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Urbanization and Housing Investment

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Abstract

This paper provides the first systematic empirical assessment of the pace at which housing investment has responded to rising demand from urbanization. The assessment used National Accounts Statistics to build a data set of residential housing investment for more than 90 countries. The data set explicitly accounts for investment by households, the government, and the private sector. The analysis finds that housing investment follows an S-shaped trajectory taking off around per capita GDP of about $3,000 (US$2005) and tapering down at per capita GDP around $36,000 (US$2005). The analysis also finds that between 2001 and 2011, housing investment in low-income economies averaged 4.56 percent of gross domestic product and 9.12 percent in upper-middle-income economies. An important finding is that countries in Sub-Saharan Africa have housing elasticities similar to comparable low-income and lower-middle-income economies. In financing housing investment, the paper finds that developing countries tend to rely much more on domestic savings and government debt, whereas high-income Organisation for Economic Co-operation and Development countries lever capital markets by tapping foreign savings. Not only does excessive reliance on domestic savings and government debt increase the sensitivity of housing investment to the cyclicality of growth of gross domestic product, it also can potentially crowd out investments in health and education.

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1. Background and Motivation

Emerging economies are urbanizing fast. The United Nations projects that the world's urban population will increase by 2.6 billion people, up from 3.6 billion in 2011 to 6.3 billion in 2050. Almost all growth will take place in emerging economies, with Asia's urban population increasing by 1.4 billion and Africa's by 0.9 billion (United Nations, 2012). The rapid pace and magnitude of urbanization has stretched the capacity of countries to finance the large capital outlays needed to provide housing, infrastructure, and services as cities grow and urbanization picks up speed (World Bank 2013). In this paper, we focus on housing, as its consumption has direct bearing on living standards, and investment in housing is often the largest asset class held by families. For instance, the private wealth in housing for British households is 5.5 trillion—more than a third of the country's total private wealth of 15 trillion (Collier and Venables 2013). Further, the construction of housing also contributes to job creation, especially in developing economies where the sector is typically more labor intensive than other sectors (Collier and Venables, 2013).

Our investigation focuses on answering two main questions. First, what has been the extent to which investment in housing has kept pace with demand from urbanization? Second, what are the impacts of differences in financing capabilities of countries on housing investment? In particular, what are the implications of relying solely on domestic savings to finance housing investments vis-à-vis the ability to leverage financial markets and foreign investments? We assemble a national accounts consistent data set of housing investment covering over 90 countries across the globe that explicitly accounts for investments by households, the government, and the private sector. These data cover structures used entirely or primarily as residences, including any associated structures, and permanent fixtures installed in residences. Investment figures include the costs of site clearance and preparation, and cover both formal and informal structures. Such a comprehensive and globally comparable data set on housing investment has never been compiled before.

This data set allows us to extend the literature on housing supply, which has previously focused on "single-family houses" and their corresponding prices for developed countries such as the United States (Proterba 1984, Topel and Rosen 1988). Despite the focus of the literature on single-family housing, these types of new 'structures' only represent a subset of total housing investment. In most developing countries, especially in Sub-Saharan Africa, formal housing

constitutes a very small share of aggregate housing. In many African cities and towns, less than 10% of the population lives in formal housing.[1] Our data set encompasses all housing types, including informal housing such as mobile homes, barges, slums, and caravans.

Our analysis shows that housing investment follows an *S*-shaped trajectory where housing investment takes off when countries' per capita GDP is around $3,000 (2005 USD). With many developing countries rapidly urbanizing at lower income levels, urbanization will be messy in the near future as there is still some way to go before investments in durable structures such as housing take off. In fact, the median low income country invested 5.6 percent of gross domestic product (GDP) and the median middle income country invested 8.8 percent of GDP in housing between 2001 and 2011.The good news here is that with economic development, the elasticities of housing investment growth to urban growth are steadily increasing for developing countries and specifically for Sub-Saharan African countries.

On financing housing investments, we use a *Feasible Generalized Least Squares* (*FGLS*) estimation framework and find that for low and middle income countries in (SSA) and East Asia and the Pacific (EAP), domestic savings are the most important determinant of housing investment.[2] In OECD countries, however, we find a strong positive relationship between savings and housing investment. Further, we find a strong inverse relationship between the current account balance and housing investment in OECD countries, highlighting the role of international capital mobility in stepping up housing investment. For low and middle income countries with limited ability to lever internationally mobile capital, mobilization of domestic savings lies at the core of stepping up housing investment. Finally, we find that there are short run trade-offs between housing investment and aggregate consumption, but the long run effects are negligible.

