

Report Part Title: A Model of Housing Affordability

Report Title: Housing Affordability in a Global Perspective

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weak, it shows that within the same country, the more productive a city is, the more unaffordable housing is. This echoes the findings of earlier studies (Glaeser and Gyourko 2003) that focused in the US and explored the impact between housing affordability and city productivity and found that in highly productive metropolitan areas zoning and other land use controls, play the dominant role in making housing expensive and unaffordable. Chang and Moretti (2015) conclude that local land use regulations that restrict housing supply in dynamic labor markets have important externalities on the rest of the country. Our findings suggest that this situation is not particular to the US, but a pattern observed in the countries of the sample. While this relationship is not causal, land use and zoning regulations tend to exacerbate housing affordability levels, as we will see later.

A Model of Housing Affordability

The survey results presented in the previous section provide a series of new findings concerning the composition of the housing sector, the housing affordability across the sample, in cities in developed countries and cities in less developed countries, and the affordability of housing within countries and across housing subsectors.

In this section, we explore the relationship between housing affordability and a series of independent variables. Specifically, we are interested in the effects of the presence of informal housing and public housing, of population size, the effect of urban extent density, and the effect of land use regulations restricting the supply of land, on the overall affordability of housing.

Model Hypotheses

The presence of informal housing and public housing improves overall city housing affordability.

Earlier on, we discussed the relationship between housing affordability and the presence of informal housing and public housing. Clearly, in the cities of less developed countries, the presence of informal housing is a symptom of the lack of affordability (Brueckner and Lall 2015). As a result, we can expect that the presence of informal housing in a given city would improve the overall housing affordability of the housing sector.¹⁰ Similarly, the extensive presence of public housing should reduce overall city housing affordability, though we would expect to deteriorate the affordability of the private housing sector. The interest in these variables stems from the fact that the presence of informal and public housing could have both effects: on the one hand, improve overall affordability as we hypothesize, on the other deteriorate the

¹⁰ Brueckner and Selod (2009) address this issue from a theoretical perspective. They note that formal tenure and squatting represent two interlinked land uses within a single housing market; as a result, squatter settlements “squeeze” the formal market by occupying land that could be developed for formal use. In result, this would reduce the supply of land for housing and therefore increase land prices in the formal private housing sector. Yet it is unclear whether the effects for the formal private sector housing affordability would offset the improvements in housing affordability through access to informal housing.

housing affordability of the sector by constraining land supply for the formal private housing sector.

As city population increases, housing affordability deteriorates.

While the effects of city size and productivity have been extensively studied, the relationship between the cost of housing and city population has not been given much attention. As Combes et al. (2016) note larger cities, through increasing agglomeration effects are expected to become more productive, but also more expensive due to increased costs of housing, transportation, and other costs. Holly and Jones (1997), show that there is a positive correlation between the growth of population, and housing prices. The increase in demand for housing in the short run is absorbed by higher prices, since supply is fixed and property developers cannot satisfy immediately the rising demand (Arestis and González 2013). This positive relationship is especially strong in those areas that are densely populated due to the fact that the constraints regarding the availability of land for housing renders its supply more inelastic. Even if this relationship has been demonstrated in previous studies, there is little evidence on the relationship between the affordability of housing and city size. Following previous studies that estimate the elasticity of housing prices with respect to city population (Albouy 2008; Bleakley and Lin 2012; Baum-Snow and Pavan 2012), Combes et al. (2016) find that the elasticity of urban costs (including housing expenditure) increases with city population. Based on these findings, we expect to see a similar pattern across the global sample: households in larger – based on their population – cities would incur higher housing costs and face greater challenges in terms of housing affordability.

To test this hypothesis we use city population, a variable that refers to the population of a city's urban extent, described in section 3.1, circa 2014. The method for obtaining the population of an urban extent of a given city at a particular date required identifying the set of enumeration zones and their populations that fully contained that urban extent at that date, or interpolating or extrapolating the populations of these enumeration zones to estimate their populations at that date.¹¹

Without controlling for other variables, a univariate linear regression between city population size and occupant affordability generates a significant slope of 0.06 and R^2 of 0.06. Without controlling for other variables, for 10 percent increase in population size, we can expect on average 0.5 percent increase in the price-to-income ratio of occupant affordability.

