Wage Inequality across Cities

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Summary

This thesis considers the fact and sources of wage inequality across cities within the national boundary by investigating some essential deviations from a perfect world or a perfect economy.

In general, equalized factor prices (or wage) gradually driven by the free mobility of labor and capital in long-run equilibria, are based on some crucial conditions that do not divert from what they are supposed to be in a perfect world. Wage inequality across cities may arise due to realized deviations where 'perfect world' collapses in some sense. Widely documented deviations and their impacts on spatial wage differentials in literature are mainly centering on differences in four dimensions with respect to city attributes. They are differences in local composition of skills, differences in local returns to skill, differences in costs of living and locational amenities, and differences in local labor market conditions. For each of these, this paper focuses on three main questions: how it works theoretically on wages, how large effect it shows from the empirical evidence and how to assess its relative importance regarding different settings.

Theoretically, these deviations are mainly rooted in the heterogeneity of workers and firms, the existence of externality and scale economies, heterogeneous space, and imperfect mobility. Firstly, workers are different in human capital and firms are different regarding the goods they produce, whereby the local composition of skills could differ from city to city. Secondly, the presence of increasing urban returns are taking forms of interactions in labor markets, linkages among production chains and knowledge spillovers, which generate productivity gains at the corporate level and an urban wage premium. In addition, differences in endowments across cities could also affect local efficiency of production. Thirdly, against a homogeneous space, differences in locational amenity and consumption opportunities across cities deflate inequality in nominal wages regarding local welfare incidence on individual utility. Finally, in the face of the nontrivial costs of moving and institutional interventions, mobility of workers and firms are imperfect and spatial adjustment take time for absorbing shocks to the local economy and for relocating resources efficiently across areas.

Empirically, anecdotal evidence indicates that the differences in skills across cities could be the main reason for wage inequality across cities, with at least half of the spatial wage differences explained by spatial ability bias. Yet, arguments on estimated causal effects of

higher level of local educational attainments or the human capital externality effect on wages still has a lack of consensus. The role of local externalities and economies of scale in explaining wage differences manifests itself in apparent the wage premium that is accrued on an urban scale and is consistently showing up regardless of the use of different datasets. On the other hand, the extent to which differences in local endowment advantages could explain spatial wage disparities depends on the geographical discrepancies of the national territory. Furthermore, real wage inequality that is deflated appropriately by a local consumption price index is modest in some cases and substantively justified by preferences for locational amenity and consumption opportunities. Regarding labor mobility, wages are more flexible in the context where workers evidently respond to spatial wage differentials. For this reason, residuals of measured wage inequality across cities, conditional on education, experience, cost of living, amenities or consumption externalities, and scale externalities, are plausibly explained by local shocks or business cycle effects in most cases for the US. Alternatively, for countries with lower mobility of labor, unexplained portions of inequality, after correcting for observed sources, are probably ascribed to segmented markets caused by differing local welfare-systems, imperfections within the housing market, such as rents controls or absence of laws protecting landlords' property, along with other labor regulations.

Differences in estimates of specific effects on wage differentials across countries could be ascribed to different datasets. More importantly, differences in the geographic environment, the demographic factors, as well as economic organizations, influences the relative importance of explanatory variables. In general, cities featured as educated, large, coastal, sunny and mild are more likely to be prosperous and render relatively favorable wages. More importantly, a long-run equilibrium concept might justify the wage inequalities across cities as spatially economic efficiency, while potential disequilibrium could caution a true spatial disparity or the lack of efficient adjustment mechanisms; whereby, rationales of both equity and efficiency for government intervention in the economy are challenged.

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Preface

Finally I am able to draw a full stop of this thesis seeing the spring coming each day in Norway. With so many joys and pity I have experienced during the two-year study in UiO, I am really grateful and would like to thank those people from whom I received encouragements and discipline.

First and foremost I want to thank my supervisor Marcus Hagedorn, for academic guidance, inspiration, moral support and the freedom he gave me to move on in the process of investigating the topic.

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1 Introduction

A general phenomenon that wage inequality across cities has been widely documented for a long time, spurring an increasing interest among economists, as well as policy designers. According to Baum-Snow and Pavan (2012), data from the 2000 census in the United States shows that white males aged of 18-55, in metropolitan areas, with population over 1.5 million, earn 32 percent more per hour, on average, than their counterparts working in small cities with less than 250 thousand residents. Additionally, in France from 1976 to 1996, the wage premiums for Paris and its nearby areas, over large, medium, and small sized French employment areas are 15 percent, 35 percent and 60 percent, respectively(Combes, Duranton, & Gobillon, 2008). The empirical regularity that workers in densely populated cities commonly earn higher wages than their counterparts in smaller scale city sizes is neither new nor temporary, typically known as the urban wage premium.

On the other hand, there are substantial cross-municipality differences in incomes for a large number of countries in the Americas. As documented by Acemoglu and Dell (2009), after weighting by income (Theil index) and population (Mean Log Deviation index) shares respectively, differences in mean labor income across municipalities are approximately twice the size of that across countries, testing on 10 Latin American countries, namely Bolivia, Brazil, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Venezuela. Moreover, the extent of city size disparities within national boundaries varies from country to country. For instance, index suggesting the degree to which average incomes diverge across municipalities is 0.125 for Brazil, 0.115 for Mexico, 0.078 for Panama, 0.050 for the United States and 0.030 for Venezuela (Acemoglu & Dell, 2009). It is, thus, implying that within the national boundary, some countries exhibit marked unevenness in inter-city wages, while such gaps may not be quite as obvious in other nations.

One cannot make sense of this fact within a perfect world where competitive equilibrium would equate the average wage level across cities. As is well-known, if one regards the individual worker and firm, in the real world, as negligible enough to merely take the wage on the market as a given and labor mobility across cities is likely to be less an issue within a national boundary, every participant will be attracted by a more profitable place for making a living, whereby the inequalities would be eliminated progressively over time.

More specifically, in a perfect world, space is homogeneous, endowed with the same natural resources and embedded with an identical firm performing production under the same technology. Economic activity is identical everywhere, such that small-size city is merely a larger one in miniature. Household have a homothetic utility function of consumption expenditure levels bound by their labor income, provided that commuting costs are offset by land rent. Agents are supposed to be identical in terms of the quantity and quality of labor supply. The smooth working of market clearing along with the arbitrage tendency among agents would yield one equilibrium price for input and output goods respectively independent of location, which is to say wages are equal among cities such that individual achieve the same level of utility and resources are efficiently allocated.

Intuitively, spatial wage variation may be related to differences in production resources such as the composition of skills in the local workforce, the industry mix, and the presence of natural resources or public infrastructures influenced by local institutions and so forth. Such explanations are in line with standard growth theory. On the other hand, spatial wage differentials have been more investigated in the context of agglomeration economies and spatial equilibrium, which are conceived to be the fundamental driving forces behind the dynamic persistence of wage inequality across cities. Besides, in the spirit of labor economists, imperfect markets and other unobserved heterogeneity could play a significant role in explaining wage differences. Empirical studies have highlighted several factors in the wage determination. In general, explanatory variables are classified into two dimensions; with one set referring to individual characteristics such as education, experience, gender, and unobserved ability captured by fixed effects, while another set of variables incorporating locational attributes like employment density, cost of living, amenities, local labor market conditions, and institutional factors and/or area fixed effects.

Specifically, there is an extensive amount of literatures on the sources of wage inequality across workers, industries, regions, and countries. Empirical researches on city size wage gap, or urban wage premium, within the national boundary, began with separating wage variance into person-based and location-based components(Duranton & Monastiriotis, 2002; Glaeser & Mar, 2001). On one hand, one line of inquiry focusing on differences in productivity across cities bears on potential scale externalities of productive inputs clustering at the city level (Duranton & Puga, 2004; Marshall, 1895), also known as agglomeration economies. In addition, differences in total factor productivity across cities are in some cases ascribed to

differently local endowments such as, local institutions (Acemoglu & Dell, 2009). Empirical studies are estimating the relative importance of urban attributes in OLS regression, based on specifications of production function and use wages as proxy for local productivity. On the other hand, some researchers investigate factors giving rise to wage dispersions that are embedded in the workers. These studies exploring the pattern of workers' sorting across cities(Baum-Snow & Pavan, 2012; Kennan & Walker, 2011) give emphasis on the differences in the local composition of human capital, which, in turn, affects local production (Lucas, 1988) and leads to variance in returns to skills across cities.

The concentration of highly educated workers could explain substantively spatial variation in wages in its own right. On the other hand, researchers are also interested in whether the relative advantage of locale having higher level of averagely educational attainments presents positively causal effects on local wages in the sense that individuals with various educational levels could enjoy wage gains from being in the same community with highly educated people. Specifically, whether local productivity gains from the social returns to education (Enrico Moretti, 2003; Rauch, 1993), knowledge spillovers associated with the proximity to more educated workers (Rosenthal & Strange, 2008) or utilization of occupation-specific skills(Combes et al., 2008; Rodrguez-Pose & Vilalta-Buf, 2005) can plausibly explain the wage inequality across cities, compared to another strand of explanations centering on the nature of cities enhancing productive efficiency in their own right featured as urban scale effects or area-fixed effects (Fingleton, 2003; Glaeser & Mar, 2001; Wheaton & Lewis, 2002). Yet, arguments on estimated causal effects of higher level of local educational attainments on wages still lack consensus.

Ever since Marshall (1895) highlighted the role of local externalities and economies of scale in productivity improvements that accrue in urban locations, a renewed interest in explaining wage inequality across cities with different sizes of urban populations are growing in recent decades. Indeed, after accounting for individual effects, the estimated magnitude of net urban scale effects on wages are varying among nations. Specifically, Combes et al. (2008) report an estimate of around 2 percent for the elasticity of wages with respect to employment density in France while the figure is about 2.7 percent with respect to the US Statistical Metropolitan Area (MSA) population level (ChristopherH Wheeler, 2001). In Japan, nominal wages elasticity with respect to the Standard Metropolitan Employment Area population amounts to 10 percent nevertheless being negative in real terms according to Tabuchi and Yoshida

(2000). Sabrina Di Addario and Patacchini (2008) find that every additional 100,000 inhabitants in the Italian local labor market increases wages by about 0.1 per cent, which is consistent with the results reported by Diamond and Simon (1990), who suggest that an increase of 1-2 percent in wages is correlated to an extra 1 million population in the US MSAs. Andersson, Klaesson, and Larsson (2014) find agglomeration effects in Sweden are in general small, and appear to be specific to workers performing non-routine job tasks. Specifically, they report that, doubling either municipal or regional density slightly increases wage by about 0.5 per cent, after accounting for observed and unobserved characteristics of workers. As noted by Andersson et al. (2014), compared to countries hosting a bunch of urban areas, such as the US (Glaeser & Mar, 2001; Gould, 2007), Germany (Haas, 2002) and France (Combes et al., 2008), Sweden is a rather sparsely populated country with only Stockholm likely classified as metropolitan area, which might justify the weak weight of agglomeration economies in explaining spatial wage differentials in Sweden. Given that the Italian local labor markets (LLMs) are quite small areas (Sabrina Di Addario & Patacchini, 2008), and agglomeration economies attenuate with distance, the pattern of real wage inequality across cities could be more featured as an urban wage premium increasing along the urban scales. In this respect, the intercity wage inequality is well explained by differences in local price of a given worker, provided that agglomeration differentials give rise to local productivity discrepancies.

Differences in cost of living and amenity stand out in explaining how wage or price differentials across space can persist in long-run equilibrium, as well as uncover the effects of shocks to local economy on spatial wage distribution. In the Rosen–Roback framework, if the elasticity of local labor supply is infinite, but housing supply is limitedly elastic, then in equilibrium the land price could plausibly capitalize effects of local shocks within the labor market (Roback, 1982). For example, suppose a locale enjoys a positive productivity shock in traded sectors, which raises the local nominal wages; non-traded sectors that produce houses have to increase prices of products, in order to offset the higher costs of labor, such that in new equilibrium though local workers are more productive than their counterparts in anywhere, they are not better off in real terms. Whether local shocks are fully capitalized in land price depends on the respective elasticity of local labor supply compared with local housing supply (E. Moretti, 2011). Analogically, as location amenity could also be partially reflected in local land prices, empirically appropriate adjustment of wages for costs of living

renders quite smaller discrepancies in wages across areas, than that measured in nominal term, with in some cases intercity wage inequality being insignificant.

Since the framework of spatial equilibrium is based on the assumption that firms and workers are fully mobile, if mobility is limited, then workers and housing stock could not fully adjust to shocks, so do the local prices. In this respect, it is thus uncertain whether currently economic status is a general equilibrium, transitory state or lagged adjustment. Besides, in the presence of institutional interventions (such as tax rates, minimum wage legislation and union power etc.), local wage rates are likely to be non-competitive rents. Therefore, imperfect markets and other unobserved heterogeneity, in the spirit of labor economists, could play a significant role in explaining wage differences.

In general, wages are more flexible in the context where workers evidently respond to spatial wage differentials, such that residuals of observed wage inequality across cities, conditional on education, experience, cost of living, amenities or consumption externalities, and scale economies, are plausibly related to local labor market conditions as well as policy factors. Alternatively, if labor mobility is quite lower, and the unexplained portion of inequality remains significant after correcting for observable factors, then there might be possibilities of segmented markets indicating true and inefficient differentials across areas.

Considering that studies on the city size wage gap are mostly performed within a particular country, initially and vastly for the US, later followed by examinations in a few of European countries, such as the UK, France, Italy, this thesis will study some stylized factors contributing to wage inequality across cities highlighted in the literature, and test to what extent particular explanation can be applied to some certain settings by investigating deviations from a perfect world as a canonical model.

Differences in estimates of specific effects on wage differentials across countries could be ascribed to different datasets. More importantly, differences in the geographic environment, the demographic factors, as well as economic organizations, influences the relative importance of explanatory variables. Firstly, for countries hosting a broad territory, whereby geographic environments vary greatly across subnational boundaries, local endowments and amenities could obviously divert from the context of a homogeneous space. Secondly, city size effects, incorporating both consumption externality and productive externality, are pronounced in the process of wage determination. Finally, in the context where operating

business in cities are more characterized as the function a city performs, local wages are related to the local mix of traded industries, in the sense that occupational structure shapes the skill composition of local workforce, which appears to be the most important determinant of urban growth. In general, cities featured as educated, large, coastal, sunny and mild are more likely to be prosperous and render relatively favorable wages.

Theoretically, equalized factor prices (or wage) gradually driven by the free mobility of labor and capital in long-run equilibria, are based on some crucial conditions that do not divert from what they are supposed to be in a perfect world. Wages could be different between cities due to one or mixed deviations of relevant assumptions. One that has been documented by labor economists in extensive literatures is heterogeneous workers, regarding human capital or skills differentials, along with human capital externality (Abowd, Kramarz, & Margolis, 1999; Gibbons & Katz, 1992; Krueger & Summers, 1988). In this context, spatial wage inequalities arise due to the uneven distribution of skills across cities. In other words, high wage cities are those concentrated by more able workers or being rich human capital areas, which has been stylized as ability bias or sorting effects. The fact that skilled workers are overrepresented in high wage cities also motivates researchers to investigate the pattern of and factors underlying spatial sorting of specific educational cohort(Baum-Snow & Pavan, 2012; Kennan & Walker, 2011). There are, however, other deviations that give rise to city-size wage inequality. If one is willing to believe that local labor markets are under relatively perfect competition, wages should be equal to labor productivity, whereby differences in labor productivity result in wage inequality across cities. Discrepancies in labor productivity across locations, that are causing differences in local returns to identical skill across cities, could be driven by various sources. In the spirit of growth theory and modified neoclassical framework, essential deviations could be advantages of endowment amenity presenting differently across space (Acemoglu & Dell, 2009; Durlauf & Quah, 1999; Temple, 1999); alternatively, the nontrivial costs of transportation and the product differentiations, inducing localized cost-saving linkages between suppliers, producers and consumers, are at the heart of the new economic geography (NEG) theories (Fujita, Krugman, & Venables, 1999); in addition, imperfect information and localized knowledge spill-overs, generating aggregate increasing returns to scale, justify the existence of city in urban economics (Duranton & Puga, 2004). Scale externalities especially agglomeration economies have come to bear more explanatory weight in spatial wage disparities. On the other hand, spatial equilibrium theory, featured as quality-of-life framework, appears to plausibly explain persistent spatial

differentials in wages as markets are increasingly integrated nowadays. Provided that freely mobile labor could arguably arbitrage away wage differentials across space, differences in cost of living and amenities stand out, regarding the persistence of intercity differentials in wages and prices across locations in long-run equilibrium, as well as uncovering the effects of shocks to local economy on spatial wage distribution. In this strand of studies, various versions of modeling general spatial equilibrium are mostly derived from the quality-of-life framework posed by Rosen (1979) and Roback (1982). Alternatively, wages are probably set in an environment that diverts from the competitive labor market. In this context, wage inequalities across cities may arise from local disequilibrium or segmented and imperfect markets. Despite the relative importance of potential sources and mechanisms that give rise to spatial wage inequality could vary among existing theories, such deviations discussed above are mainly stylized facts or factors, which have been commonly documented for a long time and examined in different settings. Considering that they are neither new nor reaching a consensus, it is necessary to understand and compare what implications these deviations indicate under specific settings.

The thesis is organized as follows. Section 2 presents more descriptions of facts on wage inequality across cities in contrast to what would happen in a perfect world. In Section 3, existing theoretical explanations are reviewed, while empirical tests on potential causes behind spatial wage differences in the literature are presented in Section 4. In the end, I discuss the assessment in Section 5 on the consistency and differences among empirical findings, as well as the application of theories in interpreting inter-city wage inequality with respect to different settings.