The research reported in this paper is the first systematic economy wide assessment of the patterns and determinants of housing investment. The rest of the paper is organized as follows. Section 2 describes the data set and provides stylized facts on the patterns of housing investment. Section 3 examines the determinants of housing investment. Section 4 examines the implications of alternate approaches to finance housing investment. Section 5 concludes.

[1] "A few examples are illustrative. In Zambia, 74% of urban dwellers live in slums; in Nigeria, 80%; in Sudan, 85.7%; in Tanzania, 92.1%; in Madagascar 92.9%; and in Ethiopia, a staggering 99.4%"— "*Housing Challenges and Opportunities in Sub Saharan Africa*", International Housing Coalition, 2007.

[2] Results for EAP and other regions are not included in this paper but are available from the authors upon request.

2. Patterns of Housing Investment

2.1 Housing Investment: An S-shaped trajectory

We build a database of housing investment using the variable 'o*wnership of dwelling, value added'* in the National Account Statistics. The national accounts report housing investment by taking into account investment in dwellings by households, the government, and the private sector. By definition, this variable includes buildings that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences. Houseboats, barges, mobile homes and caravans used as principal residences of households are identified primarily as dwellings as well. As a part of investment in dwellings, costs of site clearance and preparation are also included.[3] However, there are a few limitations with these data. First, o*wnership of Dwellings* does not include housing that has been built but is recorded in inventories. Second, the value is measured based on market prices but it uses cost in the absence of reference prices. Thus, actual value may differ from country to country.

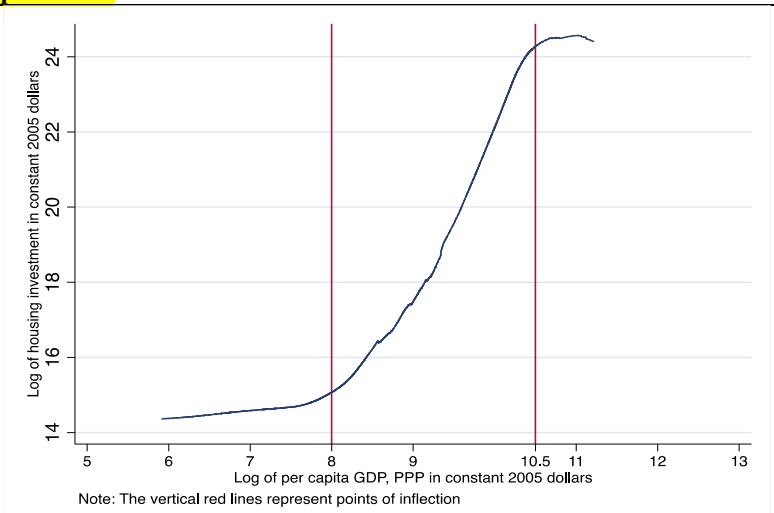
The evidence from our data set points out that investments in housing pick up pace as countries approach middle incomes. In fact, housing investment follows an *S*-shaped trajectory where low income economies have low income elasticities stemming from both demand and supply constraints. Rigidities in the supply of materials, organization of the construction industry, and nascent markets for land transactions constrain housing expansion in urban areas. On the demand side, when incomes are low at early stages of development, the claims of other consumption expenditures such as food tend to be stronger (Lakshmanan et al 1978, Regmi et al 2001). After lagging early in development, the income elasticity of housing expenditures is likely to increase during periods of rapid industrialization and then begins to decline at high levels of per capita incomes. Why? Rising incomes free up room for consumption of housing and related durables, and are typically associated with the building of technical and institutional capabilities that enable housing investment. Asset formation in housing provides a hedge against the erosion of savings driven by inflationary pressures. Finally, as countries approach high incomes, much of the housing and physical infrastructure is in place and residents instead demand many

[3] Examples include products included in Central Product Classification (CPC) a class 5211, residential buildings and CPC group 387, prefabricated buildings, such as one- and two-dwelling buildings and other (System of National Accounts (SNA) Manual, 1993).

commodities that are substitutes for housing services (e.g., recreation vehicles, boats, etc.) or complements (e.g., household furnishings and equipment). This reduces the demand and income elasticity of housing.

Figure 1 provides supporting evidence that housing investment and consumption reflect stages of economic development. It plots housing investment and national per capita GDP for all countries spanning 1960-2011. There are two inflection points – the first one is observed when housing investment takes off around national development levels of about $3,000 (2005 USD) and the second one, when housing investment slows down at development levels around $36,000 (2005 USD). Consider Africa, where cities are growing rapidly but the region's development is only at around $ 992 (2005 USD). Urbanization is likely to be messy in the near future as there is still some way to go before housing investments take off.