¹¹ We have sought to obtain the most detailed maps of enumeration zones for the cities in the global sample, using a number of valuable sources, including but not limited to: The Center for International Earth Science Information Network (CIESIN) at Columbia University, www.citypopulation.de (Brinkhoff 2016), the Chinese Academy of Sciences, and various national census bureaus.

In denser cities, housing appears to be less affordable.

Higher urban densities have been associated with greater environmental sustainability, but also, many other urban benefits including housing affordability. But while density correlates with access to services and public transportation, the argument that density will facilitate the development of more affordable housing options is contested by theoretical models Alonso (1964) and Muth (1969), and later empirical evidence showing that higher density does not lead to more affordable housing (Burton 2000) and that cities that have curbed their expansion have—with limited exceptions—failed to compensate with densification, resulting in decreased housing production than has created serious implications in terms of housing affordability (Romem, 2016). Another recent analysis of housing in Swedish cities that uses of urban population density and local land development as predictors of housing supply has shown that more densely populated cities or cities whose land has been more intensively developed tend to experience a larger degree of housing supply shortage (Ho 2015). While these measures do not distinguish the effects of natural land constraints versus regulations; however, average real house price growth and population density are often highly correlated.

In order to test for this hypothesis, we will use *Urban Extent Density* a variable that represents the ratio of the total population of a given city and its urban extent, measured in persons per hectare.

A linear regression between urban extent density and occupant affordability generates a significant slope of 0.12 and R^2 of 7 percent. Without controlling for other variables, for a 10 percent increase in urban extent density, we can expect on average 1.1 percent increase in their price-to-income ratio of occupant affordability. The effect of urban extent density on the median affordability is similar to its effect on occupant affordability.

Cities that enforce regulations that limit their land supply restrict the land available for housing and therefore deteriorate housing affordability.

Land availability and the role of regulations have been central considerations in understanding housing supply and its effect on housing affordability. There is an extensive literature in both developed and developing countries discussing this literature. In higher income countries, Glaeser and Gyourko (2003) explored the impact of zoning on housing affordability and demonstrated that in some of the most productive cities in the United States the price of housing is significantly higher than construction costs. Similarly, in the United Kingdom, Cheshire and Sheppard (1989) and later, Morrison and Monk (2006) found that higher housing costs and increasing housing shortages are associated with planning and physical constraints on land availability. A later study by Gyourko and Molloy (2014) find that regulation in the US appears to be the single most important influence on the supply of homes. Looking at house prices and construction costs over the past 30 years, the authors conclude that the growing wedge between the two illustrates that the price of land has been trending upward over time. More recently, Chang and Moretti (2015) quantified the amount of spatial misallocation of labor across US cities and its aggregate costs. They traced the labor misallocation in high productivity US cities

like New York and the San Francisco Bay Area, on the stringent restrictions to new housing supply that effectively limit the number of workers who have access to such high productivity. They estimated that in the period 1964 to 2009, these constraints lowered aggregate US growth by more than 50 percent.

While the empirical evidence is less extensive, recent research has shown that in developing countries, many cities fail to address the housing challenges associated with population growth, often due to unresponsive land use regulations that restrict land supply and push a large number of households towards informal housing (Lozano-Gracia and Young 2014). When regulatory standards are appropriate for a given household income, they function as a form of mental shorthand that reduces costs (Collier and Venables, 2013). In contrast, when the regulatory framework does not respond to the actual conditions, standards act very much like an implicit tax on housing, particularly for low-income households, who, because of these regulations, have to pay higher costs for properties that remain outside of the ambit of legal transactions (Bertaud 2010; Glaeser, Gyourko, and Saks 2005; Buckley et al. 2016). As Collier and Venables (2013: 6) rightly question: “How out of line were the standards of the 1947 British Town and Country Planning Act with African incomes?” They respond by showing that current per capita income in the region is less than a twentieth of the British incomes in 1970.