2 More description of facts

Why interesting: More what happens in a perfect world

Differences in average earnings across cities are pronounced and widespread in different countries. For instance, Glaeser and Mar (2001) report that for larger metropolitan areas holding over 1 million inhabitants in the US in 1970 the urban-rural wage gap was 36% whereas for smaller cities the gap was 21%. In France from 1976 to 1996, the wage premiums for Paris and nearby areas are 15 percent, 35 percent and 60 percent over large, medium and small size of French employment areas respectively (Combes et al., 2008). In China, annual earnings of full-time workers in Shanghai with population more than 1 billion is averagely 71,923 RMB compared to 31,080 RMB in small city Fenghu with slightly less than 1 million residents. In Sweden, nominal wage premium of metropolitan areas encompassing Stockholm, Gothenburg and Malmo over nonmetropolitan areas is around 20% (Andersson et al., 2014).

The fact that wages are unequal across cities within the national boundary is neither new nor temporary. As reported by Duranton and Monastiriotis (2002), using data from the Office for National Statistics (ONS), comparing to the national average earnings in UK, mean wages in London exhibited a premium of about 21 percent while the South East region showed a premium of around 3 percent in 1982. By 1997, wage premium in London and the South East over the national average level rose to 37 percent and 9 percent respectively. Moreover, estimated with aggregate figures, they show that regional inequalities in terms of average earnings had trebled over the year 1982 to 1997, with the South area generally more prosperous than the North. On the other hand, as pointed out by E. Moretti (2011), an upward slope in the plot of average hourly wage in 1980 against the average wage in 20002 by metropolitan area indicates that wage inequality across cities has increased over time. Cities where high school graduates or college graduates earn more per hour than do equivalent labor in other places in 1980 offer even higher payments in 2000 (E. Moretti, 2011). According to his findings, though about a quarter of metropolitan areas changed their position from low wage in 1980 to high wage in 2000 or vice versa, in most cases, wage gaps between cities are persistent over the same period of time. Similar argument has been put forward by Glaeser and Gottlieb (2009), who estimate on total income of individual rather than full-time worker and confirm that differences in income across US metropolitan areas have diverged during

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year 1980 to1990. Though their sample could involve differences in unearned income and in number of hours worked, Glaeser and Gottlieb (2009) find limited evidence of convergence in spatial distribution of income across metro areas during the period of year 1990-2000. In this respect, they conclude that between 1980 and 2000 *"rich places have stayed rich and poor places have stayed poor"*(Glaeser & Gottlieb, 2009, pp. 983-1028).

While for a long time, economists have devoted to understand differences in economic outcomes across countries, the differences in wages across subnational areas in particular across municipalities within a nation might be even more remarkable. As documented by Acemoglu and Dell (2009), after weighting by income (Theil index) and population (Mean Log Deviation index) shares respectively, differences of mean labor income across municipalities are striking with approximately twice the size of inequality between countries, estimating on 10 Latin American countries in 2000 (Bolivia, Brazil, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Venezuela). According to their results, the extent of city size disparities varies among countries, for instance, with 0.125, 0.115, 0.078, 0.050, 0.030 for Brazil, Mexico, Panama, United States and Venezuela respectively. On the other hand, figures on earnings disparity between regionals could also indicate an uneven distribution of incomes across cities. As reported by Escobal and Torero (2005), dispersion in income per capita and consumption per capita is large in Peru by regions as well as within the different geographical regions, with comparing the regional income per capita dispersion in Peru (0.561) to Argentina, Mexico, Chile, Brazil and Colombia (0.736, 0.502, 0.470, 0.424 and 0.358 respectively). Provided that within a country, labor and capital are expected to be less constrained to mobile across regions, it is difficult to understand the widespread inequality in wages across local labor markets within a country.

Wage inequality across cities is in contrast with a perfect world where competitive equilibrium would equate the average wage level across space. As is well-known, if one regards individual worker and firm in the real world as negligible enough to merely take the wage on the market as given and labor mobility across cities is likely to be less an issue within a national boundary, every participant will be attracted by a more profitable place for making a living whereby the inequalities would be eliminated progressively over time.

More specifically, in a perfect world, space is homogeneous, endowed with the same nature resources and embedded with an identical firm performing production under the same technology with constant returns to scale. Economic activity is identical everywhere such that

small-size city is merely larger one in miniature. Household have homothetic utility function of consumption expenditure bounded by their labor income in the context where commuting costs are offset by land rent. Agents are supposed to be identical in terms of the quantity and quality of labor supply. The smooth working of market clearing along with the arbitrage tendency among agents would yield one equilibrium price for input and output goods respectively independent of location, which is to say wages are equal among cities such that individual achieve the same level of utility and resources are efficiently allocated.

However, this is not the case in the real world as implied by the observed wage inequality across cities showing up in most countries. While within the national boundary, some countries exhibit marked unevenness in the city size wages, such gaps may not be quite as obvious in other nations. Commonly spatial wage discrepancies at the city level present a positive correlation with their population size, as made clear by Baum-Snow and Pavan (2012). Importantly, these substantial wage inequalities across cities in the process of urbanization could also indicate other deviations from the perfect world in various respects. Firstly, city differs more than their population size when regarding their naturally geographical environment (Escobal & Torero, 2005) as well as institutions (Acemoglu & Dell, 2009) that are determined exogenously and constant over time but have an impact on city-specific TFP as well as spatial wage disparities. Secondly, due to certain non-tradable goods or facilities in addition to some indivisibilities of input-output linkage in productive activity, neither the variety of goods and economic structure nor the extent of development can be replicated in each space (Duranton & Puga, 2004). Put differently, firms are clustering differently across cities in terms of quantity as well as variety. For instance, some cities might be specialized in financial industries whereas some others are clustered with manufacture factory. On the other hand, metropolitan areas are commonly performing a diversified economic activities compared with small-scale business operations in small towns or and medium-sized cities. Hence, despite that the technological know-how may be not quite different at the subnational level the productivities under different industrial structures could vary from small city to metropolitan area (Rosenthal & Strange, 2004). Thirdly, if some consumption amenities in certain cities are appear to be more attractive to individual and impossible to be simply replicated in other spaces, thinking about opera, museum, architectural heritage in Paris, such comparative attractiveness among spaces could render both land rent and commuting cost differentials, provided that relatively attractive place is crowded by more candidates at the same time. For that reason, wage differentials could arise

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due to dual effects of consumption amenities and congestion dis-amenities. In the case of consumption amenities, lower nominal wages are needed to avoid city being exploded. However, when congestion costs dominates wage premium is required to compensate workers for excessive costs of living (Eeckhout, Pinheiro, & Schmidheiny, 2014). Analogously, cities present extreme living conditions such as cold climate, mountainous region or surrounded by manufacture plans, so that living there requires higher heating and commuting costs or risks health whereby a wage premium arise from compensating for location disadvantage. Furthermore, individuals in the real word are not economically equivalent with respect to their labor supply. On one hand, skilled workers have a higher marginal productivity thus if they are overrepresented in some local workforce rather than randomly or evenly distributed across space (Combes et al., 2008), one can expect to see the discrepancy in citywide wage level between human capital rich and human capital poor cities. On the other hand, in the presence of human capital externality, not only larger amount of well-educated workers, but also local complementarity of labor skill taking various forms of human capital externality are believed to be closely related to the localized productivity of different types of workers (Eeckhout et al., 2014). The last but not the least, as is well known, wages may not be fully determined in a competitive labor market in the presence of bargain power of union or local labor protection policies (Salverda & Checchi, 2014), for instance various minimum wages legislation across cities, in which case, sticky wages and different extents of allowance for unemployment could impede the smooth adjustment of wage rates to different labor market conditions, which partially affect the wage level across cities. Such so, wage inequality across cites could arise due to realized deviations whereby the perfect world collapse in some sense.

Probably an intuitive deviation is that spatial variation in average wages could be a consequence of differences in labor market outcomes across different skill workers, as the more able and productive one is the higher wages are paid. In this case, unevenly spatial distribution of labor skill across cities whereby some locations are concentrated by more skilled workers and some others mainly retain low skilled inhabitants generates the observed wage inequality across space. Therefore, high wage cities are merely employing more skilled workers.

However, remunerations of similar skilled workers are possibly varying across cities. For instance, in the US high wage cities ranking in the top of the wage distribution could offer as more than twice as could low wage cities at the bottom along the wage distribution, regarding

observably equivalent labor traits (E. Moretti, 2011). Specifically, using 2000 Census data, E. Moretti (2011) ranks 288 metropolitan areas in the US in terms of average hourly nominal wage for workers with high school diplomas and reports that the amount of wages at the 10th, 50th and 90th percentile along the distribution across metropolitan areas are $12.5, $14.1 and $16.5, respectively, exhibiting a 32% difference between the points at 10th and 90th percentile. For metro areas at the 99th percentile of the distribution, hourly wages of high school graduates are averagely 60% higher than that in metro areas at the 1st percentile, with amount of $19.0 and $11.9 for each point respectively (E. Moretti, 2011). Regarding college graduates, wage inequality across metropolitan areas is much larger, with a wide gap of 41% between 10th and 90th percentile and 112% between the 1st and 99th percentile (E. Moretti, 2011). For instance, in Stamford, CT or San Jose, workers with merely high school diplomas earn twice the amount of equivalently educated workers in Brownsville, TX or McAllen(E. Moretti, 2011). College graduates in Stamford, CT are paid triple wage per hour comparing to their counterparts in Jacksonville, NC(E. Moretti, 2011). In particular, observed differences in wage across metropolitan areas are shown to be much severer for college graduates comparing to that for high school graduates. Therefore, skill differentials and differences in local workforce could not completely explain the wage inequality across cities.

A general regularity that has been widely documented in empirical studies is that wages appear to grow with the size of urban population. According to Baum-Snow and Pavan (2012), data from the 2000 census in the United States shows that white male aged of 18-55 in metropolitan areas with population over 1.5 million earn 32 percent more per hour on average than their counterparts working in small cities with less than 250 thousand residents. Such discrepancy was initially smaller with 24 percent in 1980 but has grown into a substantial wage gap along the full range of city size. Specifically, an increase of 1 percent point in average wages is found to be associated with an extra 100,000 amount in population. Early in the work of Glaeser and Mar (2001), correlation between logarithms of metropolitan area population and metropolitan area wages is estimated to be higher than 75%.

Of course costs of living within a country differ greatly across space and might explain, as one would expect, spatial variation in wages for observably identical individuals. For example, living in Los Angeles costs 18.4% more comparing to the national average level of living costs in 2012, while it was much cheaper to live in Milwaukee with 4.7% lower than the national mean (Prime, Grimes, & Walker, 2016). After excluding housing costs, non-

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housing costs of living in Los Angeles was still 5.9% higher than the national level while that in Milwaukee was 5.2% lower (Prime et al., 2016). In this respect, one could expect workers in Los Angeles earn higher incomes than their counterparts in Milwaukee, provided that living in the former place is more expensive than in the latter area. Indeed, for workers with graduate degrees the median annual salary in Los Angeles was $73,642, comparing to $66,024 in Milwaukee (Prime et al., 2016). However, costs of living do not tell the whole story, since according to Prime et al. (2016), for high school graduates the median wage in Los Angeles was lower than that in Milwaukee, with $25,693 and $28,708 for each places respectively (in real 2012 dollars). In the absence of heterogeneous preferences for local amenity and provided that workers are freely mobile across cities, high school graduates should have moved out from Los Angeles to Milwaukee such that Los Angeles were populated by graduates whereas Milwaukee were featured as plausible destination of high school graduates. This is obviously contrary to what we observe in reality because we can always observe these two types of workers present in both cities. Indeed, as noted by Eeckhout et al. (2014), both high-skilled workers and low-skilled ones are found to be overrepresented in large cities whereas workers with average level of skills are relatively constant across MSAs in the US.

If mobility of labor and firms is perfect such that each individual group of agents seeks to reach their maximum value of utility across space, in spatial equilibrium either the same type of agent is expected to completely concentrate in the same locations or differences in wages of same type of workers across cities are expected to be arbitraged away. However, differences in real wages across cities are significant though smaller comparing to wage differences in nominal terms. For example, real wages of high school graduates deflated by local consumption price index was $10.0 in metro areas at the 10th percentile of the wage distribution, while at the 90th point the wage amount was $11.7, a 17% difference, based on data from the 2000 Census of Population in US (E. Moretti, 2011). As for college graduates, differences in real wages between metropolitan areas at 10th and 90th percentile along wage distribution are approximately 22%, with hourly wages being $16.7 and $20.4 for locations ranking at respective point. Furthermore, as noted by Combes et al. (2008), differences in real wages across French employment areas are quite persistent over time. During the period of 1976-1996, average wages in employment areas at the top along the wage distribution are about 1.62-1.88 times the amount presented in the area ranking at bottom of the distribution,

and the ratio of mean wage in employment area at the 90th percentile to mean wage in employment area at the 10th percentile ranges from 1.19 to 1.23 (Combes et al., 2008).

Perhaps, remarkable disparities in nominal wages across cities could reflect partially differences in firms-level productivity across cities such that even for economically identical workers, returns to skill are unequal across localities. Indeed, as for manufacturing-sector companies, along the total factor productivity (TFP) distribution across areas in the US, locations at the top point of the distribution exhibit almost threefold TFP of areas ranking at the bottom (E. Moretti, 2011). Specifically, log TFP of plants at county level controlling for labor, capital and industry, is 1.54, 1.70 and 2.20, estimated respectively at the 10th percentile, median, and 90th percentile along the TFP distribution, with a gap of 2.9 times between the top areas and the bottom areas (E. Moretti, 2011). The estimated coefficient on slope in plotting TFP in 1992 against TFP in 1977 is 0.919 with standard error of 0.003, implying rather persistent differences in local productivity across locations (E. Moretti, 2011).

In addition, evidences on local productivity gains from city size effects are numerous. For instance, Shefer (1973) estimating with a cross-section of MSAs and a group of two-digit manufacturing industries in the U.S. in 1958 and in 1963, suggests that productivity could increase by ranging from 14% to 27% as city size grow twofold. The numerical value however, is largely adjusted and confirmed by more studies later to an increase of around 3% to 8% (Rosenthal & Strange, 2004). As suggested by Ciccone and Hall (1993), elasticity of labor productivity with respect to employment density is estimated to be at about 5% in U.S. whereas for Europe it is around 4.5% (Ciccone, 2002).

Ever since Marshall (1895) highlighted the role of local externalities and economies of scale in productivity advantages that accrue to urban locations, a renewed interest in explaining wage inequality across cities with different population sizes is growing in recent decades. In other words, the inter-city wage differentials have widely been investigated in the context of agglomeration theory documenting the relation between the citywide wage level and the scale of urban population ((Glaeser & Mar, 2001; Gould, 2007; ChristopherH Wheeler, 2001; Yankow, 2006) for US, (Lehmer & Möller, 2010; Möller & Haas, 2002) for Germany, (Sabrina Di Addario & Patacchini, 2008) for Italy, and (Combes et al., 2008) for France). For instance, according to Glaeser and Mar (2001), unconditional mean wage premium for the US Statistical Metropolitan Area (MSA) over outsiders is about 33 per cent for MSAs holding at least one municipality with over 1 million inhabitants. Urban wage premium in the US is

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around 24–28 per cent for the same type of MSAs populated by more than 500,000 residents while approximately 13-19 per cent for the equivalently populated MSAs but containing no municipality (Glaeser & Mar, 2001). Instead of analyzing on the raw urban wage premium (UWP), Combes et al. (2008) estimate real wages level that are deflated by consumer prices index and report the average wage premium in Paris is around 15 per cent over other large French cities, about 35 per cent and 60 per cent comparing to mid-sized cities and French rural areas respectively. In the same manner, Sabrina Di Addario and Patacchini (2008) report that real wages in the largest Italian Local Labor Markets (LLMs) are on average 5 percent higher than the rest of the country. In general, stylized facts highlighted in these studies are consistent with the agglomeration economies postulating that densely populated areas bring about higher wages level.

Alternatively, wage inequality across cities could be driven by shocks in local labor markets that might not be easily traced out in practice. Provided that within the national boundary labor mobility is expected to have less restriction, local shocks in a locale affect not only wages of workers living there, but also induce relocation of workers with different skills as well as influence spatial equilibrium prices across cities. In this respect, essential links between shock-involved cities and non-affected cities depend on the degree of labor mobility. In the case of elastically mobile workers, general equilibrium prices or wages could partially undo the shocks effects on partial equilibrium wages in shock-affected cities with simultaneous changes in prices in non-affected locations. For this reason, differences in local labor market conditions could significantly affect spatial wage differentials. Since the framework of spatial equilibrium is based on the assumption that firms and workers are fully mobile, if mobility is limited, then workers and housing stock could not fully adjust to shocks, so do the local prices. In this respect, it is thus uncertain whether currently economic status is a spatial equilibrium or lagged adjustment. Beyond the sources mentioned, another potential strand of explanations for wage differentials is imperfect markets. In the spirit of labor economists, imperfect markets and other unobserved heterogeneity could play a significant role in explaining wage differences. In the presence of institutional interventions (such as tax rates, minimum wage legislation and union power etc.), wage rates are likely to be non-competitive rents.

3 Organize theoretical explanations: Deviations from perfect world

In general, equalized factor prices (or wage) gradually driven by the free mobility of labor and capital in long-run equilibria, are based on some crucial conditions that do not divert from what they are supposed to be in a perfect world. Wage inequality across cities may arise due to realized deviations where 'perfect world' collapses in some sense. Widely documented deviations and their impacts on spatial wage differentials in literatures are mainly centering on differences in four dimensions with respect to city attributes; namely local composition of skills, local returns to skill, costs of living and locational amenities, and local labor market conditions.