Figure 1: Housing investment and stages of economic development – An S-shaped curve



Source: World Bank staff estimates based on dataset of housing investment; data from national accounts and World Development indicators. Lowess graph shown here.

2.2 Magnitude of housing investment increases with economic development

Consistent with the S-shaped trajectory, we find that the share of housing investment in GDP has been steadily increasing for developing countries across different stages of income. Between 2001 and 2011, housing investment in low income countries averaged 4.56 percent of GDP (up from 2.51 percent between 1960 and 1971) and 9.12 percent in upper middle income countries

(up from 5.11 percent between 1960 and 1971). In contrast, housing investment has been gradually declining in high income/ OECD countries, having peaked in the 1960s. In fact, urban growth was rapid for OECD countries through the 1960s (Table 1). For example, annual urban growth in Norway during 1960-70s was on average 3.24 percent, before gradually tapering down in the following decades. During the period of high urban growth, Norway's housing investment was 14.6 percent of GDP. Similarly, the Republic of Korea maintained housing investments of around 5 percent of GDP when its urban growth was more than 6 percent. Countries like USA, Germany, Canada, Australia and Netherlands had already urbanized by that time. They however maintained a steady share of housing investment, which ranged from 4.5 to 6 percent of GDP during this period despite gradual declines in urban growth.

Table 1 Decadal average of housing supply (% of GDP) across income categories

	Decade				
Income category	1960-70	1971-80	1981-90	1991-00	2001-11
Low income	2.51	3.00	3.58	4.79	4.56
Lower middle income	4.38	4.97	5.41	6.10	6.06
Upper middle income	5.11	8.49	9.14	8.86	9.12
High income: OECD	11.29	9.87	8.06	6.03	5.71

While housing investment has been increasing for developing nations across income groups, we observe pronounced regional differences. For example, table 2 shows that low income East Asia invested 7.2 percent of GDP between 2001 and 2011 in comparison with low income Sub-Saharan Africa, where countries invested 4.9 percent of GDP in housing during the same time span. Among upper middle income countries, the MNA region has been investing 12.9 percent of GDP in housing, followed by LAC (10.3 percent), ECA (9.5 percent), SSA (6.6 percent) and EAP (4.9 percent).

Table 2 Decadal average of housing supply (% of GDP) across regions and income categories

	1960-70	1971-80	1981-90	1991-00	2001-11
Low income countries					
East Asia & Pacific				6.34	7.16
Europe & Central Asia			2.62	1.70	1.47
Sub-Saharan Africa	2.51	3.00	3.61	5.53	4.94
Lower middle income					
East Asia & Pacific	6.88	6.75	5.90	8.44	8.64
Europe & Central Asia				2.27	3.36
Latin America & Caribbean	3.32	4.50	4.61	4.42	3.87
Middle East & North Africa	3.77	2.85	2.26	2.70	2.76

Sub-Saharan Africa		8.71	7.63	6.61	7.30
Upper middle income					
East Asia & Pacific	5.99	4.35	3.56	4.36	4.90
Europe & Central Asia				8.62	9.52
Latin America & Caribbean	6.93	12.75	11.80	10.20	10.25
Middle East & North Africa	2.34	4.01	9.33	13.20	12.90
Sub-Saharan Africa	3.67	5.08	5.83	4.80	6.64
High income					
OECD	11.29	9.87	8.06	6.03	5.71

2.2.1 Who invests the most in housing?

Using the full sample in our data set, we provide country rankings of housing investment (as percent of GDP in 2001-2011) in table 3 below. Not surprisingly, we find that small low and lower middle economies are among the top investors. Topping the charts is Kiribati (26 percent), followed by Panama (15.6 percent). Small economies such as St. Vincent and the Grenadines (14.3 percent), St. Lucia (13.1 percent) and Grenada (12.4 percent) are also among the top ten (Table 3). It is interesting to note that in SSA, low income countries such as Lesotho, Rwanda, Ethiopia, and Eretria, and middle income countries such as Mauritius and Namibia ranked among the top 30 for housing investments between 2001 and 2011.