In order to explore the effect of regulations on housing affordability we develop a variable representing enforced containment. This variable represents a combined binary indicator of the existence of enforced land use containment regulations at the periphery of a city. The variable seeks to determine whether containing the expansion of land in a given city is an explicit goal of the zoning and land use plan, and whether containment is strictly enforced through the use of a greenbelt, an urban growth boundary, through quotas on the amount of land that can be converted to urban use, or by defining quotas on the issuance of building permits. Data for this variable comes from the regulatory component of *The Land and Housing Survey in a Global Sample of Cities* that focused on the rules and regulations governing the development of new residential land and housing and their enforcement.

Modelling Occupant Affordability

We apply a multiple linear regression where the dependent variable is occupant affordability for each housing type, in each city of the global sample. The independent variables are city population size, urban extent density (person/hectare), and enforced containment, an indicator of regulatory restrictions in the supply of land. The model is tested in a logarithmic form:

$$\begin{aligned} \ln(\text{Occupant Affordability}) &= \beta_0 + \beta_1(\text{share informal}) + \beta_2(\text{share public}) + \beta_3 \cdot \ln(\text{population}) + \beta_4 \\ &\cdot \ln(\text{urban extent density}) + \beta_5(\text{enforced containment}) + \varepsilon \end{aligned} \quad (3)$$

The model confirms our hypotheses. Controlling for other variables, occupant affordability price-to-income ratio is on average 38 percent lower for the informal housing sector, and 15 percent lower for the public housing sector compared to the other housing types. All rest being

equal, for a 10 percent increase in city population size, we expect to see on average 0.3 percent increase in the price-to-income ratio of occupant affordability. For a 10 percent increase in urban extent density, we expect to see 0.8 percent increase in the price-to-income ratio of occupant affordability. For a city with enforced containment, we expect the price-to-income ratio to be 1.6 percent higher on average. The effects of urban extent density and regulation are strong after controlling for other variables. Interestingly, the adjusted GDP per capita could not fit into the model after controlling for other variables as it has a relatively weaker effect on price-to-income ratio.

Figure 10: Parameter estimates of independent variables in the model shown with standard error (SE), and p-values

Dependent Variable: Log occupant affordability

Independent Variables	beta (SE), p-value	
Housing Sector Type: Informal	-0.48 (0.05), <0.001	***
Housing Sector Type: Public	-0.16 (0.05), <0.001	***
Log Population Size circa 2015	0.03 (0.01), 0.015	*
Log Urban Extent Density circa 2015	0.09 (0.03), 0.002	***
Regulation: Enforced Containment	0.16 (0.04), <0.001	***
<i>Intercept</i>	0.98 (0.18), <0.001	***
Total Observations	568	
Adjusted R ²	0.18	

The significance level is shown as: *<0.05, ***<0.001.

Conclusion

The paper presented findings from the *Land and Housing Survey* in a global sample of 200 cities. The main finding of the survey confirms the previously raised concerns about housing affordability in cities. Based on the two affordability measures that we developed, there is a global housing affordability crisis that the formal private housing market alone is failing to confront. Globally, we estimate that using the occupant affordability measure, which specifies how affordable a dwelling is for the household that occupies that dwelling, the house price-to-income ratio is 4.9. Using the median affordability measure, a metric of the affordability of the private formal housing sector, the median house price-to-income ratio is 6.2.

Our findings confirm earlier studies and show that housing affordability deteriorates as cities face increases in population and the density of their urban extent. Our findings also confirm that the imposition of restrictions in the supply of land affect housing supply and overall housing affordability. Finally, the presence of informal housing and public housing improve the overall affordability of housing. However, the affordability of the informal housing sector should not be considered independently of the housing quality and the deprivations that households occupying a dwelling in the informal sector face. The degree of deprivation in terms of housing quality