0020
	(-0.55)	(-0.26)	(-0.12)
Population	0.0056***	0.0038*	0.0026
	(6.08)	(1.73)	(1.20)
Gini coefficient 1990	0.246***	0.387***	0.261***
	(10.26)	(8.81)	(6.04)
State fixed effects	Yes	Yes	Yes
Sample of counties	1,968	843	859
R-sq.	0.519	0.628	0.600
F- test First stage	>15	>15	>15
t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01. F-statistics for local, state and federal governments.			

Similar to the case of metropolitan counties, OLS estimates for nonmetropolitan areas are also appear to be affected by a downward bias. In absolute terms, the magnitude of the IV estimates for the federal government are considerably larger when 2SLS is performed. The instruments again appear to be strong in the first stage. Likewise, the Sargan test cannot be rejected at the 5% level of significance in all cases, suggesting that the instruments are exogenous. While for the recession period, an increase of one standard deviation (0.03) of the share of federal government, would lower the income inequality in about 0.003 points. For the post-recession period this change is larger, reaching 0.007 points.

Independent Variables	2008-2012	2007-2009	2010-2012
	Gini	Gini	Gini
Local Employment 2001	0.0068	-0.0201	-0.0940*
	(0.31)	(-0.42)	(-1.95)
State employment 2001	-0.0188	-0.0423	-0.0299
	(-0.90)	(-1.35)	(-0.95)
Federal Employment 2001	-0.101***	-0.0913**	-0.224***
	(-3.50)	(-2.28)	(-5.59)
Manufacturing 2001	0.0094	-0.0239	-0.0417*
	(0.86)	(-1.11)	(-1.84)
FIRE 2001	0.0112	-0.0573	-0.0517
	(0.24)	(-0.73)	(-0.66)
Services 2001	0.0225*	0.0032	0.0209
	(1.79)	(0.13)	(0.86)
Industrial mix growth	0.0002	-0.0008**	-0.0006**
	(1.23)	(-2.29)	(-2.12)
Children	-0.0691**	-0.154***	-0.110**
	(-2.17)	(-2.84)	(-2.03)
Age 65+	0.0079	-0.0387	-0.103**
	(0.28)	(-0.81)	(-2.15)

Table 13. 2SLS estimates, two instruments for every endogenous variable, Nonmetropolitan Counties (continued)

Table 13 continued

College degree	0.143***	0.193***	0.145***
	(8.78)	(7.37)	(5.62)
African-American	0.0230***	0.0257***	0.0452***
	(3.25)	(2.62)	(4.64)
Hispanic	0.0120	0.0289***	0.0221**
	(1.55)	(2.58)	(2.00)
Unemployment 2000	0.0320	0.167*	-0.0927
	(0.55)	(1.85)	(-1.03)
Women/labor force	-0.0219	-0.0193	-0.0690**
	(-1.16)	(-0.59)	(-2.13)
Median of Household income	0.0253	-0.0138	0.0045
	(0.12)	(-0.04)	(0.01)
Median of Household income (Sq.)	-0.0046	-0.0025	-0.0035
	(-0.44)	(-0.15)	(-0.21)
Population	0.0054***	0.0033	0.0028
	(6.03)	(1.56)	(1.31)
Gini coefficient 1990	0.249***	0.382***	0.259***
	(10.40)	(8.78)	(6.04)
State fixed effects	Yes	Yes	Yes
Sample of counties	1,968	843	859
R-sq.	0.519	0.629	0.601
F- statistic	>15	>15	>15
Sargan test (p-value)	0.0628	0.6165	0.7755
t-statistics in parenthesis, * p<0.1, *** p<0.05 *** p<0.01. F-statistics for local, state and federal governments.			

Many control variables display statistical associations similar as for the metropolitan models. Counties with higher shares of college degree, African American, and Hispanic populations, display higher levels of income inequality, thereby strongly suggesting that disadvantaged minorities widen income distribution across metro and nonmetropolitan counties. Likewise, the proportion of children is negatively related to income inequality for nonmetropolitan counties. Also, the coefficient for women participation in labor force is negatively associated with income inequality across nonmetro counties.

For the post-recession period, the share of manufacturing employment has the expected negative sign, reducing income inequality. Interestingly, in nonmetropolitan areas, industrial mix employment growth does display a significant association with the dependent variable. As specified in Table 12, higher employment growth counties exhibit a lower income inequality, suggesting that employment growth brings job opportunities to more vulnerable people.

Finally, the population is not significant neither recession nor post-recession periods, reflecting that agglomeration economies are related to more dense areas. The lagged Gini coefficients, as expected, are positively associated with the current income inequality[20].

In analyzing income inequality by using 95/20 ratio as a robustness check, previous results are partially confirmed. Although there are some differences on estimated parameters, since the 95/20 ratio focuses on the tails of the income distribution rather than on the middle as Gini coefficient, results support the facts that local government employment displays a key role in reducing inequality in metropolitan counties whereas for nonmetropolitan areas federal government employment is the most important in dampening income inequality.