Table 3 Ranking of countries based on share of housing supply in GDP

		Decades					
Country	Income group	1960-70	1971-80	1981-90	1991-00	2001-11	Rank
Kiribati	LIC and LMIC				21.7	26.4	1
Panama	UMIC				15.5	15.6	2
Iran, Islamic Rep.	UMIC	2.3	4.0	9.3	13.1	14.9	3
St. Vincent and the Grenadines	UMIC		26.3	20.7	17.6	14.3	4
Lesotho	LIC and LMIC		14.4	14.0	13.5	14.0	5
Argentina	UMIC				14.5	13.9	6
Uruguay	UMIC			13.1	13.8	13.3	7
St. Lucia	UMIC		7.5	7.0	7.6	13.1	8
Grenada	UMIC		25.0	20.5	16.0	12.1	9
Spain	HIC				13.3	11.7	10
Jordan	UMIC				13.3	11.3	11
Greece	HIC	32.8	35.7	29.1	14.0	11.1	12
Tonga	LIC and LMIC				10.9	11.0	13
Montenegro	UMIC				11.6	10.8	14
Brazil	UMIC			9.6	9.5	10.2	15
Venezuela, RB	UMIC			10.6	10.1	10.0	16
Dominica	UMIC		10.8	10.1	9.1	9.8	17
Norway	HIC	14.6	13.4	12.4	10.1	9.7	18
Philippines	LIC and LMIC	15.0	11.4	9.9	9.9	9.5	19
Mauritius	UMIC		8.8	8.8	7.5	9.2	20
Namibia	UMIC		5.3	5.6	5.4	8.9	21
Antigua and Barbuda	UMIC		12.6	10.6	9.1	8.9	22
Jamaica	UMIC			5.4	5.8	8.7	23
Rwanda	LIC and LMIC				8.9	8.7	24
Mozambique	LIC and LMIC				12.9	8.5	25
Turkey	UMIC				7.6	8.2	26
Ireland	HIC				7.1	8.2	27

Vanuatu	LIC and LMIC			6.8	6.9	7.7	28
Ethiopia	LIC and LMIC			5.7	6.4	7.7	29
Belize	LIC and LMIC	12.2	10.3	8.7	7.0	7.5	30
Hungary	HIC				8.9	7.3	31
Korea, Rep.	HIC	4.7	4.4	6.4	10.3	7.3	32
Cambodia	LIC and LMIC				6.3	7.2	33
Portugal	HIC	13.5	14.2	16.9	9.8	7.1	34
Senegal	LIC and LMIC		5.1	5.3	5.8	6.6	35
Australia	HIC	6.6	6.0	5.9	6.2	6.5	36
Canada	HIC	5.6	6.3	6.2	5.6	6.5	37
Estonia	HIC				5.2	6.4	38
Tuvalu	UMIC				6.5	6.3	39
Czech Republic	HIC				8.1	6.2	40
New Zealand	HIC		7.1	5.7	6.1	6.1	41
Dominican Republic	UMIC	10.6	10.4	9.8	7.7	5.8	42
Swaziland	LIC and LMIC		10.2	9.8	5.3	5.6	43
Netherlands	HIC		5.4	6.2	5.4	5.6	44
Cape Verde	LIC and LMIC		0.8	1.4	1.8	5.5	45
Belgium	HIC				5.4	5.5	46
France	HIC		6.5	6.8	4.8	5.4	47
Italy	HIC	13.8	9.7	7.5	5.6	5.4	48
Finland	HIC		6.5	6.2	4.6	5.4	49
Israel	HIC		11.2	9.1	8.3	5.3	50
Germany	HIC		5.8	6.8	6.3	5.3	51
Chile	UMIC	6.3	6.2	8.5	5.9	5.0	52
Poland	HIC				5.5	5.0	53
Palau	UMIC			4.3	5.2	5.0	54
Mongolia	LIC and LMIC			4.3	5.0	4.9	55
Slovenia	HIC				5.5	4.8	56
Honduras	LIC and LMIC	4.6	4.3	4.5	4.7	4.6	57
Bolivia	LIC and LMIC		5.3	6.0	5.2	4.6	58
Yemen, Rep.	LIC and LMIC			4.5	4.3	4.6	59
United States	HIC	4.1	5.0	4.4	4.2	4.5	60
China	UMIC		2.2	3.1	4.0	4.4	61
Slovak Republic	HIC				5.0	4.4	62
Austria	HIC		6.2	6.6	5.6	4.3	63
Armenia	LIC and LMIC				4.5	3.9	64
Thailand	UMIC	6.0	5.2	4.0	3.7	3.9	65
Denmark	HIC		4.2	4.4	3.0	3.8	66
Iceland	HIC				3.5	3.8	67
Lao PDR	LIC and LMIC			3.7	5.6	3.7	68
Madagascar	LIC and LMIC			1.0	1.4	3.6	69
Gambia, The	LIC and LMIC					3.5	70
Switzerland	HIC			3.9	3.4	3.3	71
United Kingdom	HIC		3.2	4.2	2.7	3.3	72
Samoa	LIC and LMIC				3.6	3.1	73
Japan	HIC		6.0	4.9	3.3	3.0	74
Kenya	LIC and LMIC	2.1	2.3	2.6	2.6	2.8	75
Georgia	LIC and LMIC				1.8	2.8	76
Peru	UMIC				4.1	2.8	77
Indonesia	LIC and LMIC	1.5	2.1	2.8	3.1	2.7	78
Sweden	HIC	5.9	3.7	4.1	2.0	2.6	79
Luxembourg	HIC				2.7	2.5	80
Tajikistan	LIC and LMIC			2.6	2.5	2.4	81
Togo	LIC and LMIC				2.2	2.4	82
Eritrea	LIC and LMIC				1.8	2.1	83
Ghana	LIC and LMIC					1.9	84
Morocco	LIC and LMIC	2.2	2.3	2.1	2.0	1.9	85
Paraguay	LIC and LMIC	3.2	2.5	2.8	1.9	1.9	86
South Africa	UMIC	3.7	3.2	2.8	1.5	1.8	87
Egypt, Arab Rep.	LIC and LMIC	4.3	3.4	2.2	1.7	1.8	88
Guyana	LIC and LMIC	0.7	0.8	1.0	1.0	1.1	89
Kyrgyz Republic	LIC and LMIC				0.9	0.4	90
Tanzania	LIC and LMIC			4.6	6.4		
Uganda	LIC and LMIC	2.9	3.7	5.0	7.2		
Seychelles	UMIC			6.2			