In the context of inter-city system, skills' differentials refer to ability bias in high wage cities, explaining wage differences on the basis of standard competitive models and human capital theory, which line-up the concept that the more able one earns higher wages. Differences in returns to observationally equivalent workers are explained by localized aggregate increasing returns to scale and advantages of local endowments, resting on agglomeration theory and growth economics, which bears on the question why firms stay in high wage cities given that local labor is more costly. Differences in the value of local amenities could compensate individual utility for wage differences across local labor markets, such that welfare incidence could be indifferent across space. Theoretical explanations, based on the quality-of- life framework or compensating-differential models, reconcile the persistence of wage differentials with the fact that not all individuals flock to high wage and cities do not explode. As for inter-city wage differentials that cannot be explained by differences in skills, amenities, productivity gains from agglomeration economies and endowment advantages, the residual of disparities in wages could be ascribed to the imperfect mobility of workers and firms, whereby lagged adjustment might arise from costly migrations, non-competitive housing markets or institutional factors.

3.1 Differences in skills across cities

3.1.1 Ability bias

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There is an abundance of studies showing that regions differ largely in the composition of their workforces. For instance, Simon and Nardinelli (2002) report that urban workers on average are more educated than rural ones. In China, northern regions and some central regions present a higher level of average educational attainments than western regions, with the share of people obtaining at least college degrees varying to the greatest extent across 31 urban areas, compared with other human capital indicators such as the illiteracy rate and the share of high school graduates (Jiang, 2011). In Sweden, the three biggest labor market regions, namely Stockholm, Gothenburg and Malmo, contribute a share of 36% to the overall skilled workers who perform science-based, engineering and corporate management occupations (Andersson et al., 2014).

Heterogeneity of labor

As workers with favorable labor traits are undoubtedly better rewarded in labor market, unevenness in geographical distribution of human capital arguably explain the intercity wage differentials. In this case, wages are prices of each kind of individual skills, independent of location, such that each location presents different wages corresponding to its local skills bundles. Moreover, regarding that individuals are heterogeneous in terms of human capital, spatial concentration of skilled workers could provide a source of positive knowledge spillovers (Lucas, 1988), whereby increased economic efficiency renders higher wage levels. As argued by Lucas (1988) and Glaeser (1999), locations rich in human capital stock are able to provide more opportunities for individuals to learn from others, and thus improve their own productive ability. In any case, the more able one, who has comparative advantage in either acquired or innate knowledge, will be valued in the market on the basis that skills increase firm's profits.

This explanation, arguing that cities own a higher average earning level merely because of a larger number of talented workers living there, are in line with the human capital theory. Specifically, every difference in remuneration on the labor market is due to individual heterogeneity in human capital. If two workers with the same level of measured human capital are paid differently in each respective location, it must be because the higher wage worker has higher skills in other dimensions, which fails to be captured by econometricians. With a relatively competitive labor market, all wage differences are related to skills. Therefore, if high wage cities are basically featured as employing a larger group of more

productive people, both in terms of measured and unmeasured characteristics, then the spatial wage inequality could merely reflect that workers sort across employment areas regarding their heterogeneous abilities and preferences.

Uneven distribution of skills across space

In a homogeneous space without differences in locational amenity, one might expect to see that identical worker uniformly distributed across areas, such that the skill composition of local workforce is indifferent across cities. However, if different cities attract different industry mixes that present various occupational structure, then cities specialized in more skill-intensive industries are expected to display a higher level of average wages. In an equilibrium model of wage determination with constant returns to labor in each location, wage differences across cities are entirely determined by individual productivity differences. On the supply side, skilled workers complete more tasks than others with one unit labor supply and get highly paid. On the demand side, local firms are able to pay higher wage for skilled labor when the value of the marginal product of labor is higher in cities, which in the context of heterogeneous labor skills, may be due to workers with higher earnings increase local consumption demand and product prices.

Such skill-based explanations, referring to spatial ability bias causing systematic wage differences between groups of workers, are typically rooted in the individual heterogeneity. Notably, wage-related skills incorporate both observable indicators, such as education and experiences, and unobservable indicators like motivation or ambition. Given that workers are free to move across cities, the systematic differences in local workforces could only be understood by the differing endogenous location decisions of individuals. For instance, this deviation could be the result of different types of workers respond differently to higher mean wage level of city regarding their ability (Baum-Snow & Pavan, 2012; Kennan & Walker, 2011), of different endogenous history of education and career choices (Gould, 2007), and of personal preference for certain consumption amenities in cities (such as big shopping venues, opera, golf course, etc.). on the other hand, average income, the number of health personnel per 10,000 inhabitants and the number of street lights per city turn out to be positively related with the local stock of human capital, and with the local share of people obtaining more than a high school degree; however, living costs is found negatively related with human capital stock in a region but does not affect the local percentage of highly educated people (Jiang, 2011).

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Existing wage differentials across cities could also induce a dynamic out-flow of educated people from poor developed cities to larger cities. All of these facts may contribute to the inequality in geographic distribution of human capital, whereby wages are unequal across cities.

Empirical predictions of ability bias

Empirical studies on spatial wage differentials normally begin with decomposing individual wage determination into worker-based and location-based components, with generally overwhelming evidences showing a substantial reduction in wage disparity after controlling for individually observable and unobservable characteristics. For instance, as suggested by Acemoglu and Dell (2009), estimating on 10 countries in Latin American in 2000 (Bolivia, Brazil, El Salvador, Guatemala, Honduras, Mexico, Panama, Paraguay, Peru, and Venezuela), years of schooling and the experience of the labor force can explain about half of the differences in incomes across municipalities as well as across countries. Besides, urban economists exploring urban wage premium (UWP) centering around whether non-random spatial sorting of heterogeneous workers or a genuine productive effect from urban location contribute more to the observed wage disparities across employment areas, generally report a finding that individual skills account for a larger fraction of wage gap (Combes et al., 2008). Importantly, as shown by Bacolod, Blum, and Strange (2009), UWP is not uniform across workers, but depends on workers' skills, with more able one enjoying a higher UWP.

3.1.2 Human capital externality

In a perfect world, costs or benefits of an activity are assumed to have no impact on third parties whereas the existence of human capital externalities has come to bear considerable explanatory weight as a wage-determining factor in literatures of both labor and urban economics.

Conceptual environment

As initially pointed out by Marshall (1895), in the presence of knowledge spill-over, geographic concentration of human capital can boost economic development. In other words, the sharing of knowledge and skills between workers makes individuals learn from each other, encourages new ideas and further enhances worker's productivity. Such forms of

externalities are embedded in formal theoretical models by Lucas (1988), Azariadis and Drazen (1990), taking the average level of human capital as a social input in aggregation production.

More specifically, according to Heuermann, Halfdanarson, and Suedekum (2010), the advantage of employing more skilled labor in the local work force could be materialized through pecuniary and technological externalities in production, and generate wage differences across cities. According to Acemoglu (1996), given there is complementarity between the input of human capital and physical capital, and given that searching on labor market is costly for firms, pecuniary externalities exist when a higher contemporary education level induces a higher physical capital investment by employers, who expect previous investment bring about more educated employees in the future. In this manner, all types of workers enjoy a higher productivity due to a higher level of effective physical capital. On the other hand, the technological externalities, as modeled by Jovanovic and Rob (1989), have emphasis on productive efficiency that accrue to individuals who have increased their knowledge and skills when working with skilled colleagues, whereas the originally skilled one is not compensated by firms for their model effect. In this context, the larger amount of skilled workers clustering in particular locale contributes to the wage inequality across cities by speeding up local accumulation of human capital in the work force.

For simplicity, the effect of human capital externalities on wage inequality across cities can be illustrated by the reduced form of individual wage determination, where $w_i = A(s_a)s_i(s_a)$ such that the average wage of city a is given by $w_a = A(s_a)s_a$, where w_i denotes the wage of worker i, individual skills is s_i, the average level of skill at city a is s_a and A refers to the productivity of labor, capturing human capital externality that is independent of location but governed by the intensity of local human capital. In general, the basic idea is that both individual and aggregate labor productivity are correlated with the average level of human capital.

Empirical predictions of HCE

The hypothesis assert that productive gains from human capital externality (HCE) along with the fact that workers and thus the stock of localized human capital level are not evenly distributed across cities yield a real wage premium even after deflating nominal wages with the cost of living (Glaeser & Mar, 2001). As HCE relies on learning process and

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accumulating knowledge, it takes time to make differences in productive gains, which indicates a faster wage growth in human capital rich cities and a wage premium owing to knowledge increment accrue to workers, typically noted as wage growth effect.

Observed spatial variation in wages could directly reflect spatial bias of ability in both observed and unobserved dimension. On the other hand, researchers are also interested in whether the relative advantage of higher educational attainment presents causal effects on local wages, in the sense that individuals with various educational levels could also enjoy wage gains from being in the same community with highly educated people. Specifically, whether local productivity gains from the social returns to education (Enrico Moretti, 2004a; Rauch, 1993), knowledge spillovers associated with the proximity to more educated workers (Rosenthal & Strange, 2008), utilization of occupation-specific skills (Combes et al., 2008; Rodrguez-Pose & Vilalta-Buf, 2005) can plausibly explain the wage inequality across cities, comparing to another strand of explanations centering on the nature of cities enhancing productive efficiency in their own right featured as urban scale effects or area-fixed effects (Fingleton, 2003; Glaeser & Mar, 2001; Wheaton & Lewis, 2002).

3.2 Differences in returns to skill

Instead of skill differentials, there might be a genuine effect of location on labor productivity, whereby local returns to economically equivalent skills could diverge across cities. Specifically, firms in high wage cities employ equivalent workers, but are able to bear a higher payroll in the long run equilibrium given a relatively competitive setting, only when there are productivity gains from other local attributes rather than from unobserved heterogeneity of skills; otherwise, employers would have left high wage locales if higher costs of labor are not compensated for by higher productivity (Carlton, 1983). As argued by Glaeser and Mar (2001), cities make workers more productive. In other words, costly labor inputs in high wage cities are arguably offset by other locational advantages in productivity, generally be it for endowment and agglomeration economies. Hence, this deviation could well explain why firms stay in high wage cities.

3.2.1 Differences in endowment

There is a broad group of explanations contending that spatial wage differentials can be partially ascribed to differences in local non-human endowments that give rise to divergence in productive efficiency. In line with growth economists (Acemoglu & Dell, 2009; Durlauf & Quah, 1999; Temple, 1999), the broadest sense of local endowments, that have impacts on wages, could be production factors, technology, geographic conditions, local provision of public goods, cultural environments and local institutions and regulations.

Conceptual environment

Cities are located in various areas endowed with different resources rather than distributed in a homogeneous space. Favorable locational features could become productive amenities, such as accessibility to a navigable port or river, closeness to some raw materials or mineral resources, flat land area facilitating plant operation and so forth. In this context, the marginal product of labor can be improved and workers get paid higher wages, because local firms are benefiting from either lower exporting costs, cheaper supplies or productive facilities. Besides the natural amenities, artificial productive amenities could be infrastructures tailored to firms' needs. For instance airport, high-speed train lines, paved roads and other public intermediate inputs like specialized schools or universities, which are more related to and rely on local public or private capital, technology and institutions (Acemoglu & Dell, 2009). On the other hand, differences in endowments or local productive amenities are referred to as non-tradable and indivisible goods by urban economists (Buchanan, 1965). As argued by urban economists (Behrens & Robert-Nicoud, 2014; Buchanan, 1965; Duranton & Puga, 2004), it is the gains from sharing indivisibilities that evoke succeeding agglomeration of firms and workers. In this case of productive amenities, holding other things equal, wage differentials could arise due to differences in regional endowments that influence local productivity efficiency. In the view of growth theories, these local characteristics related to production but distinguished from regular inputs are referred to as total factors productivity (TFP). In general, city-size wage level can be formalized as $w_a = A(E_a)$ (Combes et al., 2008).

However, most models, asserting local endowments have a direct influence on economic growth, take these endowments as given, which might be a restricted assumption as one could argue that except for physical geography, other endowments more or less appear to respond to local economic conditions. It is commonly observed that areas presenting economic prosperity are also areas where fundamental establishment is well-developed and public

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services are of first-class standard. Therefore, empirically estimated results could be interpreted as causal effects of endowments on local productivity and wages with assuming that all factors of production including labor are immobile, instead of being intertwined with agglomeration economies (Rosenthal & Strange, 2004). However, at least two elements, namely nature amenity ((Ellison & Glaeser, 1999; Sukkoo Kim, 1999; Marshall, 1895) and institutions (Acemoglu & Dell, 2009) stand out.

Empirical predictions of hypothesis

Local non-human endowments are undoubtedly playing a crucial role in economic growth and closely related with wages, nevertheless, empirical estimations on sources contributing to wage inequality across cities do not give much support to this endowment based explanations. For instance, Combes et al. (2008) encompass all the potential explanations within a unified framework to estimate relative effect on spatial wage disparities in France, using a large panel of micro data. They separate skills and individual fixed-effect from area fixed-effect, and further decompose area effect into endowments and interactions. According to their findings, the explanatory power of local endowment is the least if there is any, compared to the most importance of individual skills differentials and second importance for interactions (consisting of agglomeration economies and market access).

Yet, it may also worth paying attention on the noticeable correlation between worker effects and area effects, with an estimate of 0.29 reported by Combes et al. (2008), indicating that spatial sorting of ability could be induced by some certain area-specific amenities in the first place. In other words, different areas may attract different industry mixes that lay the foundation of local composition of skills, in which case, industry mix is endogenously formed by firms choosing to locate in somewhere presenting locational advantages (Goldfarb & Yezer, 1976). For instance, based on Either's (1982) demand-side perspective of Dixit and Stiglitz (1977), NEG economists (Abdel-Rahman & Fujita, 1990; Fan, 2007) emphasize the importance of local productive endowments or infrastructure facilities, on the basis that cost advantage will encourage local clustering of a wider variety of firms and agglomeration of economic activities. As made clearly by Fujita et al. (1999) and Krugman (1991), higher nominal wages could arise where stronger linkages between markets of intermediate and final products are established owing to the local provision of accessorial facilities.

Therefore, it is worthy of making it clear that the emphasis of endowment, in understanding wage inequality across cities, are based on their contribution to local growth through city-specific TFP but also to the local mix of industry and skills across areas.

3.2.2 Urban agglomeration economies

Another strand of explanations on wage differentials across cities and regions are put forward by urban and reginal economists emphasizing the effects of increasing returns to scale on labor productivity, and highlighting a host of mechanisms to justify the stylized fact that the magnitude of urban wage premium (UWP) increases along city sizes. This argument is originally explaining the urban-rural wage gap, but rooted in the urban agglomeration economies.

As noted early by Weber (1899), workers in densely populated area earn higher wages, which is continually confirmed by more studies in the inquiry about reasons for the urban-rural wage gap (Sabrina Di Addario & Patacchini, 2008; Glaeser & Mar, 2001; Yankow, 2006). For instance, Glaeser and Mar (2001) report that the urban wage premium for Standard Metropolitan Statistical Areas (SMSAs) with over 1 million inhabitants was 36%, compared to 21% for smaller cities. Such density wage premium is cited as evidence of agglomeration economies by economists, demonstrating that a densely populated urban area makes firms and workers more productive.

Conceptual environment

More specifically, productivity gains stem from interactions among firms and workers, with more intensive interactions expected of a denser place. As highlighted initially by Marshall (1895), these interactions could induce positive externalities in various manners, for instance, communications between clustered workers as well as between local firms foster diffusion of knowledge   and innovation, a thicker labor market generates more and better matching of employers and employees, and a variety of firms could benefit from proximity to a gathering scales of input suppliers as well as output consumers.

According to Duranton and Puga (2004), agglomeration economies take three main forms, namely sharing, matching and learning. Firstly, sharing occurs when some indivisible goods and facilities are more profitable to supply with a large population, whereby increasing

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returns generated in the provision of local public services (Buchanan, 1965). Sharing could also arise in productive activities where firms are sharing a variety of intermediate inputs and risk in face of market fluctuations. Secondly, matching exists when intensive economic activities generate a finer inter-firm division of labor and differentiate skills. In this context, labor pooling or a thicker labor markets is more likely to make particular skills well matched with job tasks (Helsley & Strange, 1990; Sunwoong Kim, 1990). Finally, learning refers to faster diffusion and renewal of knowledge as face-to-face interactions between workers increase (Duranton & Puga, 2001; Jacobs, 1969). Though learning mechanism could be overlapped with human capital externality (HCE) in the case of ability bias, agglomeration effects are more emphasize the effects of the quantity of local labor supply whereas HCE of ability bias are resting on the quality of local workforce as a whole.

Concretely, larger cities are more likely to offer higher wages on the basis that an increase in the workforce shifts the extensive as well as the intensive margin of production. As argued early by Adam Smith's (1776), as employees increase in the workplace, it is more likely that each worker specializes on a narrower set of tasks and become sophisticated, whereby workers become more productive. In this manner, agglomeration economies could take place in dense economic activities even with initially identical labor, while human capital externality arises conditional on skills discrepancy or heterogeneous workers in the first place. More specifically, workers benefit from agglomeration economies due to skills specialization or performing non-routine tasks. For this reason, working skills could also be distinguished between transferable or specific skills in some empirical studies (Andersson et al., 2014). Moreover, densely populated cities allow more intensive communications between workers as well as firms within a limited spatial area, thereby localized technology innovations could take place and enhanced productive efficiency benefits both firms and workers. Finally, labor efficiency could also arise provided that a thick labor market is more likely to yield more and better matchings between firms' need and labor's qualification. Imagine that densely concentrated economic activities are taking place in cities, it becomes easier to get a job and more likely that the job suits to one's skills in face of more job opportunities presented.