[20] For non-metropolitan counties, when 2000's Gini is used, local government employment remains as statistically insignificant.

6. Conclusion

This study examined the effect of government employment on income inequality across US counties, during the both recession and post-recession periods. According to the results, metropolitan and nonmetropolitan counties are affected differently by government employments. While for metropolitan areas local government employment enhances population well-being by reducing income inequality, in nonmetropolitan counties federal government employment dampens income inequality.

While local government employment does seem to be important in reducing inequality across nonmetropolitan areas, federal government employment performs a significant role. Some reasons may help to explain this result. As stressed by Gutierrez et al. (2010), adverse economic conditions, low quality of life in rural areas and devastating effect of the recession have decreased significantly the tax receipts. However, federal government has performed a more important role in protecting vulnerable people in rural areas. This help us to understand why, according to the estimates, federal government dampens income inequality in nonmetropolitan counties.

This study also concludes that bias is a serious issue when analyzing the impact of government on population well-being. Results indicate that estimates are downwardly biased, hiding the real positive impact of government to reduce the income inequality, which is significant for both metropolitan and nonmetropolitan counties.

The analysis also confirms that disadvantaged populations widen income distribution in both metro and nonmetropolitan counties. Less-educated people, African

American and Hispanic populations still characterize counties with higher levels of income inequality.

As a complex social and economic phenomenon, income inequality is greatly determined by the past. The inequality that characterized counties in 1990 is still relevant when current levels of income inequality is analyzed. This suggests how difficult it is modify income distribution, even in a long time span. This concern is especially important for policy makers that may design government interventions.

Overall, the empirical evidence indicates that government plays a significant positive role in affecting the well-being of the U.S. population, providing interesting elements to the debate about how valuable are state interventions, especially during recession periods. This study also calls attention to how important federal government is for nonmetropolitan communities

Finally, this study provides a powerful econometric tool for analyzing regional disparities, IVMATCH technique seems to be a suitable technique when dealing with highly endogenous variables, and the main focus is to reduce the bias and find the causal effect of some well-being indicators.

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Chapter 1

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Appendix A: Estimates of wage and housing rent models

Variables	Year				
	2000	**2003**	**2006**	**2009**	**2011**
Years of schooling	0.0677	0.0642	0.0633	0.0493	0.0637
	(72.46)	(68.53)	(70.32)	(53.11)	(59.6)
Experience	0.0180	0.0167	0.0171	0.0139	0.0143
	(25.93)	(25.07)	(28.17)	(22.09)	(20.4)
Experience^2	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(-10.70)	(-10.46)	(-12.27)	(-8.67)	(-8.15)
Woman	-0.1918	-0.1712	-0.1851	-0.1762	-0.1977
	(-31.36)	(-29.36)	(-33.98)	(-31.41)	(-32.16)
Married	0.0881	0.0819	0.0752	0.0636	0.0731
	(16.71)	(15.86)	(15.18)	(12.29)	(12.71)
Race	-0.1202	-0.137	-0.1122	-0.0527	-0.0357
	(-11.86)	(-15.49)	(-14.2)	(-6.4)	(-4.26)
Rural	-0.1044	-0.086	-0.0727	-0.0658	-0.0799
	(-17.48)	(-14.68)	(-13.5)	(-11.73)	(-10.73)
Sample size	71,827	78,545	89,107	78,579	71,059
R-squared	0.3799	0.3703	0.3148	0.2644	0.3056
t-statistics in parenthesis. All regressions included occupational categories and industrial classifications. All estimates are statistically significant, $p<0.01$.					

Table 14. Estimates of the wage regression

Variables	Year				
	2000	2003	2006	2009	2011
Bedrooms	0.1634	0.1294	0.1144	0.1162	0.0870
	(21.45)	(17.46)	(16.51)	(17.51)	(14.13)
Bathrooms	0.5587	0.5725	0.5526	0.5035	0.4656
	(36.16)	(40.2)	(37.87)	(34.85)	(32.89)
Wall quality	0.2310	0.2309	0.2711	0.1708	0.2036
	(10.81)	(9.9)	(12.71)	(8.36)	(8.23)
Floor quality	0.2187	0.2168	0.1901	0.2034	0.1244
	(13.36)	(13.59)	(12.28)	(13.59)	(8.29)
Roof quality	0.1576	0.2374	0.1410	0.1185	0.2999
	(6.58)	(9.6)	(5.98)	(5.58)	(20.24)
Sample size	6,979	7,612	7,957	8,020	9,050
R-squared	0.4064	0.388	0.3206	0.2838	0.266
t-statistics in parenthesis. All estimates are statistically significant, $p<0.01$.					

Table 15. Estimates of the housing rent regression