Note: Countries are ranked based on decadal averages of share of housing investment in GDP (2001-2011).

2.3 The timing of housing investment

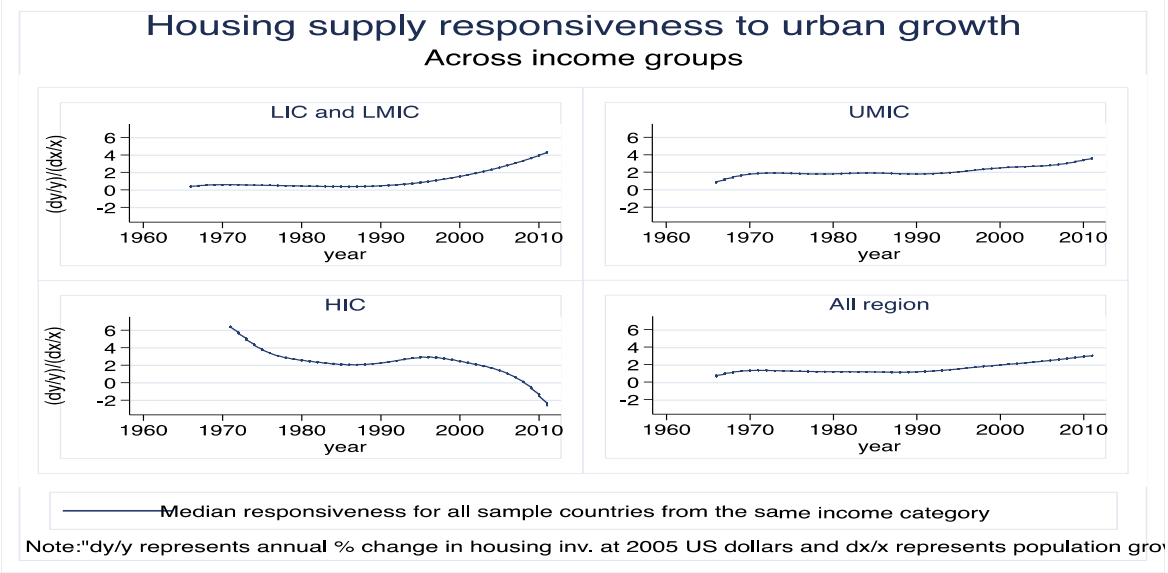
Today, the major concern for rapidly growing cities is to keep pace with the demand for housing and related services. With 2.6 billion people expected to join urban areas by 2050, the supply of affordable houses will need to be stepped up across countries, especially in Asia and Africa. If the supply of affordable housing does not keep pace with urban growth, the potential prosperity from cities will be dashed by poor living conditions, education and health outcomes, and low productivity. To better understand the challenges for future supply of affordable housing, it becomes important to examine and learn from decisions made in the past. In this section, we therefore examine the extent to which investment in housing has kept pace with demand from urbanization.