Empirical predictions of hypothesis

The existence of agglomeration economies results in differences in local returns to identical skill. In this context, workers with relatively similar labor traits (education, experience, age,

gender, etc.) could be rewarded differently between city sizes whereby productivity gains from urban agglomeration are captured by a density wage premium.

In addition, urbanization economies could be partially captured by diversity of economic activities. Cities with a diversified economy can foster the generation of new ideas and technologies as posited by Jacobs (1969) and Duranton and Puga (2001). For instance, as noted by Jacobs (1969), brassiere industry in New York stemmed initially from dressmakers' innovations rather than from the lingerie industry. In addition to facilitating cross-fertilization of knowledges and innovations, different types of industries congregating within the locality provide a way to achieve complementarity as well as to share risk among different types of workers. As made clear by Marshall (1895), textile industries are typically found congregated in the neighborhood of mining and engineering industries such that the mixed industrial district provide a variety of employment to strong man as well as women and children. In general, diversely modern economy in large cities or metropolitans is more featured as performing a particular function.

On the other hand, the New Economic Geography theories emphasize cost and demand linkages and measure the market access of a locale as the main source for agglomeration economies. Firms experience productivity advantages due to physical proximity to inputs suppliers and products consumers, such that costs of inputs and transportation may decrease while products price may increase in a larger demand market (Fujita et al., 1999). In this case, differences in market access could account for interregional wage disparities. As reported by H. Hanson (2005), wage elasticity with respect to market access is estimated to range from 13% to 20% when studying the variation in incomes across counties in the US. The figure is estimated at around 30% in the works of Redding and Venables (2004) and Knaap (2006), about 10% for EU according to Head and Mayer (2006). Fan (2007)using data on 216 prefecture cities in 1997 in China finds that doubling the level of local market access would increase the local average earnings by about 15-20%. However, this set of models are constructed on the assumptions that technology is increasing returns to scale, imperfect competition and factors may be mobile across locations such that incomes and factor prices are endogenously determined. In this case, wage differentials arise due to lack of extra employment to meet the excess demand, which leads to adjustment in price and wages. For this reason, results generally imply insufficient mobility of labor and employers in face of nontrivial transportation cost and other mobility restrictions on labor.

3.2.3 Differences in local industry mix across cities

This section is motivated by the longstanding debate on whether the size of overall markets or concentration of activities within specific industry contributes more to agglomeration gains, namely the relative importance between urbanization economies and localization economies (Combes & Overman, 2004). As different industries could get differential benefits from being proximity to large cities, some industries may find it cost-effective to locate in or near high wages or larger cities while other types of industry might be indifferent across areas. Put differently, agglomeration economies vary along industrial scope (Rosenthal & Strange, 2004) and make it worth concerning differences in industry mix influencing labor productivity and accounting for differences in returns to skills.

Conceptual environment

In a perfect world, there is one representative firm for each city performing production under constant return to scale and perfect competition. There would be no inherently high wage industry given perfectly competitive factor and product markets with no barriers to spatial mobility (Goldfarb & Yezer, 1976). In the real world, the spatial distribution of economic activities is obviously unevenness throughout the space. As reported by Glaeser and Mar (2001), America's five largest metropolitan statistical areas present more than 22% of U.S. nonfarm business establishments. In the New York City area alone, which has the highest wages in the country, there are 555,000 establishments (Glaeser & Mar, 2001). Both the New York area and the five largest metropolitan areas taken as a whole have more nonfarm establishments per capita than the country as a whole (Glaeser & Mar, 2001).

In the case of industrial concentration in cities or regions, external economies may also take place (Marshall, 1895; Porter, 1990; Romer, 1986), such that local technology depending on the composition and size of local industry could vary from city to city and result in differences in returns to industry-related characteristics. This is typically featured as localization economies indicating external economies of scale are internal to respective industry in a specific locality. According to Henderson (1986), the scale of local employment in the industry of the firm in question generates economies in four manners. Firstly, larger industry size allows deeper specialization among firms with respect to their detailed functions. Secondly, thicker similar skilled labor pooling reduces search costs for firms given workers are trained in relevant knowledge. Thirdly, frequent communications among firms

facilitates innovations. Lastly, more profitable provision of public intermediate inputs could be tailored to the specific needs of the industry.

Empirical predictions of hypothesis

If industries vary in their nonpecuniary returns to work, then different areas might have different wage levels in the long run to balance these nonpecuniary features. In this respect, industry mix could partially explain interarea wage differentials. If however, industries differ essentially in occupational structure, then mean wages differentials across cities could explained by differences in human capital per worker or potential outcomes of human capital externalities(Enrico Moretti, 2003). On the other hand, localization economies assert that higher degree to which a city's employment is specialized and/or the absolute scale of activity encourage growth , measured as the share of a city's employment in a particular industry and the industry's share of employment in a particular city.

The inclusion of industry dummies and variables proxy for localization economies in an estimated wage equation in empirical studies is reconciled with an old inquiry about the sources of salient inter-industry wage differentials even after accounting for a bulk of individual and job characteristics (Abowd et al., 1999; Gibbons & Katz, 1992; Krueger & Summers, 1988). As discussed by Rosenthal and Strange (2004), localization economies or external effects stemming from the concentration of an industry could vary from industry to industry, with evidences showing localization economies in effect in several industries whereas no evidence of external economies at all for some industries regarding two-digit manufacturing industries. In addition, as noted by Moomaw (1981), doubling city size would enhance local economy efficiency with an increase about 2.7% in productivity, particularly with the nonmanufacturing sector sharing most of productivity gains that are more than twice as large as those accruing to manufacturing sector. Besides, Combes (2000) using a data of 341 employment areas in France during 1984-1993 finds that service sectors benefits from diversity but not specialization while for most of manufacturing sectors, neither specialization nor diversity has a positive impact on growth. Moreover, as noted by Shefer (1973), even classifications of the two-digit manufacturing industries are sufficiently different, that interarea variances in product-mix could still be significant. In this respect, after concluding the existence of localization economies in the city manufacturing sectors, he points out that when taking all manufacturing industries in an area together, local industrial mix are expected

to play a most important role. Therefore, differences in local industry mix could contribute to spatial wage differentials, which are empirically captured in the wage formation by industry dummies and localization economies proxy by the share of local employment in a particular industry and the industry's share of total employment in the locale.

3.3 Differences in costs of living and amenity

One alternative interpretation of wage differences in labor economics is compensating differentials arguing that a worker might be paid less in money but receiving part of compensation from other dimensions that could be hard to observe, for instance, pleasant working conditions, better amenities or lower effort requirements of the job and so forth. In the case of spatial disparities, wage inequality across cities is equalizing locational amenity differences, such that individual utility is indifferent between locations in a long run spatial equilibrium. The idea here is in line of the quality-of-life literatures (Roback, 1982; Rosen, 1979). While literatures on UWP suggests that the observed spatial wage gap in the nominal terms could be interpreted as local productivity differences, in the quality-of-life framework, wages inequality across cities can be offset by differences in costs of living and urban amenities. According to the compensating or equalizing differential theories, high wages cities are areas where high urban housing prices and costs of living yield high urban wages to compensate for. In other words, spatial differences in real wages concerning individual utility rooted in urban amenities could well explain why not everyone flock to the high pay city.

Conceptual environment

Cost of living could be raised by either geographical features, for instance, a colder climate require a higher heating cost compared to a warmer region, or urban congestions, such as longer commuting, higher housing rents. As suggested by Fuchs (1967), density wage premium may partly reflect the increased commuting costs connected with living in larger cities.

Alternatively, in the case of differences in amenities, unique features of different cities could result in differences in wage rates. For instance, if most of the population prefers to living in a relatively warm climate, all else equal provided that there were no cost of living differentials, the favorable cities would have to render a lower wage rate than that offered by cities with

colder climate such that people are willing to live and work in both places. Analogously, if life in small cities with a wider offer of cultural goods is considered more pleasant, wages would reflect this view. On the other hand, higher wages could be required to compensate workers for dis-amenity, for instance extreme climatic or pollution.

In more general cases, amenity could affect cost of living and wages at the same time. One can imagine clean air, favorable climate, or a wider offer of cultural consumptions such as architectural heritage, museums that make a city more preferable than other places and cause higher land rents but lower nominal wages (Roback, 1982). In this context, lower nominal wages are compensated for by consumption amenities so as to equalize individual utility in all areas whereas higher land rents leading to higher housing prices and cost of living could need a wage premium whereby net effect on wage differentials could be unclear or offset.

The literature on cost of living in cities of various sizes has focused largely on public goods provision and commuting costs. Indeed, empirical literatures on COL in cities along various sizes suggest that both the commuting costs and public service costs begin to rise as city size exceeds 100,000, possibly even at an increasing rate (Hirsch, 1970) though per capita public service costs are commonly conceived to fall as population grows below the threshold of 100,000 or employment less than 40,000.

In some studies on urban and regional economics, amenity differences are captured by a regional dummy variable to examine factors underlying city size-wage rate relationships (Goldfarb & Yezer, 1976), in consideration of intercity amenities differences are not commonly in line with city sizes. Amenity might be decreasing over one range of city sizes but increasing over another. Accordingly, it might be plausible to control for regional differences in unobserved amenity values that is common to all individuals, in which case estimates associated with this regional variable could partially reveal the extent to which local wages compensate for potentially unmeasured locational amenities.

A more serious issue is that some amenities valued by individual preferences are correlated with firm productivity. Suppose workers have a preference for big cities because of a larger variety of shopping centers or other creational activities associated with large cities, this will work to increase rents and reduce wages. If firms consider workers in big cities more productive, this works to raise wages and higher rents. In the case where workers amenity effect dominates over firm productivity effects lower wages and higher rents will exist in

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large cities in spite of agglomeration economies. Additionally, in line with the quality-of-life framework (Roback, 1982), if educated areas entail a consumption value for individuals regarding that lower crime rate also affect the quality of life, workers will accept a lower wages to live in a city endowed with better human capital. In this case, rents and land prices will be much higher in educated areas, but the net effect on nominal wages depends on whether human capital is predominantly a productive amenity for firms or consumptive amenity for workers. Hence, the empirical interpretation of differences in cost of living and local amenities in explaining spatial wage inequality depends on the extent to which household amenities are correlated with firm productivity effects. In the case of big cities, however, consumption amenities depend on productivity rather than exogenous and nonpecuniary amenities such as climate and might partially appeal to certain groups of people instead of common to individuals.

Empirical predictions of hypothesis

As discussed above, given some local amenities for workers could be intertwined with productive amenities (endowments) for firms, a simplified endowment variable could present positive, negative or mixed effects on wages, which leads to the effects of the endowments as a whole in explaining wage inequality across cities could be ambiguous. As pointed out by Combes et al. (2008), the weak role of endowment shown in estimation could be due to failure in choosing proper factors as a proxy that can capture the desirability of a location for firms or for workers. In the case with agglomeration or human capital amenity, the consumption externalities from amenity could also distort estimates on agglomeration effects or human capital effects. Therefore, empirical studies on spatial wage disparity could need to well specify and distinguish the two different types of amenities, with the pure amenity affecting wages in single direction as well as cost of living, whereas the mixed amenities influencing wage in a more complex manner.

3.4 Disequilibrium

There are other explanations quite different in spirit from the long-run deviations, referred to as disequilibrium indicating transitory or lack of efficient adjustment to wage differentials across cities. Specifically, provided that in long-run equilibrium cities are indifferent on the basis that spatial wage disparities are merely compensated for by locational amenity value, it

could be that particular cities or areas temporarily have higher wages due to local labor demand shocks or imperfect markets in face of policy interventions. Since gradual adjustment could be less costly for workers and employers (Kennan & Walker, 2011), wage differentials could arise from lagged adjustment to location-specific shocks or non-competitive rents in face of institutional factors. Shortly speaking, because of high adjustment costs, existing wage inequality could partially indicate a non-stationary state where the process of wages is interacting with local labor market conditions.

Conceptual environment

Consider an economy where preferences over unique features of different locations is common to all individuals and for each type of skills there is one price independent of locations. There are wage differentials across space, but these just compensate for the differences in amenity such that individual is indifferent between cities. In steady state equilibrium, people move across areas for various reasons, but there would be just as many workers flocking into each area as those would be fleeing from. Thus one may expect to observe neither correlation between wage change and net migration nor correlation between wages and mobility in the steady state.

However, in face of nontrivial cost of moving, labor supply adjustments could take time, in which case positive demand shock for instance demand for the products produced locally had risen in particular cities or areas will raise wages in the short run, because the temporarily higher wage had not yet drawn sufficient immigration to counteract the shift in the labor demand (Muth, 1971). For instance, in practice, individuals concerns about costs of moving, involving directly monetary expense but also psychology costs (Bayer & Juessen, 2012). In this respect, people could only move when the expected payoffs are more than enough to cover the unfavorable costs of moving. In other words, there are good reasons to suspect that short-run supply of labor to a particular location might not be as elastic as the long-run supply.

These arguments suggest that elastic spatial labor supply could affect wage's flexibility within local labor markets. As argued by Topel (1986), an increase in local demand for labor causing by relative shock could temporarily raise relative wages in that locale, but costly migration arbitrages these geographic wage differences in forms of consequential increased migration gradually reducing the current wages. Specifically, in face of the costs of moving workers

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have the incentives to maximize their present value of future incomes and thus response to the interarea wages differences, which makes local wages sensitive to transitory changes in market conditions. As mentioned by Hoover and Giarratani (1971), wages present different degrees of fluctuations with respect to differential mobility of differently demographic groups, with immobile groups showing more variances in wages. Alternatively, disequilibrium from short-run to long-run could possibly arise from other labor market inefficiencies such as a non-competitive housing market (Henley, 1998) or institutional interventions exacerbating or lessening the segmentation of markets. For instance, according to (Goldfarb & Yezer, 1976), the North-South differentials in economic performance in the US could be gradually mitigated by firms relocating employment across boundaries to the South and escape the high minimum wages, unionism pressure and high wages pay in the North. In general, lagged adjustment could occur when either institutional restrictions are removed away or there are fundamental shifts in comparative advantage.

For disequilibrium to explain spatial wages, one would need to know how and when individual response to differences in wages across locations. In other words, a net wage gain that accrue to migration stemming from local labor demand shocks can induce a flow of workers toward high wage cities whereby transitory wages are influenced by the responsivity of labor. On the other hand, imperfect markets related to institutional factors could also impede the smoothness of spatial adjustment. Consider the minimum wage legislation or wage bargaining with unions, in face of costly adjustment, local employers could pay noncompetitive wages that are probably either below the marginal product of labor or non-profitable.

Empirical predictions of the hypothesis

On the supply side, the extent to which workers response to spatial differentials in wage rates imply that migration flows could either widen or narrow the spatial gaps. As suggested by Topel (1986), a temporary increase in local labor demand raises relative wages within the respective area nevertheless current wages could be reduced by expectations of future demand based on increased current migration, in which case, wages are sensitive to differences in market conditions across locations.

On the demand side, it also takes time for firms to relocate employment across barriers. Provided that disequilibrium is a short-run failure in adjustment, one could expect to see gradual convergence between areas in economic outcomes over a relatively long period.

Disequilibrium could be reflected by continuing migration flows toward some certain cities or/and some locations are barely maintain their inhabitants over time. In other words, complete spatial equilibrium could yield a relatively stable city system in terms of population size whereas in a short run disequilibrium variation in city size across space are changing or fluctuate. On the other hand, comparing to a long run equilibrium where local prices could capitalize and undo the shocks (E. Moretti, 2011) lagged adjustment indicates that local labor market shocks could have long-lasting effects.

In the context where spatial labor supply are elastic, high wage cities will have large population and wages of the least mobile workers are more sensitive to local shocks, even when presenting wages differentials are merely compensate for amenity differences across areas. In the case with lower mobility of workers, unexplained wage disparities across cities could be partially ascribed to imperfect markets influenced by institutional interventions.

4 Empirical tests on deviations and explanations

4.1 Differences in skill composition of local workforce

Cities are specialized in different types of trade industries as well as workers with different levels of skills.

4.1.1 Do high wage cities employ more skilled workers?

The fundamental issue around testing this hypothesis is to what extent one can capture wage-related skills of individuals in both observable dimensions for instance education, employee's ability measured by the Armed Forces Qualification Test (AFQT) and other unobserved dimensions such as individual motivation or ambition. In the work of Bacolod, Blum, and Strange (2009), skills are clarified into three different types: cognitive skills, people-related social skills and motor skills. Based on such classifications, workers occupied in white-collar professions which present relatively high wages and appear to be more correlated with cognitive and people skills are conceived as skilled workers whereas blue-collar workers performing tasks frequently by motor skills probably earn lower wages and are conceived as unskilled or low skilled workers.

Spatial bias in ability

There is an abundance of studies showing that regions differ largely in the composition of their workforces, among which for instance, Simon and Nardinelli (2002) report urban workers on average are more educated than rural ones. In China, prosperous northern regions and some wealthy central regions consistently present a higher level of average education attainments than relatively poor western regions, with big cities like Beijing, Shanghai and Guangzhou presenting higher percentages of workers with college degrees comparing to the rest of country (Jiang, 2011). In Sweden, the three biggest labor market regions, namely Stockholm, Gothenburg and Malmo, contribute a share of 36% to the overall skilled workers performing science-based, engineering and corporate management occupations (Andersson et

al., 2014). In addition, the positive correlation between a higher local share of educated workers and higher city-level wages turns out widespread in the US. According to Richter and Nelson (2014), estimating on the 100 largest metropolitan areas for 2011, MSAs where larger amount of workers with at least a bachelor's degree are employed are found to have both lower unemployment and relatively higher level of wages. Besides, Prime et al. (2016) report that the Pearson coefficients by year range from 0.618 to 0.688 significantly on the correlation between nominal median wage in a metropolitan area and the percentage of workers with bachelor degree or more, covering 374 U.S. metropolitan statistical areas (MSAs) from year 2005 to 2012. Moreover, according to their results, the correlation between the nominal median wage of a specific educational cohort in a metropolitan area and the share of workers attaining at least a Bachelor's degree in the same location is also significantly positive for all educational groups, with most of the year-educational cohort cells being significant at 1% level except for the cohort with educational level lower than high school showing significant at 5% and 10% level for year 2007 and 2012 respectively. These facts all indicate an uneven distribution of skills across space, with typically skilled workers overrepresented in high wage cities, known as spatial bias in ability.

As suggested by Duranton and Monastiriotis (2002), spatial bias in ability could present itself in three manners.

In the case of immobile labor, unevenly spatial distribution of human capital could result from different educational choices for similar individuals. Consider a situation where few educational attainments are required in local productive activities and some bright youth drawn by high-return works leave school early. Alternatively, a priori particular cities offer better schools or universities such that it is a traditional cultural to obtain higher education. For instance, in Italy where worker mobility is extremely low, the largest local labor markets present significantly larger share of college graduates as well as higher unemployment rates for this educational group than do the rest areas (Sabrina Di Addario & Patacchini, 2008). As shown by De Blasio and Di Addario (2005), workers with less than high school attainment get higher returns in Industrial Districts comparing to workers outside with similarly qualified education, whereas more educated workers are worse off in the industrial clusters. According to Sabrina Di Addario and Patacchini (2008), Italians in large cities access to better-quality schools invest more in education rather than in job-specific knowledge capital due to cultural reasons more than monetary advantage.

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As regards mobile workers, spatial ability bias is driven by self-selective migration patterns. Perhaps motivated workers are attracted to cities where ambition is highly rewarded through learning or potentially upward career ladder can be realized. For instance, as noted by Alfred Marshall (1895) and Duranton and Monastiriotis (2002), a priori London seems to attract workers with better favorable labor traits commanding higher remunerations even when returns to education was initially lower there than in other UK regions. On the other hand, Rauch (1993) feature the migration patterns across SMSAs in the US as net flows from human capital poor to human capital rich cities in combination of unsatisfied demand for further immigration leading to both higher wages and higher land rents in human capital intensive areas. In addition, Dahl (2002) finds that higher educated workers have strong incentive to move to states offering higher returns to education as well as higher value of locational amenities.

Finally, another potential source resulting in uneven distribution of individual ability is differences in the probability of getting a full-time job. Suppose unobserved abilities are uniformly distributed across individuals and locations, spatial differences in the jobs opportunities could also lead to uneven distribution of unobserved abilities for individuals at work across areas. In this context, spatial selectivity bias is induced by unemployment and potentially indicates spatial inequality.

4.1.2 Relatively explanatory weight or causal effects on wage formation

The fact that high wage cities are disproportionally concentrated by more highly skilled people comparing to other locations could be misleading as one attempt to interpret the observed wage inequality across cities as an implication that anyone could be better off in high wage cities. In other words, in interpreting wage inequality across cities, it is important to strike the right balance between assigning earning differentials to individual differences in skills and intercity differences in the mean wage level effect. Hence, in explaining inter-city wage differentials, and therefore in concerning about true differences across space, it is a preliminary exercise to distinguish spatial bias in the distribution of individual ability (observed and unobserved) from differences in regional prices of similar skills.

Observed ability bias

If there is spatial bias in observed ability across cities, that is, cities where more educated workers disproportionally agglomerate stand out as being relatively rich, observed inter-city wage inequality could be ascribed to heterogeneity in individual skills rather than inequality in citywide mean wage effects across space. As in the spirit of human capital theory and with competitive markets more able ones command higher wages, spatial wage inequality might merely reflect the differences in the level of human capital across areas. This hypothesis is evidenced as spatial variation in wage rates decrease significantly when accounting for individual information on human capital and other wage-determining attributes.

As reported by Acemoglu and Dell (2009), differences in education and working experience account for up to half of the inequality in labor incomes and household expenditure across countries as well as across municipalities, estimating on the Americas involving Canada, Latin America, and the United States.

As reported by Duranton and Monastiriotis (2002), using data from the Office for National Statistics (ONS), comparing to the national average earnings in UK, mean wages in London exhibited a premium of about 21 percent while the South East region showed a premium of around 3 percent in 1982. According to their findings, wage premium in London and the South East over the national average rose to 37 percent and 9 percent by 1997 respectively. Moreover, estimated with aggregate figures, they show that regional inequalities in terms of average earnings had trebled over year 1982 to 1997, with the South area generally more prosperous than the North. In contrast, they find that variations in regional prices of basic labor characteristics regarding gender, education and experience were decreasing during 1982-1997, so was the regional fixed-effects after controlling for spatial distribution of human capital. In other words, individual with a given level of education and experience could get equivalent wages among different UK regions. For this reason, Duranton and Monastiriotis (2002) argue salient discrepancies in average earnings across areas are mainly due to uneven distribution of skills, with educated workers are disproportionally concentrated in London and the South East. Similar findings are provided by Blackaby and Murphy (1991) who suggest that in UK differences in labor characteristics between North and South are the main source behind the North-South divide. Therefore, spatial ability bias plays a predominant role in explaining observed inter-area inequality in average earnings in UK.

Unobserved ability

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Although uneven distribution of educated workers across space is commonly intuitive, the most likely spatial bias is about individuals with higher unobserved abilities sorting to the same place. This could be equilibrium where highly skilled and motivated workers realize higher wages when their skills are most advantageously utilized and rewarded by the perspective locale than in other alternative locations (Borjas, Bronars, & Trejo, 1992). Spatial sorting on unmeasured abilities could arise when high wage cities are also places demanding, attracting and retaining higher-quality employees than do firms in other locations (Fuchs, 1967). In this case, differences in distribution of unmeasured labor characteristics could probably reflect differences in skill requirement of occupation and thus might be traced in differences in local occupational structure. Therefore, a substantial reduction in wage difference across areas due to correcting for selectivity bias of unobserved ability could yield a predominant role of spatial ability bias in explaining inter-city wage inequality. Empirical studies on spatial inequality typically include fixed-effects in estimation as strategy for separating effects of individual factors from effects of location-related characteristics in process of wage differentials. In addition, as noted by Yankow (2006), in the context of spatial bias on unobserved abilities, one might expect to see that migrants are receiving higher wages prior to moving compared to stayers with observationally equivalent human capital.

Empirical evidences initially come from studies on explaining urban wage premium or wage gaps between urban and rural area in the US. For instance, Glaeser and Mar (2001) tackle the issue of unobserved heterogeneity by including worker fixed effects in a panel model using individual wage data. Estimating on migrants between cities and rural areas, they report that ability bias reduces city-rural wage gap from 33 per cent to around 11 per cent, which is later confirmed by Yankow (2006) reporting around two-thirds of the urban wage premium is explained by differences in local workers regarding unobserved abilities. Gould (2007), on the other hand, explains the wage inequality between urban and rural for blue-collar workers and white-collar workers respectively. With a structural two-stage model considering self-selection issue, Gould (2007) finds that for blue-collar workers, only more able ones enjoy a wage increase after a move to city comparing to those with lower latent ability indifferent between locations. For white-collar workers, both unobservable learning capacities of workers (skills) and location effects matter, with the personal effects contributing two-thirds of an increase in wages. Hence, a large portion of wage premium over rural areas for urban in particular for metropolitan areas with larger population size could be due to cities attract workers with higher level of unobserved ability and skills.

Combes et al. (2008) concern wage inequality across employment areas in France. Applying two-stage estimation on a large panel data for French workers, they find that worker fixed effect presents the biggest explanatory weight and accounts for about 40 percent to 50 percent of the spatial wage differences when controlling for consumption price index(CPI), area-year fixed effects, industry fixed effects and the local characteristics of industry. Specifically, according to their results, spatial distribution of workers with respect to unobservable (individual fixed effect) and observable characteristics (age and its square) shows a remarkable variation across French areas, with 0.294 compared to 0.364 for spatial variation in log wages, along with a correlation of 0.8 between worker fixed effects and wages. Besides, they find that individual fixed effects are highly correlated with area fixed effects, suggesting that workers with higher latent ability are tend to agglomerate in the same places typically featured as densely populated and more skilled employment area. Hence, their work suggests that in France high wage employment areas do employ more skilled workers.

On the other hand, Baum-Snow and Pavan (2012) study city-size wage gap using data of MSAs in the US. They clarify MSAs into large cities (with population of more than 1.5 million), medium cities (with population of 0.25-1.5 million) and smaller areas (population below 0.25 million). According to their results, correcting for differences in education and experience across areas reduces the nominal wage gap between large cities and smaller area from 0.29 to 0.22 while for medium-smaller cities, nominal wage gap decreases from 0.19 to 0.14. Further inclusion of individual fixed effects substantially reduces city-size wage premium over smaller areas to 0.15 and 0.07 for large cities and medium cities respectively (Baum-Snow & Pavan, 2012). Overall, differences in skills in both measured and unmeasured dimensions across areas play a predominant role in explaining the city-size wage differentials.

As maintained by Bacolod et al. (2009), horizontal differentials in skills cannot be simply equated with education levels. In the study of Duranton and Monastiriotis (2002), occupational dummies categorized as unskilled, skilled and professional are included as a strategy for capturing unobserved ability bias provided that individual self-selection across locations could be related to career ladder or individual preferences for area-specific amenities. They highlight two findings. First, when accounting for occupation differentials, coefficients on education and experience are still significant but decrease fairly. Second, upward trends in wages over time are found for both skilled and professional variables, with the latter one exhibiting a steeper slope. In this respect, they argue wage premium of human

capital is not solely for education and experience per se, but related to jobs qualification. In other words, occupation-related skills appear to explain wage differences better than do observed educational attainments and experience. Their findings also report a better performance of regression after adding occupation dummies for London more than do other regions, which indicates that London has higher wages because better occupation-related skills are relatively concentrated in that city comparing to other localities.

In addition, unevenly spatial distribution of skills is also the main sources of wage inequality across cities in Sweden. Andersson et al. (2014) distinguish occupations in Sweden by involved share of routine vs. non-routine tasks where non-routine tasks refer to non-repetitive work methods or tasks cannot be solely performed by computers in which cognitive and people skills play a more important role, in line with Bacolod et al. (2009), Autor, Levy, and Murnane (2003) and SpitzOener (2006). In this manner, workers' non-routine skills are measured by fraction of non-routine tasks in their perspective occupations. In general, the highest share of non-routine job tasks is found in occupations related to science-based, engineering and corporate management while sectors of agriculture, fishing, extraction and simpler transport services present a lower than the mean degree of non-routine job tasks. Descriptive results suggest that the three biggest labor market regions, namely Stockholm, Gothenburg and Malmo, contribute a disproportionately large share of 36% to the overall skilled workers performing science-based, engineering and corporate management occupations (Andersson et al., 2014). Specifically, for the Swedish private sector as a whole, about 15 percent of overall employment in the population is university graduate (Andersson et al., 2014). The three biggest labor market regions: Stockholm, Gothenburg and Malmo share around one third of the whole employment across all types of professions, sharing 36% of overall employment in high fraction non-routine tasks and 19% of all workers in low fraction non-routine tasks (Andersson et al., 2014). As noted by Andersson et al. (2014), the fact that workers with similar skill or high fixed effects tend to agglomerate in the same areas makes locations distinguished by differences in skill composition of local workforce and thus become the main source of differences in wages across Sweden.

According to Andersson et al. (2014), nominal wage gap between urban and rural is at 20% for occupations associated with high degree of non-routine job tasks whereas that for low fractions of non-routine tasks is -2%. Without controlling for individual fixed effects, they find a nominal wage-density elasticity of roughly 3 per cent significantly for workers mainly

performing non-routine job tasks, yet coefficient dropping sharply to 0.8 per cent when fixed effects accounted for. On the other hand, little evidence of agglomeration economies is found for routine job tasks in any case. In this respect, they suggest that high wage in denser areas is simply resulting from difference in local skills.

Human capital externality (HCE)

As reported by Rauch (1993), the effect of local level of education on individual wages are estimated to be an increment of 3.3 percent for metropolitan areas after controlling for area of residence within the US, local cultural activity, weather and population. However, these results are criticized as not properly tackling endogeneity given that higher incomes inducing higher schooling (Acemoglu & Angrist, 2001). Instead of examining on the aver-age level of education, Enrico Moretti (2004a) estimates the effect of the local share of college-educated workers on individual wages and finds a growth of about 1.1–1.3 per cent in wages for an additional percentage point in the share of college graduates. Similar figure is found by Muravyev (2008) in Russia with the magnitude of 1.5 percent. Heuermann (2011) report an estimate of 1.8 per cent for high-skilled and of 0.6 per cent for low-skilled workers in western Germany. Furthermore, as argued by Heuermann (2011), HCE more prevails in manufacturing rather than in the service industry.

More importantly, not only the absolute quantity of skilled workers but also the relative ratio between high-skilled and low-skilled in an area matter in face of the imperfect substitutes between different types of workers. As suggested by Enrico Moretti (2003), low-skilled workers benefit from local human capital share through both HCE and imperfect substitution effects while for high-skilled individual HCE over-compensates possible supply effects. Though these evidences might indicate that workers are more productive in human capital rich cities, they are rarely directly considering spatial variations in wage rates. On the other hand, Ciccone and Peri (2006) doubt the role of HCE. They identify externalities as changes in regional average wages and hold regional skill composition constant over time for eliminating imperfect substitution effects. As a result, they find no significant evidence for HCE.

When one suspects that HCE might work as a driving-force behind the wage inequality across cities, there are two questions worthy being considered. One could be what is the magnitude of HCE uniquely explain the spatial variations in wage rates. The other could be is there

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evidence revealing the mechanisms through which HCE influences city wages. However, it is notably demanding to identify a true causal effect of HCE. A plausible way could be to comparing wages of workers in cities with differing levels of human capital, which is challenging in face of a multitude of factors influencing wages. Alternatively, according to Heuermann et al. (2010), HCE are regarded as the dynamics of processes of social learning in a human-capital-intensive area. In this respect, HCE are expected to be identified in either examining on-the-job wage growth effects or investigating evidence for knowledge spillovers related to urbanization and localization effects. Put differently, HCE can be explored through analyzing potential wage growth effects from industries providing fertile grounds for social learning or from workers benefiting from intra-industry knowledge spillovers. In general, as argued by Heuermann et al. (2010), HCE has a limited but undeniable contribution to regional wage level with around 1-3 percent for an extra year of regional education or percentage point in the regional college share.

Combes et al. (2008) consider the sources of spatial wage disparities in France. In their work, HCE is captured by the share of workers in professional occupations in the industry of employment instead of the share of professionals in local work force and a part of within industry interaction. As argued by Rosenthal and Strange (2008), knowledge spillovers attenuate with distance and external economies are more likely to present within rather narrow space like at zip code level. In this manner, they estimate the average effect of HCE on wages across industries is large at 11.8%, which is more in line with the result of Rauch (1993). Though rewards to intra-industry knowledge spillovers might be remarkable, when controlling for worker fixed effects, area fixed effects and industry fixed effects, a small standard deviation of effects of the share of professionals in the industry hardly stands out for the spatial variance in wage rates (Combes et al., 2008).

On the other hand, in contrast to Combes et al. (2008) containing HCE as a part of within-industry interaction, Wheeler (2007) estimate hedonic wage equations encompassing both aggregate human capital and level of industry concentration. He finds that each of the two vectors of variable has a respective highly significant effect on wages no matter including the other vector in the same regression or not, which indicates that HCE do not arise through the concentration of industry alone.

It is worthwhile comparing the empirical results based on individual data to those using aggregate level data. As pointed out by Combes et al. (2008), when implementing micro-

founded wage specifications with aggregate variables, typically occupations could be used to proxy for skills, being for instance classified as self-employed, professional, skilled, unskilled white-collar, unskilled blue-collar. In this case, skill composition effects and intra-industrial HCE cannot be separately identified such that estimated coefficient associated to the share of professionals captures both skill composition effects and local interactions. Consequently, as reported by Combes et al. (2008), the coefficients on specialization effects are overestimated by 100% due to failure in properly controlling for sorting. In other word, as remained unobserved individual heterogeneity is captured by aggregate variable in the case with aggregate data, estimates on HCE are inevitably combined with skills composition effects and could be overestimated.