To answer this question, we first evaluate the elasticity of housing investment to changes in urban population. For this, we construct two data series for each country: (i) rate of change in urban population or urban growth, and (ii) growth in housing investment. Urban growth is calculated by taking the annual percentage change in urban population in each country between 1960 and 2011. The growth in housing investment is calculated as the annual percentage change in value of "ownership of dwelling" (in 2005 US dollars) for each country. Using these two series, the supply elasticity is calculated from the ratio of percentage change in housing investment to the percentage change in urban population for each year between 1960 and 2011. Linking housing investment directly with urban growth in a graphical exposition, *ceteris paribus*, provides us with an estimate of the elasticity of housing supply to urban growth.

Figure 2 shows that elasticities of housing investment growth to urban growth are steadily increasing for developing countries (around 4 in 2011) and on the decline for high income economies where housing elasticities peaked in the 1970s. OECD countries invested heavily in housing during periods of rapid urbanization. For example, during 1960-70s, when annual average urban growth in HICs was 2.31 percent, housing investment was 11.29 percent of GDP. Figure 2 also shows that between the mid-1960s and 2011, the median housing supply elasticity has steadily increased in upper middle income countries. In comparison, for low and lower middle income countries, housing elasticities have increased significantly since the 1990s. As we find from estimates of housing investment at the country level, several low and lower middle

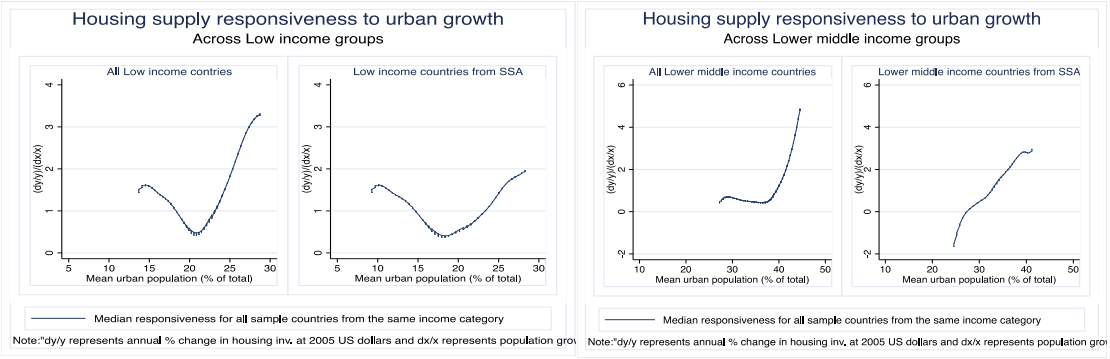
income countries such as Senegal, Yemen, Armenia, Georgia, Ethiopia, Eritrea, Cape Verde, Egypt, Indonesia, and Belize maintained an average annual growth of housing investment over 10 percent between 2001 and 2011 while corresponding urban growth was around 2 to 2.5 percent.

Figure 2: Elasticity of housing supply (responsiveness) to urban growth



An important finding here is that housing elasticities in Sub-Saharan Africa are similar to other low income and lower middle income economies (figure 3). A comparison of the median elasticity of housing supply in low income countries over all (including SSA countries) and low income countries from SSA shows a similar pattern. Housing investment response however is slow beyond urbanization rates of 25 percent. Similarly, for lower middle income countries in SSA, elasticity of housing supply has been similar to the overall trend for all lower middle income countries. The only difference is in investment levels. Annex 1 provides country specific rankings of housing elasticities.

Figure 3: Elasticity of housing supply - Low Income Countries and Africa



2.4 Has housing investment kept pace with urbanization?

In the previous section, we discussed differences in responsiveness of growth in housing investment to urban growth. Here we present a complementary assessment to develop a typology of housing investment as follows: (a) *leading*, where housing investments are ahead of demand (measured as urbanization); (b) *synchronous*, where investment is contemporaneous to demand; and (c) *lagging*, where housing supply trails urbanization.

For the assessment, we calculate a cross correlation coefficient between urbanization and growth in housing investments for all years between 1960 and 2011. The lead, lag or contemporaneous relationship between urbanization and housing growth is identified using cross correlation coefficients and presented in the form of a cross-correlogram. A *cross-correlogram* is a commonly used tool for checking randomness in a data set. It graphs the cross correlation coefficient ($\rho_{ij}(k)$) between two series (in the Y axis) against leads and lags (in the X axis). For this analysis, cross correlations between urbanization (demand) and growth in housing investments are calculated for 10 years of leads and lags.