On the contrary, Prime et al. (2016) report no significant human capital effects on wages. They examine the extent to which the median real wage of a specific educational cohort could be influenced by the local share of more educated people in a metro area, covering 374 U.S. metropolitan statistical areas (MSAs) from year 2005 to 2012. More educated people are defined as those who have at least a bachelor's diploma. A significantly positive coefficient associated with this variable would indicate the presence of knowledge spillovers effects stemming from intensive human capital. They analyze spatial wage differentials for workers with equivalently educational attainment regarding potential explanatory variables as urban cost of living, amenities or consumer externalities, policy factors, human capital externalities and local labor market conditions. Deflated median wages, housing rents and the minimum wages are expressed in natural logs and the others presented as shares. A base model taking all types of workers as a whole estimates the local median real wages on human capital intensity and housing costs, with temporally set aside other explanatory variables. In this case, Prime et al. (2016) find that the higher share of more educated individuals in a metro area significantly increase the local median real wage, with a 10% increase in the former causing a 2% increase in the latter. However, when performing regression by educational category, results are generally insignificant, similar outcomes in further analysis using full wage equations (Prime et al., 2016). In other words, the presence of highly educated workers appears to barely influence wages of others with variously lower educational levels. Higher median wages are typically affiliated to higher educational level but not stemming from simply living in the same MSA with more highly educated people. In this respect, Prime et al. (2016) argue that though analysis on spatial wage disparities with aggregating local workers as a whole could yield a facial positive effect of HCE on wages, by disaggregating

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educational attainments and properly controlling for differences in cost of living, results indicate little evidence for monetary spillovers stemming from the presence of highly educated people transmitting to other educational cohorts.

Comments

To sum up, as for individual effects on citywide wage differentials, different studies consistently show the predominant role of spatial differences in distribution of skilled labor. On one hand, individual ability in forms of both measured and unmeasured dimensions is undoubtedly predominantly determine the potential wages level one could get. This could be evidenced by controlling for education or individual fixed effects substantially reduce the spatial differences in wages. Hence, one implication consistent with the human capital theory could be that who you are could be more important than where you live. On the other hand, spatial bias in ability in some cases is investigated in the context of differences in local composition of job-specific skills or occupational structure, which indicates high wage cities are also places where more skilled jobs are presented. In this respect, differences in local composition of occupation-specific skills could also be a mirror of differences in local industrial mix. Overall, anecdotal evidence on skills differentials in explaining wage inequality across areas at least indicates that heterogeneity in individuals and firms being the essential elements of local economy are playing the most important roles in explaining wage inequality across cities.

On the other hand, arguments on HCE mechanisms and empirically estimated causal effects of higher level of local educational attainment on wages are still lack of consensus. Nevertheless, note that in the spirit of spatial equilibrium concept, if the non-market externality of human capital turns out to become consumption amenities, for instance, lower criminal rates, then the net effect on nominal wages could be ambiguous. For this reason, even an insignificant coefficient of local human capital on individual wages does not necessarily indicate the absence of HCE, since productive and consumptive effects may simply cancel out.

4.2 Differences in cost of living and amenity

Cost-amenity explanations involve two types of amenity that affect wages in different ways. One is the pure consumptive amenity over which everyone has the same preference and is exogenous determined such as climate. If these consumptive amenities have nothing to do with the production, then amenity value will be capitalized in lower nominal wages to equalize real wages across space. For instance, the relatively lower wages payroll in California than where the weather was less pleasant could be related to its climate. On the other hand, amenities presenting mixed consumptive and productive effects for instance human capital or big city could raise rent but have an ambiguous net effect on nominal wages. In any case, according to the quality-of- life framework (Roback, 1982), amenity value could be measured in consumption units such as non-traded good that are allowed to differ in price across locations and time periods. In this manner, amenity value is conceived to be involved in consumer expenditure such that differences in cost of living are believed to compensate for amenity differences and the real wages that have been deflated by cost of living could possibly eliminate the observed wage inequality across cities in nominal terms for similar skill and ability. Otherwise, remained real wage variation across cities would then most likely be explained by a real skill or productivity difference or spatial disequilibrium.

4.2.1 Are high wage cities more expensive to live in?

Costs of living vary from area to area within a nation. For instance, in UK, variation in regional price index increased during year 1982 to 1989, but then strongly decreased by year 1993 and stayed constant thereafter until year 1997 (Duranton & Monastiriotis, 2002). Using adjusted wages to get the real regional fixed-effects distinguished from effects of individual characteristics involving education, experience and gender, Duranton and Monastiriotis (2002) report a period of 22 years for convergence in real regional fixed-effects among UK regions whereas convergence in nominal terms would yield a period as long as 44 years. In other words, the real wages of a male worker with neither educational attainment nor experience might be quite similar across regions after 22 years while one would still observed the wages inequality in nominal terms across areas.

Empirical literatures on COL in cities along various sizes suggest that both the commuting costs and public service costs begin to rise as city size exceeds 100,000, possibly even at an increasing rate (Hirsch, 1970) though per capita public service costs are commonly conceived to fall as population grows below the threshold of 100,000 or employment less than 40,000.

Given that wages are found to grow with city size as well, it is reasonable to suspect that wage premium for large cities over smaller cities is compensating for differences in costs of living across cities.

The local price index is expected to fully measure the required incomes for living in that locale, with housing taken into consideration as well. The path of local costs of living is expected to have nothing to do with the returns to labor market traits yet is found positively linked to the size of local population, which could probably due to consumption externality. For example, living in Los Angeles cost 18.4% more comparing to the national average level of living costs in 2012, while it was much cheaper to live in Milwaukee with 4.7% lower than the national mean (Prime et al., 2016). After excluding housing costs, non-housing costs of living in Los Angeles was still 5.9% higher than the national level while that in Milwaukee was 5.2% lower (Prime et al., 2016). In this respect, one could expect workers in Los Angeles earn higher incomes than their counterparts in Milwaukee, provided that living in the former place is more expensive than in the latter area. Indeed, for workers with graduate degrees the median annual salary in Los Angeles was $73,642, comparing to $66,024 in Milwaukee (Prime et al., 2016). On the other hand, according to Prime et al. (2016), for high school graduates the median wage in Los Angeles was lower than that in Milwaukee, with $25,693 and $28,708 for each places respectively (in real 2012 dollars). It could be that amenity value of a place is different among workers distinguished by different educational attainments, and high school graduates turn out to favor Los Angeles more than Milwaukee. If workers within the same educational cohort have higher preference for living in particular locations such that they are willing to accept relatively lower wages in exchange for other local amenities in the residence, spatial wage differentials for this group of people could be the result of compensating for differences in location amenity.

4.2.2 Relatively explanatory weight

Are skilled workers better off in high wage cities? Why do not all skilled workers flock to high wage cities?

Costs-of-living

If city size wage relation merely reflects the higher commuting costs associated with living in large cities, then wage inequality across cities is an apparent phenomenon rather than a true

differential, since fully deflating wages for costs of living would eliminate it and render an equalized real wages across areas.

One primary issue in empirical tests on these explanations is data availability for cost of living (COL). Most researches use the price indices based on the American Chamber of Commerce Research Association (ACCRA) as proxy for COL (Glaeser & Mar, 2001; Kennan & Walker, 2011; Yankow, 2006). On the other hand, Baum-Snow and Pavan (2012) construct the COL index in line with a compensating differentials framework.

As reported by Glaeser and Mar (2001), though a mean nominal wage gap over rural areas is about 36% for big cities with population over 1 million and 21% for smaller cities, the real wages deflated by COL show no significant UWP for big cities, using a combination of city and metropolitan area data books, the1990 census, and panel data from the Panel Study of Income Dynamics (PSID) and examine men between 17 and 36 in the National Longitudinal Survey of Youth (NLSY) from the years 1983–1993. Consistently, the raw UWP vanishes when control for COL in study of Yankow (2006), estimating on much younger workers between the ages of 14 and 22 in the initial year in National Longitudinal Survey of Youth 1979 (NLSY79) over the years 1979–1994. However, COL could also be affected by wages, as the price of local non-traded goods could be raised due to productivity gains in traded production increase wages in all sectors. For this reason, one would want to separate the COL effects from the productivity effects driven by city sizes as well as human capital. As reported by Yankow (2006), after controlling for basic observable characteristics such as experience or ability measured by the Armed Forces Qualification Test (AFQT) and using a partial COL adjustment suggested by DuMond, Hirsch, and Macpherson (1999), COL reduce the previous estimates of UWP for big cities from 17%-22% to 5%-12%. Hence, a portion but not all of the wage inequality can be considered as a nominal phenomenon.

On the other hand, Baum-Snow and Pavan (2012) report an estimates of elasticity of real wages with respect to urban population at about 0.017 net of education and experience effects, compared to 0.055 without COL adjustment, using data from NLSY79 estimating on a sample of white men aged 14-21 years from the time of initially entry labor force until 15 years of work experience. More interesting, the inclusion of COL change the pattern of city size wage premium from a simply upward slop to an inverse U profile, with medium-size MSAs presenting the highest real wages. Concretely, by dividing cities into large, medium and small size, with population of more than 1.5 million, 0.25-1.5 million and below 0.25 million

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respectively, estimated nominal wage premium net of individual observable and fixed effects over small cities is 0.07 and 0.15 for medium and large cities respectively whereas the city size premium in real terms is 0.05 and significant for medium and 0.03 but insignificant for large cities. One interpretation is that COL is much higher in big cities than that in smaller areas and controlling for it generates salient reductions and changes gradients between city size wages, which may indicate that high wages in big cities could be a nominal phenomenon.

Although a significant portion of real wage premium for medium MSAs still exist and the inverse U profile in real wage premium against city scale apply for most levels of experience, with the medium size cities having the highest real wage level and similar results brought about by analyzing separately for samples of college and high school graduates, there is a notable implication so far that high wage cities do paid more in consideration of costly local expenditure and COL might primarily affect measured wage levels rather than measured wage growth (Baum-Snow and Pavan, 2011), with evidence as nominal wages at labor force entry monotonically increasing along city scale.

Location amenity

In the spirit of quality-of-life framework, real wages inequality might exist due to differentials in consumer amenity values across locations (Roback, 1982). For instance, suppose that educated or wealthier individuals concern more about large cities might bring about higher crime rate, sever pollution than the less-educated ones (Adamson, Clark, & Partridge, 2004) and thus present a strong aversion to stay in large cities, which could result in a positive correlation between returns to education and urban scale; in contrast, if the more educated ones turn out to be more capable to enjoy and favor the kaleidoscope of consumption in large cities such that willing to forgo part of their income distorted by spatial equilibrium (Black, Kolesnikova, & Taylor, 2005), then larger urban scale could indicates lower returns to education. Though Baum-Snow and Pavan (2011) reject these compensation differentials hypothesis based on endogenous on-the-job search model and estimated increasing returns to experience, this is not the case in Italy, as shown by Sabrina Di Addario and Patacchini (2008).

According to Di Addario and Patacchini (2008), raw data involving 22,996 employees from 242 LLMs present about 5 percent of wage premium in the largest local labor market over elsewhere in Italy. However, deflating Italian wages with consumer price index, they show an

opposite pattern comparing to that found by Baum-Snow and Pavan (2011) in returns to education, experience against local labor market population level or urban scale. Specifically, the entire urban scale effects on wages are on average of 0.1 percent increase in workers earnings associated with an additional population of 100,000 on current local labor market (LLM). As regards wage determinants, returns to education are decreasing as resident urban population grows with no significant effects of urbanization on returns to experience. As reported by Di Addario and Patacchini (2008), the largest LLMs bear on the college graduates with a wage reduction ranging approximately from 0.4 percent to 0.5 percent. An increase of 100 workers per square kilometer in resident city could depress the wage of a college graduate by around 0.9 percent (Sabrina Di Addario & Patacchini, 2006). Provided that the average amount of urban wage premium over all education levels is positive, workers with elementary education or less are found to benefit more from large urban locations than elsewhere in the form of wages. Besides, the largest LLMs on average display a significantly higher level of years of schooling as well as a larger share of individuals with college degree or higher comparing to the rest of the nation, with a significantly lower share of workers from middle school and indifferent numbers of workers regarding high school education or college education less than 3 years. As argued by Di Addario and Patacchini (2008), the fact that highly educated individuals are congested in large cities leads to a relatively lower return to education in the process of urbanization. They also provide evidence as unemployment rates are found higher in graduates (5.9 per cent) than that in elementary education or less (3.1) considering 24 Italian municipalities with population larger than 150,000. According to Di Addario and Patacchini (2008), the reason why educated workers more favor large cities despite monetary loss in the form of wages is possibly that in Italy large municipalities are typically associated with better quality of public goods and facilities as well as cultural amenity.

Similar evidence is also found in the US. As shown by Black et al. (2005), returns to university degree are lower in cities presenting high-amenity and expensive cost of living such as San Francisco, New York and Seattle comparing to Houston, Pittsburgh where locale exhibits low-amenity consumptions. Adamson et al. (2004) suggest a reduction around 2 percent in returns to university degree associated with doubling the MSA population. However, also note that contrary evidence could arise in which case education is considered as productive amenity from the view of firms and dominates the congestion stemming from consumption amenities.

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As location amenity could be capitalized in local land prices, differences in real wages adjusted for costs of living are expected to be rather smaller than that in nominal term across areas. For instance, using 2000 Census data, Moretti (2011) ranks 288 metropolitan areas in the US in terms of average hourly nominal wage for workers with high school diplomas and reports that the amount of wages at the 10thand 90th percentile along the distribution across metropolitan areas are $12.5 and $16.5, respectively, exhibiting a 32% difference between the points at 10th and 90th percentile. Regarding college graduates, wage inequality across metropolitan areas is much larger, with a wide gap of 41% between 10th and 90th percentile (E. Moretti, 2011). Nevertheless, real wages of high school graduates deflated by costs of housing was $10.0 in metro areas at the 10th percentile of the wage distribution, while at the 90th point the wage amount was $11.7, a 17% difference, based on data from the 2000 Census of Population in US (E. Moretti, 2011). As for college graduates, differences in real wages between metropolitan areas at 10th and 90th percentile along wage distribution are 22%, with hourly wages being $16.7 and $20.4 for locations ranking at respective point. Hence, high wage cities generally take costs of living into consideration in the process of wage determination whereby a portion of wage premium is aimed at compensating for costly local expenditure.

In addition, if land values are assumed to be fully reflected in housing costs, according to Glaeser and Gottlieb (2008), equalized real wages across space in long run equilibrium would yield a coefficient on log cost of housing approaching to the share of housing expenditures, considering log nominal wage as the dependent variable. Plausibly empirical results are provided by Moretti (2011), who perform a regression of individual log earnings on log average housing rents conditional on basic labor traits, with standard errors clustered by metro area. According to his findings, estimated coefficient is around 0.513 with standard error of 0.024, which is quite close to a share of 41% in income for housing costs in 2000. In this respect, a portion of observed wage inequality across cities could be ascribed to adjustment for spatial differences in amenity differentials, which is in line with the spatial equilibrium theory.

Non-housing costs of living and preferences for location amenity by education

Prime et al. (2016) examine the effects of local share of highly educated people on the real median annual wage of each individual education cohort, covering 374 U.S. metropolitan

statistical areas (MSAs) from year 2005 to 2012. Specifically, by examining the extent to which the median real wage of a specific educational cohort could be influenced by the local share of more educated people in a metro area, their study indeed explores the sources of spatial differences in the welfare of workers conditional on educational level. According to their results, spatial wage differentials for workers with equivalently educational attainment are explained by urban cost of living, amenities or consumer externalities, policy factors, human capital externalities and local labor market conditions.

In the work of Prime et al. (2016), the dependent variable is median wages in real terms. In deflating nominal wages, they also apply a partial cost-of-living adjustment based on regional price parities but excluding housing costs as strategy for deflating nominal wages, in a sense that local houses could be partially treated as local amenity such that housing costs are included as an explanatory variable. They use the median rent as an index for housing cost being an independent variable in the wage equation provided that some location amenity could be incorporated in land rent and thus in housing costs, for which local wages would only partially adjust (DuMond et al., 1999). In this manner, if a rise in housing costs is to be fully compensated for by wage premium in real terms, the coefficient on housing costs would approach an estimate of 1.0 while an estimate of 0.0 would yield that higher housing costs are offset by location amenity. As reported by Prime et al. (2016), the median real wage is estimated to partially correct for the price of housing with a coefficient estimate of around 0.4. Interestingly, according to their results, estimated coefficients on the housing costs variable are in most cases significantly positive for all groups of workers except for graduates. In this respect, one interpretation they propose is that workers with a graduate degree are compensated by location amenity instead of higher wages for the higher housing costs while for the less educated workers, a rise in the cost of housing indeed exceeds the value of location amenity such that a wage premium in real terms is more likely to retain them.

Regarding consumption amenity, wage-determining location amenities are mainly featured as provision of culture and leisure consumptions (such as museums, parks, golf courses, amusement parks, etc.), accessibility for higher education, public transportation and the presence of durable manufacturing industry. The last factor could have negative consumption externalities since in most cases those factories exhibit unfavorable working conditions such that a wage premium could be required to compensate for working there or living nearby while desirable amenities could potentially lower the acceptable wages. Prime et al. (2016)

measure such consumption externality effects by using the local share of total wage and salary employment in respective industry by MSA as proxy and examining the corresponding coefficients. As reported by Prime et al. (2016), arts and recreational amenities are shown to have significantly negative effects on wages for all workers without controlling for educational attainment, for high school drop-outs and for workers with some college education or an associate's degree. Regarding the dis-amenity of durable manufacturing, significantly positive coefficients at 5% level exist for each individual cohort with educational attainment lower than a bachelor's degree. For example, if the value of variable in question changes from 5% to 8%, workers within the cohort specified as some college education or an associate's degree at the median point would earn about $35,638 annually comparing the original amount of $35,000. Of course one could interpret this result either as compensating for dis-amenity or potentially reversal effects of higher wages in durables manufacturing disproportionally attracting less educated workers. Nevertheless, as Prime et al. (2016) argue, the fact that local employment in most metro areas is represented by rather small share of durables manufacturing favors the former explanation.