The values on the X axis (labeled as lag) show years of lead or lag. The value 0 on the X axis represents contemporaneous relation (x_{1t}, x_{2t}), with x_{1t}, and x_{2t} representing the variables for which cross correlations are being calculated for time t, in this case, urbanization and growth in housing investment. Positive values on the X axis suggest housing investment growth lags urbanization and negative value reflect that housing investment growth leads urbanization. The values of Y range between (-1) and (+1) showing negative or positive cross correlation respectively. The value 0 in the middle marks the point of no correlation. The cross correlation coefficient presented on the Y axis is measured using the following formula of cross correlation:

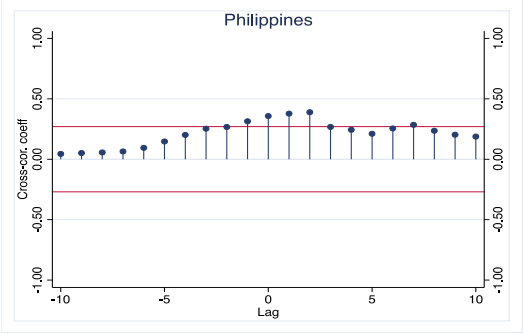
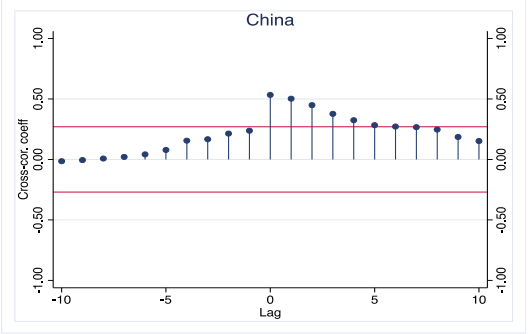
$$\rho_{ij}(k) = corr\{xi_t, xj_{t\pm k}\} = \left(\frac{R_{ij}(k)}{\sqrt{R_{ii}(0) + R_{jj}(0)}}\right)$$

Where k indicates number of lags (-ve for lead and +ve for lag in this case). A value close to zero for $\rho_{ij}(k)$ indicates a random relationship. Given that in the cross-correlogram, correlations are calculated across variables and time periods considering different leads and lags, interpretation of the correlogram is not straight forward. Two characteristics of the correlogram are important for its interpretation: the overall pattern and the peak value. In particular, an irregular pattern of the

correlogram together with low values of $\rho_{ij}(k)$ would suggest white noise process or weak correlation. A systematic pattern with a peak on the contrary, would be indicative of a correlation with the number of lags (or leads) for which the peak is found. Furthermore, it is important to look at the correlogram with some criteria of a significance level. Only a peak that satisfies such criteria could be used to conclude a significant correlation between the two variables of interest. To identify the significance of lead or lag we construct the confidence interval at 95%. For this, we used the average annual percent change in housing investment and urbanization for the respective years between 1960 and 2011. To avoid overlooking nuances due to cross-country variation across regions or income groups, we calculate cross correlation coefficients for each country based on available data between 1960 and 2011.

The number of leads or lags based on *cross-correlograms* for each country is reported in Annex 2. These results suggest that the relationship between housing supply and urban growth varies by region. For example, for most countries in the EAP region, growth in housing supply is contemporaneous with urban growth. The evidence shows that other than Kiribati, which lags 5 years, almost all countries in our nine country sample within the EAP region are either contemporaneous or very close to a synchronous relationship between investment and demand. For instance, housing investment in China is contemporaneous while in the Philippines it lags demand by 2 years. This is observed by looking at Figure 4 below. The blue marks indicate the cross correlation coefficient for urbanization and growth in housing investment. In particular, the mark shown for say Lag 5 (on the X-axis) indicates the correlation between urbanization at time t and housing investment at time t-5. The red lines mark the confidence intervals for a significance level of 95%, suggesting that any correlation found between the lines would not be statistically significant. Both cross-correlograms suggest a regular pattern and therefore we cannot conclude that the relationship between these two series is just white noise. As mentioned above, the second important element of the cross-correlogram is the peak. For the Philippines we see that the peak is at lag 2 suggesting that housing investment lags demand by 2 years. We can state this with confidence given that the peak is well outside our confidence interval for a significance level of 95%. For China, the peak of the correlogram appears at lag 0 suggesting synchronism between the two variables.