Comments

As illustrated above, systematic cost of living differences could be one component of observed wage inequality across cities, evidenced as spatial wage variation in nominal term substantially discounted after adjusting for cost-of-living expenditure. In addition, compensating for differences in amenity values of locations are partially capitalized in real wages as well.

4.3 Differences in returns to skill

4.3.1 Spatial variation in TFP

In the presence of expensive labor costs as well as land rents in high wage cities, why are firms producing tradable goods willing to stay in high wage cities? One plausible reason could be that firms located in high wage cities are more productive than would they be if had located elsewhere. In this respect, remarkable disparities in nominal wages across cities could reflect, at least in part, differences in firms-level productivity across cities such that even for economically identical workers, returns to skill are unequal across localities.

Indeed, as for manufacturing-sector companies, along the total factor productivity distribution across areas in the US, locations at the top point of the distribution exhibit almost threefold TFP of areas ranking at the bottom (E. Moretti, 2011). For instance, log TFP of plants at county level controlling for labor, capital and industry, are 1.54, 1.70 and 2.20, estimated respectively at the 10th percentile, median, and 90th percentile along the TFP distribution, with a gap of 2.9 times between the top areas and the bottom areas (E. Moretti, 2011). The estimated coefficient on slope in plotting TFP in 1992 against TFP in 1977 is 0.919 with standard error of 0.003, implying rather persistent differences in local productivity across locations (E. Moretti, 2011).

One related strand of explanations contending that spatial wage differentials can be partially ascribed to differences in local non-human endowments that give rise to divergence in productive efficiency. In line with growth economists (Acemoglu & Dell, 2009; Durlauf & Quah, 1999; Temple, 1999), the broadest sense of local endowments effects on wages could be effects of factors, technology, physical geography, local public goods, cultural goods and local institutions or legislation.

Besides, evidences on local productivity gains from city size effects are numerous. For instance, Shefer (1973) estimating with a cross-section of MSAs and a group of two-digit manufacturing industries in the U.S. in 1958 and in 1963, suggests that productivity could increase by ranging from 14% to 27% as city size grow twofold. The numerical value however, is largely adjusted and confirmed by more studies later to an increase of around 3% to 8% (Rosenthal & Strange, 2004). As suggested by Ciccone and Hall (1993), elasticity of labor productivity with respect to employment density is estimated to be at 5% in U.S. whereas for Europe it is around 4.5% (Ciccone, 2002).

4.3.2 Relatively explanatory weight

Endowments advantage

Acemoglu and Dell (2009) concern the importance of the local institutional differences effects on productive efficiency for Americas, using micro data of individual income for 11 countries in the Americas. They first estimate the effects of disparities in access to paved roads on interarea income variation and then construct a model provided that empirical evidences in literatures of public goods and economic growth related to specific local institutions.

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According to their result, municipality-level labor income inequalities net of observed human capital effects are not accounted for by differences in population density whereas distance to roads impose a negative and highly significant effect on incomes. Specifically, an increase of 1 percent in municipality's average distance from paved roads leads to reduction in labor income of prime-aged males with 0.06 percent, 0.09 percent and 0.14 percent for Brazil, Mexico and Panama respectively. Besides, the measured inequality in proximity to intercity paved roads across municipalities as reported by Acemoglu and Dell (2009) is approximately 2.5 times larger than that across countries controlling for geographic characteristics such as mean annual temperature, precipitation and a full set of age dummies. They thus cautiously interpret these results as an implication that incomes could be partially affected by the provision of local public goods that are highly related with collective decisions under local institutions. Moreover, as argued by Dell (2010), the forced mining labor system, mita in Peru and Bolivia during the colonial era impose a long-run impact on household consumption today with about one-third reduction on household consumption in subjected districts. As for the long-lasting effects of institutions on public goods, Banerjee and Iyer (2002) suggest that in India investments in health and education infrastructure are still affected by colonial land revenue systems. Acemoglu, Bautista, Querubin, and Robinson (2007) report a robust correlation between political inequality in the nineteenth century (measured by the lack of turnover of mayors in the municipalities) and contemporary economic performance for Cundinamarca, Colombia. However, as noted by Acemoglu and Dell (2009), as for institutional differences vary to an enough extent across municipalities, it is more likely to consider countries with federal systems, such as Mexico and Brazil, where the authority in changing laws, de jure institutions and de facto institutions could vary substantially between cities or states.

On the other hand, the potential role of natural advantage is more obvious to see. For instance, no one would doubt the contribution of abundance in iron ore and coal in the Great Lakes region to the economic growth in the steel industry in North America and also cities located in that region. However, the natural advantage is commonly conceived as a driving force behind industry clustering (Ellison & Glaeser, 1999; Fuchs, 1959; Sukkoo Kim, 1995, 1999) and its effects on wages could be intertwined with agglomeration economies. Empirical studies on spatial wages disparity could barely find even a modest weight for endowment after controlling for industry fixed effect and employment density, but this does not mean that differences in spatial endowment such as geography difference is not important in

productivity divergence and thus incomes disparity across space. Significant evidences can come from nations with a variety of different ecological areas, presenting various climate zones and landscapes for example, Peru. As suggested by Escobal and Torero (2005) who test a causal effect of geography on the evolution of per capital expenditure at Provincial level and of households, adverse geographic conditions could limit the provision of infrastructure and result in differences in infrastructure endowments and private assets across regions, which play a significant role in explaining regional variations in income or per-capita expenditure. Specifically, they find that low altitude coastal regions present higher per capita expenditure and this pattern get more apparent over year 1973 to 1993, with per capita expenditure measured at the provincial level. As for annual growth rates in per capita expenditure, provinces with rapid growth are found to be clustered in the higher altitude jungle. Furthermore, determinants of households per capita expenditure growth indicate that temperature, land depth and altitude explain the lower levels of consumption more than urbanization do for the poorest percentiles, though it is not the case for those at 80th and 90th percentiles. Lastly, as noted by Escobal and Torero (2005), the significant role of geographic diverse in explaining spatial unevenness in income and welfare is dampened by inclusion of infrastructure variables in analysis, such as school and medical facilities, access to electricity, water and sanitation, as well as private assets. Also noted that the latter set of variables nevertheless is more related with the economic growth, it is possible a reverse causality between households expenditure and public goods.

Agglomeration economies

If city size wage relation merely reflects the higher commuting costs associated with living in large cities, then wage inequality across cities is an apparent rather than a true differential, since fully deflating wages for costs of living would eliminate it and render an equalized real wages across areas. In the study of Goldfarb and Yezer (1976), based on regression occupation-specific wages on city employment and multiple regions by each occupation, for almost all of the occupations wage increase as city size grows, but not by a uniform share of average wages across occupations as the cost of living hypothesis would seem to predict. In other words, some occupations present persistently large wage increases along the range of city sizes whereas wage patterns in some cases are not consistent with the increasing city size, which is not arguably explained by cost of living explanations because otherwise coefficients associated with respective city size variable would be systematically consistent across

occupations. Therefore, a portion of city-size wage premium could be ascribed to relative advantages in localized productivity.

On the other hand, Sveikauskas (1975) using data from manufacturing sectors for all SMSAs finds that doubling city size increases wages by around 6 percent. On the other hand, DuMond et al. (1999) concern real wages differentials across cities with different sizes of population. They suggest that comparing to smallest urban areas with population below 200,000, real wage premium adjusted for cost of living is about 5% for locations with population ranging from 200,000 to 500,000, 7% for locations populated between 1.5 to 2 million, and roughly 10% for locations with population larger than 2 million. Hence, inter-area wage variation would be partially accounted for by differences in productivity advantages accrue to urban scale.

The inter-city wage differentials have widely been investigated in the context of agglomeration theory exploring the relationships between the city-size wage level and the scale of urban population (Glaeser and Maré (2001), Wheeler (2001), Yankow (2006) and Gould (2007) for US, Möller and Haas (2002) and Lehmer and Möller (2010) for Germany, Di Addario and Patacchini (2008) for Italy, and Combes et al. (2008) for France).Some empirical studies are conducted on countries hosting large metropolitan areas, such as the US (Glaeser & Mar, 2001; Gould, 2007), Germany (Möller & Haas, 2002) and France (Combes et al., 2008) whereas some examining on sparsely populated country, such as Sweden (Andersson et al., 2014) with only Stockholm could barely be classified as metropolitan area.

Stylized facts for these countries are consistent with the agglomeration economies postulating that densely populated areas bring about higher wages level. For instance, according to Glaeser and Maré (2001), unconditional mean wage premium for the US Statistical Metropolitan Area (MSA) over outsiders is about 33 per cent for MSAs holding at least one municipality with over 1 million inhabitants. Urban wage premium in the US is around 24–28 per cent for the same type of MSAs populated by more than 500,000 residents while approximately 13-19 per cent in the equivalently populated MSAs but containing no municipality (Glaeser & Maré, 2001). Instead of analyzing on the raw UWP, Combes et al. (2008) estimate real wages level that are deflated by consumer prices index and report the average wage premium in Paris is around 15 per cent over other large French cities, about 35 per cent and 60 per cent comparing to mid-sized cities and French rural areas respectively. In the same manner, Di Addario and Patacchini (2008) report that real wages in the largest

Italian Local Labor Markets (LLMs) are on average 5 percent higher than the rest of the country.

Indeed, after accounting for individual effects, estimated magnitude of net urban scale effects on wages is different between nations. Specifically, Combes et al. (2008) report an estimate of around 2 percent for the elasticity of wages with respect to employment density in France while the figure is about 2.7 percent with respect to the US Statistical Metropolitan Area (MSA) population level (ChristopherH Wheeler, 2001). In Japan, nominal wages elasticity with respect to the Standard Metropolitan Employment Area population amounts to 10 percent whereas being negative in real terms according to Tabuchi and Yoshida (2000). Di Addario and Patacchini (2008) find that every additional 100,000 inhabitants in the LLM increases wages by about 0.1 per cent, which is consistent with the results reported by Diamond and Simon (1990), who suggest an increase of 1-2 percent in wages correlated to an extra 1 million population in the US MSAs. Andersson et al. (2014) concerns agglomeration effects in Sweden. Specifically, they report that doubling either municipal or regional density slightly increases wage by about 0.5 per cent after accounting for observed and unobserved individual effects.

Differences in returns to skills across cities with different population sizes refer to workers with equivalently observed skills (education or work experience) may even earn more in larger cities than their counterparts in small city. According to the New Economy Geography theories, the local marginal product of labor is higher may because of the presence of greater demand or because inputs are cheaper when producers are close to other suppliers, which are featured as market access effects. Besides, urban economists emphasize that population density facilitates the searching and matching process as well as improves opportunities of social learning and knowledge exchange (Duranton & Puga, 2004; Glaeser & Gottlieb, 2009; Enrico Moretti, 2004b; Rosenthal & Strange, 2004). In any case, workers could enjoy a city size wage premium due to agglomeration economies that are usually investigated by examining respective effects of employment density, city size, diversity and market access on wages.

4.4 Disequilibrium

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If mobility of labor and firms is perfect such that each individual group of agents seeks to reach their maximum value of utility across space, in spatial equilibrium either the same type of agent is expected to completely concentrate in certain locations or differences in wages of same type of workers across cities are expected to be arbitraged away. Assuming there is no population growth, in equilibrium spatial distribution of population should be stable such that city size is relatively unchanged across space. However, in reality we can always observe mixed types of workers represented in most of cities and real wage inequality for specific group of workers across cities is still significant though smaller comparing to differences in nominal terms.

In the presence of location-specific amenity, a positive shock in labor demand could be induced by an increase in productivity while for labor supply side, a shock to labor supply could stem from an increase in amenities, provided that local amenity enter both firm's production and individual's hedonic utility. Shocks to a local economy are conceived to be capitalized in local prices involving nominal wages, land values, housing prices, prices of home goods. In this respect, differences in cost of living and amenity are essential in understanding how can wage or price differentials persist across space in long-run equilibrium as well as gradually undoing the effects of shocks to local economy on spatial wage distribution. However, since the framework of spatial equilibrium is based on the assumption that firms and workers are fully mobile, if mobility is limited, then workers and housing stock could not fully adjust to shocks, so do the local prices. In this respect, it is thus uncertain whether currently economic status is a spatial equilibrium or lagged adjustment. On the other hand, in the spirit of labor economists, imperfect markets and other unobserved heterogeneity could play a significant role in explaining wage differences. In the presence of institutional interventions (such as tax rates, minimum wage legislation and union power etc.), wage rates are likely to be non-competitive rents.

4.4.1 Do high wage cities experience relatively positive shocks to local economy?

One possible short-run explanation is that local labor market shock induces a correlation between migration and wage change by workers. Specifically, if labor mobility differs systematically by occupation, then employment growth in a particular area will bid up wages with higher increment for immobile than in mobile occupations (Muth, 1971). In the case of

city system, wages could flexibly response to transitory changes in local market conditions compared with permanent ones, namely long-run explanations (Topel, 1986). In this respect, evidence of a relative stronger agglomeration of individuals towards high wage cities could support this hypothesis.

Using the National Longitudinal Survey of Youth(NLSY), Kennan and Walker (2011) suggest that the empirical results from estimating on a panel data of white male high-school graduates suggest an elasticity of wage changes with respect to migration is at roughly 0.5. Concretely, by simulating migration decisions in line with the original patterns in data, comparison between movers and stayers in terms of accumulated income and utility gains from age 20 to age 34 reports a total percentage gains of about 6.3%. Based on these results, Kennan and Walker (2011) argue that migration between states are substantially induced by geographic differences in mean wages, along with significant effects from previous location, distance, population size, home bias, age and local climate. As noted by Kennan and Walker (2011), high wage cities tend to continuingly have larger population, even when presenting wages differentials are merely compensate for amenity differences across areas. In addition, according to Duranton and Monastiriotis (2002), comparing to an increase of 6.5 percent in population for London and the South East over the year 1982 to 1997, the population of the rest regions in UK as a whole have increased by 3.3 percent.

Besides, local labor market shocks do have long-lasting effects. As suggested by Blanchard, Katz, Hall, and Eichengreen (1992), state relative wages present a strong but quite gradual convergence over a long period of 40 years, based on the Bureau of Labor Statistics (BLS) establishment survey and estimating by state with average hourly earnings of production workers in manufacturing. In addition, they report an estimate of more than 10 years for the half-life of a unit shock to the relative wages.

As suggested by theoretical explanations, in the context where workers are more mobile shocks have temporarily effects while with lower mobility of labor lack of efficient adjustment could worsen true disparities across areas.

Elastic local labor supply

The disequilibrium hypothesis postulates that there are remaining significant interarea differentials in wages that are not plausibly explained by any of the previous explanations

after controlling for observed and unobserved human capital effects, agglomeration economies, endowments, costs of living and amenity.

Disequilibrium explanations are in most cases related to a larger scope of geography for instance, inter-regional differentials in wages. As argued by Goldfarb and Yezer (1976), persistent regional wage differentials could possibly reflect incomplete adjustment to past disequilibrium. Using occupation-specific wage data at the city level from BLS Area Wage Surveys that consists of systematic samplings of straight-time hourly earnings, this hypothesis is tested by running wage regression by each occupation on a piecewise linear function that allows slope change at city size levels, in addition to adding a set of regional dummy variables. Results report that regional dummies are consistently and significantly positive and far larger for blue collar workers but insignificant for white collar workers after controlling for occupation and city size. In particular, they note that some of the largest regional variations in occupation-specific wages are found for blue collar workers such as truck drivers where factors like age, education, or experience are believed to be not varying greatly. Provided that spatial wage patterns for blue collar workers systematically differ from that for white collar whose differences in occupation-specific wages are well explained by city size variable, Goldfarb and Yezer (1976) thus ascribe the larger blue collar wage differences across regions to potential locational disequilibrium which are expected to provoke future shifts in employment location.

Indeed, as suggested by Moretti (2011), workers are mainly distinguished by differences in skills such that preferences for location amenity are specific to each skill cohort. Analogically, local shocks could be specific to individual cohort in a sense that much larger demand induced for some skill cohorts comparing to other types of labor skills. In the presence of preference for location, the lower propensity to move for individual skill cohort, the larger economic rents the respective group of workers receives. Given that in the US where workers are relatively more mobile, and the young and more educated people are found to have higher incentives to mover across locations (Kennan & Walker, 2011), the findings in Goldfarb and Yezer (1976) could be arguably explained by less mobility of blue collar workers whereby those living in prosperous regions experience more frequently positive local shock while others in the South region have less opportunities to benefit from economic rents generated by shocks to local economy.

Immobile labor or lower elasticity of labor supply

Alternatively, spatial wage inequality could result from segmented labor market. As suggested by Di Addario and Patacchini (2008), spatial equilibrium in which utility is indifferent across locations or the compensating amenity differentials hypothesis could fail to apply in the context where labor mobility across geographic boundaries within a country is extremely low and thus resulting in incomplete interpretation of the spatial wage disparities. In this respect, other potential sources such as non-competitive housing market, local institutional interventions involving tax, union, labor protection, could also give rise to diversion in non-competitive remuneration across areas.

In face of unfavorable welfare-system, imperfections of housing market such as rents controls and absence of laws protecting landlords' property along with cultural factors, Italian local labor markets are more featured as self-contained territorial units (Di Addario & Lucia, 2006; S. Di Addario, 2002). In this respect, as the labor mobility is very low in that country, uneven geographic distribution of human capital or industry or firms could imply there is a real inequality across cities regarding location productivity as well as individual utility or welfare.

Moreover, cities with initially more favorable industrial mix for example featured as business services and high-tech sectors could retain and attract more skilled workers being concentrated, in addition to triggering an increasingly local demand for other types of workers providing personal services and retail market. Relative agglomeration of population in locale could push the local prices of goods and housing whereby costs of living could be unaffordable for workers with unfavorable labor traits paid poor wages and force them to flee from popular cities (G. Hughes & McCormick, 1994; Jackman & Savouri, 1992). In this respect, unevenly distributed skills across space could be exacerbated in the presence of lagged adjustment.

According to Duranton and Monastiriotis (2002), the large and growing differences in average earnings across UK regions mainly take two forms. First, spatial ability bias plays a predominant role in explaining observed inter-region inequality in average earnings. Second, to what extent area-specific effects converge over time determines whether similar workers could gradually make similar salary across locations. As shown by their results, variations in regional prices of basic labor characteristics regarding gender, education and experience were decreasing during 1982-1997, so was the regional fixed-effects after controlling for spatial

distribution of human capital. In other words, individual with a given level of education and experience could get equivalent wages among different regions. Performing a two-stage estimation to correct spatial selectivity bias, Duranton and Monastiriotis (2002) find that the regional fixed-effects as well as regional prices of labor characteristics all exhibit evident convergences across regions, which emphasize the issue of divergence in local composition of skills across areas in the evolution of regional inequalities.

As argued by Duranton and Monastiriotis (2002), little evidence support differences in unobserved abilities effects for potentially cross-region movers between London and the South East versus other UK regions. Their findings is consistent with that of G. A. Hughes and McCormick (1985), who also find that controlling for observed labor characteristics, mobile workers do not earn significantly higher wages in London and the South East versus other UK regions. As noted by Duranton and Monastiriotis (2002), there are convergences in regional prices of labor traits across regions, hence salient discrepancies in average earnings across areas are mainly due to uneven distribution of skills. As noted by McCormick (1997), annul migration across UK regions among workers is typically less than 2 percent. However, according to Konings (1995), nearly 10 percent of plants shut down or open for a normal year in that country. In this respect, spatial divergence in local composition of skills given convergence in prices of labor traits across regions probably implies a lack of efficient adjustment mechanisms.

On the other hand, as argued by Fan (2007), who estimating the disparities in workers' earnings and market access across 216 prefecture cities in China, the salient disparities in market access among different areas indicate a segmented labor market resulting from institutional barriers to migration whereby a substantial part of spatial wage inequality net of human capital and density is highly correlated with the variance of market access. According to Fujita et al. (1999), market access measures a broadly spatial scale of markets for intermediate and final goods, which indicate locally comparative advantages with respect to supply and demand markets. In this context, if temporarily increase in labor demand is unable to be counteracted by sufficient migration, disparities could be exacerbated due to inelastic spatial labor supply or institutional restrictions.

4.4.2 Relatively explanatory weight

Local shocks effects

Perhaps one notable contribution of Prime et al. (2016) is explicitly including local labor market conditions in wage formation by measuring the labor participation rate for each respective group distinguished by educational level. Their study is based on data of MSAs in the US. Specifically, the share of on-the-job individuals out of the whole population aged 25 to 64 within the same educational cohort is expected to push up wages on the basis that tight labor markets are probably stemming from positive shock in demand for labor thus increase the wages. In consideration of these variables could be endogenously determined by local industry, they also apply lagged measures. Coefficients associated with labor market conditions are estimated to remain significantly positive in most cases except for graduates. For example, regarding workers who only completed high school, local median real wage for this educational cohort could increase from around $30,000 to $30,379 if the ratio of employed workers to working aged population in the cohort increase from 55% to 58%. In this respect, Prime et al. (2016) argue metro areas presenting better job opportunities are more likely to render higher wages than those places with limited employment opportunities.

Institutional factors

Moreover, policy factors related to wage determination are also taken into account. As Prime et al. (2016) suggest, statutory minimum wages based on local costs of living excluding housing costs vary across metro areas and are likely to impose upward pressure on wages, so do the tax rate variable. Estimated coefficients on minimum wages are significantly positive at 5% level in the case of high school drop-outs, at the 10% considering high school graduates, and insignificant for graduates. As one would expect, the minimum wage level influence most the least educated group, with the mandated minimum wage increasing from $7.25 per hour to $8.25 per hour resulting in an increase in the median real wage from roughly $20,000 a year to $20,257 a year for high school drop-outs. As for state and local tax rate, estimated coefficients are significantly positive in any case but only at 10% level for graduates. For instance, suppose taxes were increased from 10% to 11%, for the group with a graduate degree, those at the median point earn $62,000 per year would need to pay an extra amount of $620 annually in taxes. Based on the estimated model, corresponding gross income grows from $62,000 to $62,503, with 81% of the additional taxes offset. After all, a rise in state and local taxes raises the gross wage to some extent.

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5 Assessment

5.1 Discussion

This paper proposes a general framework to study the facts and reasons of wage inequality across cities by starting from looking at some deviations from the perfect world. In a perfect world, perfect competition in labor market is expected to establish the law of one price, namely the same wage for identical workers independent of locations. In contrast, observed wage inequality across cities indicates that some essential conditions are diverting from what they would be had we a perfect economy. As highlighted in literatures, besides such obvious deviations as differences in production resources involving the composition of skills in local workforce, industry mix, and the presence of nature resources or public infrastructures influenced by local institutions, external effects and economies of scale have been cited as an important driving-force behind wage premium and manifested itself as a positive correlation between local prices or wages and city size. In addition, an intuition that increasing integration of markets is expected to bring about relatively equalized wages across subnational boundaries appear to be challenged by the persistence of wage differentials in reality, whereby a crucial role play imperfect labor mobility and local labor market conditions in understanding persistently spatial discrepancies in wage rates. Spatial wage inequality that cannot be explained by differences in local skill structure, costs of living and amenity and productive efficiency, could imply disequilibrium or imperfect markets. In the presence of high costs of moving for both workers and industry, along with non-competitive housing markets, labor legislations or union power, it appears more plausible to explain the spatial wage structure by taking into consideration of the lack of efficient adjustment mechanisms within national boundary.

Existing empirical studies carry out the test on these deviations by performing examination in the context of urban economy within a country, initially and vastly for the US, later followed by some European countries such as UK, France, Sweden, Italy, etc., with estimating wage function on two strands of explanatory variables, namely labor attributes of workers and some key characteristics of locations where the respective individual works. These results provide two overall scenarios, distinguished by geographic and demographic dimensions. In the geographic perspective, country covering a broader territory might consist of a host of greatly

different areas with respect to local natural endowments as well as institutional factors including the authority in changing laws, de jure institutions and de facto institutions, etc. In this context, a homogenous space is obviously violated and differences in amenity are present whereby price differentials across areas arise. Empirical evidence for countries in Americas for example, the US and Peru in this paper corroborates the role of natural endowments and institutional factors in economic growth and thus the process of spatial wage discrepancies. On the other hand, nations featured as a composite consisting of a bunch of local labor markets could facilitate agglomeration economies whereby density wage premium along with pronounced spatial bias of ability predominantly explain the wage inequality across cities. This is the case of some European countries as well as the United States. However, what mostly distinguish EU from the US are differences in labor mobility whereby explanatory weight of local labor markets and migration or regional disparities effects in explaining spatial wage variation vary from country to country. In the US where workers are more elastic, spatial wages could be more flexible due to differences in business cycle effects across regions and, hence, shocks to local economy turn out to be important in explaining wage variation. As for the European labor markets where workers are less mobile in most cases, persistently salient wage inequality across cities could be partially ascribed to segmented labor markets or institutional characteristics where significant wage rigidity are present due to the lack or low speed of efficiency adjustment of productive sources across space, for example the case of Italy and UK presented in this paper.

Overall, anecdotal evidence indicates differences in skills across cities are the main sources of wage inequality across cities, with at least half of the spatial wage differences explained by spatial ability bias. On one hand, individual ability in forms of both measured and unmeasured dimensions is undoubtedly predominantly determine the potential wages level one could get. This could be evidenced by controlling for education or individual fixed effects substantially reduce the spatial differences in wages. Hence, one implication consistent with the human capital theory could be that who you are could be more important than where you live. On the other hand, spatial bias in ability in some cases is investigated in the context of differences in local composition of job-specific skills or occupational structure, which indicates high wage cities are also places where more skilled jobs are presented. In this respect, differences in local composition of occupation-specific skills could also be a mirror of differences in local industrial mix. Hence, heterogeneity in individuals and firms being the

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essential elements of local economy are playing the most important roles in explaining wage inequality across cities.

The inter-city wage differentials, on the other hand, can be investigated in three broad dimensions, namely, spatial productivity differentials stemming from externalities and economies of scale, spatial equilibrium based on compensating differentials and disequilibrium outcomes resulting from lagged adjustment and imperfect markets. In particular, studies on city-size wage gap have been widely investigated in the context of agglomeration theory and highlighted the important role of agglomeration economies in urban development (e.g. Glaeser and Maré (2001), Wheeler (2001), Yankow (2006) and Gould (2007) for US, Möller and Haas (2002) and Lehmer and Möller (2010) for Germany, Di Addario and Patacchini (2008) for Italy, and Combes et al. (2008) for France). Empirical results are consistent with the agglomeration economies postulating that densely populated areas bring about higher wages level. Indeed, after accounting for individual effects, estimated magnitude of net urban scale effects on wages is different between nations. Specifically, Combes et al. (2008) report an estimate of around 2 percent for the elasticity of wages with respect to employment density in France while the figure is about 2.7 percent with respect to the US Statistical Metropolitan Area (MSA) population level (Wheeler, 2001). In Japan, nominal wages elasticity with respect to the Standard Metropolitan Employment Area population amounts to 10 percent whereas being negative in real terms according to Tabuchi and Yoshida (2000). Di Addario and Patacchini (2008) find that every additional 100,000 inhabitants in the LLM increases wages by about 0.1 per cent, which is consistent with the results reported by Diamond and Simon (1990), who suggest an increase of 1-2 percent in wages correlated to an extra 1 million population in the US MSAs. Moreover, due to the nature of agglomeration economies, productivity gains are more relying on proximity advantages and knowledge spillovers. In this respect, whether agglomeration economies or density wage premium could stand out in explaining spatial wage disparities and the corresponding magnitude of effects is closely related to the job-specific skills as well as the scale of local labor market units. As noted by Andersson et al. (2014), comparing to countries hosting large amounts of urban areas such as US (Glaeser & Mar, 2001; Gould, 2007), Germany (Möller & Haas, 2002) and France (Combes et al., 2008), Sweden is rather sparsely populated country with only Stockholm could barely be classified as metropolitan area, which could justify the weak weight of agglomeration economies in explaining spatial wage differentials and specifically accrue to workers performing non-routine job tasks. On the other

hand, given that the Italian LLMs are quite small areas (Di Addario & Patacchini, 2008) and agglomeration economies attenuate with distance, the pattern of real wage inequality across cities appears to be reconciled with urban scale effects on wages and thus explained by differences in returns to skills due to local agglomeration differentials.

Differences in cost of living and amenity stand out in explaining how wage or price differentials can persist across space in long-run equilibrium. On one hand, the local price index is expected to fully measure the required incomes for living in that locale, with in most cases housing taken into consideration as well. The path of local costs of living is expected to have nothing to do with the returns to labor market traits yet is found positively linked to the size of local population, which could probably due to consumption externality. In this respect, amenities presenting mixed consumptive and productive effects for instance human capital or urban size could raise rent but have an ambiguous net effect on nominal wages whereby real wages inequality across cities for equivalently educated workers might exist due to differentials in consumption amenity values across locations, as evidenced by the case of Italy (Di Addario & Patacchini, 2008) and the US (Prime et al., 2016). On the other hand, as location amenity could be capitalized in local land prices, if land values are assumed to be fully reflected in housing costs, estimated coefficient on log cost of housing approaching to the share of housing expenditures, considering log nominal wage as the dependent variable could be regarded as evidence of equalized real wages across space, which is empirically shown by Moretti (2011). Alternatively, besides applying a partial cost-of-living adjustment, excluding housing costs as an explanatory variable make it possible to interpret the coefficient on housing costs as the extent to which a rise in housing costs is compensated for by wage premium in real terms or is offset by location amenity. Prime et al. (2016) provide empirical evidence and corroborates the view of spatial wage differences compensating local amenity differentials for the US. In general, systematic cost of living differences could be one component of observed wage inequality across cities, evidenced as spatial wage variation in nominal term substantially discounted after adjusting for cost-of-living expenditure. In addition, compensating for differences in amenity values of locations are partially capitalized in real wages as well. Overall, this strand of explanations line-up with the spatial equilibrium theory initially modelled within the quality-of-life framework by Rosen (1979) and Roback (1982), later modified and enriched by many economists (Glaeser, 2008; Topel, 1986).

Differences in local shocks might not be easily traced out but shocks to a local economy are conceived to be capitalized in local prices involving nominal wages, land values, housing prices, prices of home goods. In a simplest case following the intercity Rosen-Roback Framework, land is the only immobile factor such that spatial variation in land prices or housing costs could be driven by differences in local labor markets or local shocks to economy. Spatial general equilibrium outcomes in local labor markets are characterizes as workers' utility indifferent across locations. However, the extent to which price could capture the incidence of shocks will depend on the relative degree of elasticities of local housing supply and labor supply (Moretti, 2011). Specifically, in the presence of location-specific amenity, a positive shock in labor demand could be induced by an increase in productivity while for labor supply side, a shock to labor supply could stem from an increase in amenities, provided that local amenity enter both firm's production and individual's hedonic utility. Hence, the presence of local shocks effects is typically taking forms of spatial migration flows and/or fluctuations in local prices and wages.

In turns, in order to achieve optimal income, workers observing the geographic differences in mean wages have incentives to move in search of a better locational match, which is evidenced in the work of Kennan and Walker (2011) who estimate a correlation around 0.5 between wages and migration based on data from the US implying a substantially elastic spatial labor supply. However, workers are mainly distinguished by differences in skills such that preferences for location amenity are specific to each skill cohort. Analogically, local shocks could be specific to individual cohort in a sense that much larger demand induced for some skill cohorts comparing to other types of labor skills. For this reason, as shown by Topel (1986) and Goldfarb and Yezer (1976), the lower propensity to move for individual skill cohort, the larger economic rents the respective group of workers receives. On the demand side, it also takes time for firms to relocate employment across barriers. Provided that disequilibrium is a short-run failure in adjustment, one could expect to see gradual convergence between areas in economic outcomes over a relatively long period. Besides Blanchard et al. (1992) among numerous researchers present consistent evidence for the US, evidence from Konings (1995), McCormick (1997) and Duranton and Monastiriotis (2002) also indicates a lack of efficient adjustment among UK regions. More straightforward examination of local shocks effects on wages is done by Prime et al. (2016) using data of MSAs in the US. By showing that positive shocks in demand for labor significantly increase the wages, they assert that metro areas presenting better job opportunities are more likely to

render higher wages than those places with limited employment opportunities. In general, the main message from these empirical works is that shocks to the local economy or local labor market conditions are important to understand wage disparities across cities.

In the spatial context, as for imperfect markets giving rise to wage differences mostly concerned about by labor economists, institutional interventions (such as tax rates, minimum wage legislation and union power etc.) probably result in non-competitive wage rates or significant wage rigidity and thus influence the spatial pattern of wage inequality across cities. Alternatively, in face of differently local welfare-system, imperfections of housing market such as rents controls or absence of laws protecting landlords' property along with cultural factors, local labor markets could be more featured as self-contained territorial units whereby assuming a perfect competitive labor market could barely reconcile with the spatial wage structure in reality. Empirical evidences based on the US by Prime et al. (2016) and Italy by Di Addario (2002, 2006) corroborates these views of markets imperfection respectively. Therefore, potential sources such as imperfect housing market, local institutional interventions involving tax, union, labor protection, could also give rise to diversion in non-competitive remuneration across cities.

5.2 Conclusion

In contrast to equalized wages across a homogeneous space in a perfect world, wage inequality across cities indicates some crucial deviations are present: differences in local composition of skills, differences in local productive efficiency giving rise to spatially different returns to skills, differences in costs of living and amenity, differences in local labor markets conditions and institutional interventions. These deviations are highlighted as potential sources that are giving rise to observed wage inequality across cities, based on a wealth of theoretical justifications as well as numerous empirical studies on spatial wage discrepancies. Despite relative importance of potential sources and mechanisms that contribute to spatial wage inequality could vary among existing theories, such deviations discussed above are mainly stylized facts or factors that have been consistently documented for a long time and empirically examined in different countries. Considering that researches on inter-city wage disparities are either mostly performed within a particular country or bearing on particular strand of theoretical explanations, the framework of a perfect world allows us to understand to what extent particular explanation can be applied to some certain

settings and thus reconcile with differences in empirical estimates of specific factor-effects on wage differentials across cities by country. Besides different datasets, differences in geographic environment, demographic factor as well as economic organizations influence the relative importance of explanatory variables. For countries covering a broad territory whereby geographic environment vary greatly across subnational boundaries, local endowments and amenity value of a place could obviously divert from the context of homogeneous space. City size effects incorporating both consumption externality and productive externality are pronounced in the process of wage determination. In the context where operating business in cities are more characterized in the function city perform, local wage are related to the local mix of traded industries in a sense that occupational structure shapes the skill composition of local workforce which appear to be the most important determinant of urban growth. In other words, cities featured as educated, large, coastal, sunny and mild are more likely to be prosperous and render relatively favorable wages. Importantly, a long-run equilibrium concept might justify the wage inequality across cities as spatially economic efficiency, while potential disequilibrium could caution a true spatial disparity or the lack of efficient adjustment mechanisms whereby rationales of both equity and efficiency for government intervention in the economy are challenged.

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