Figure 4: The timing of housing investment: Philippines and China

The Philippines: Lagging (2 years)	China: Contemporaneous
	

Note: The red lines at +/- .27 represent the confidence interval.

China is undoubtedly one of the most important emerging economies in the world and its urban housing market has been experiencing rapid and unprecedented growth (Chen et al., 2011; EIU 2011). During the past 20 years, China's urban housing sector soared from 78.64 million square meters in 1997 to 970.30 million square meters in 2011. It took China approximately 15 years to build the equivalent of Europe's entire housing stock (EIU, 2011). In 2005, housing wealth accounted for 71.34 percent of the total family wealth of Chinese urban households (Qianwei et al, 2013).

Private households are the major source of housing investment in China with more than 80% of homes being privately owned. Mortgage loans are steadily gaining ground in China. According to National Bureau of Statistics, outstanding home mortgage debt grew from below 1 trillion RMB to 3 trillion RMB between 1997 and 2008 but then leapfrogged to 8 trillion between 2008 and 2011. In terms of share in GDP, this jump was from 9 in 2008 to 18 percent in 2011. One of the major reasons is a 580 billion dollar stimulus package in 2008 to weather the global financial crisis and the sharp slowdown of economic growth (Barth et al., 2012). [4]

The Philippines, on the other hand, has been experiencing housing shortages over the last several decades. Estimates suggest that the country has a shortage of 484,325 low cost housing units (Manila Bulletin 2012). Rapid increase in land prices has been a major factor in housing shortage and price appreciation (Strassman and Blunt 1993; Ballesteros 2000). The high cost of urban land is due to binding constraints in the supply side of the market, including poor planning and

[4] See Barth et al(2012) for a detail discussion on China's housing market.

uncoordinated infrastructure developments that limit the supply of developable land (Ballesteros 2000, 2002). Contradictory land laws, unclear development standards, and problems with property rights also limit the supply of urban lands while increasing the cost of servicing land (Ballesteros 2002).

2.5 Have housing investments and urbanization behaved differently in SSA?

A review of housing investment policies around the world suggests some initial differences between SSA and other regions. In the 1950s and 1960s, governments across the world were considered to be the sole providers of land and large scale affordable housing, but in most SSA countries, such large scale housing programs were not present. Several reasons have been cited to explain these differences, including low demand, limited resources, and weak institutional capacity (UN Habitat, 2011). Later on, in the 1970s, SSA countries started joining the new global trend of 'self-help' housing policies where the role of the government was smaller and focused on 'site and services programs.' These programs were popularized and adopted in countries like Kenya, Zambia, Nigeria and Tanzania in varying degrees. However, small–scale and project to project sites-and-services schemes fell short and the gap between demand and supply continued to widen.

The economic downturn experienced by many SSA countries between the late 1970s and 1990s also contributed to the limited public investments in housing supply. In the second half of the 1970s, Africa entered a prolonged recession followed by a crisis that lasted through the second half of the eighties (Fay and Opal, 2000). GDP declined on average 9.8 percent every year in the region during the crisis years (1980-86). Overall, losses amounted between 10 and 11 percent of GDP and over 60 percent of gross capital formation. The low income, HIPC countries such as Madagascar, Mozambique, Niger, Rwanda, Sudan, Togo and Zambia were hurt the most. On average their GNP declined by 3 percent per annum during 1980-86 (Ghai et al, 1990). [5] While supply of housing was limited, urban areas in SSA maintained a high population growth rate (over 5 percent per annum) during this economic downturn as the population continued to migrate to cities. Further, the literature suggests that the response of the formal private sector to housing

[5] See Ghai, D. and C. Hewitt de Alcántara (1990): The Crisis of the 1980s in Sub-Saharan Africa, Latin America and the Caribbean: Economic Impact, Social Change and Political Implications, *Development and Change*, Vol. 21, (1990). 389-426 for detail.

demand has also been limited. Reasons for this include policy rigidities, stringent regulations and lack of other factors such as lack of housing credit, depreciating currencies, decreasing real incomes, and unsupportive regulatory frameworks (UN Habitat, 2011).

A characterization of the relationship between investment in housing and demand for all regions is presented in Figure 5 below. While on average, most regions appear to face contemporaneous correlation between investments and demand, in SSA investments appear to follow demand with a lag of 8 or 9 years. But just as in other regions, there is also great variation in the relationship between investments and demand across regions. As shown in Figure 6, while investments lead demand in countries like Lesotho and Cape Verde, in Uganda and Swaziland investment has lagged demand by up to 9 years.

Figure 5: Timing of housing investment by region.

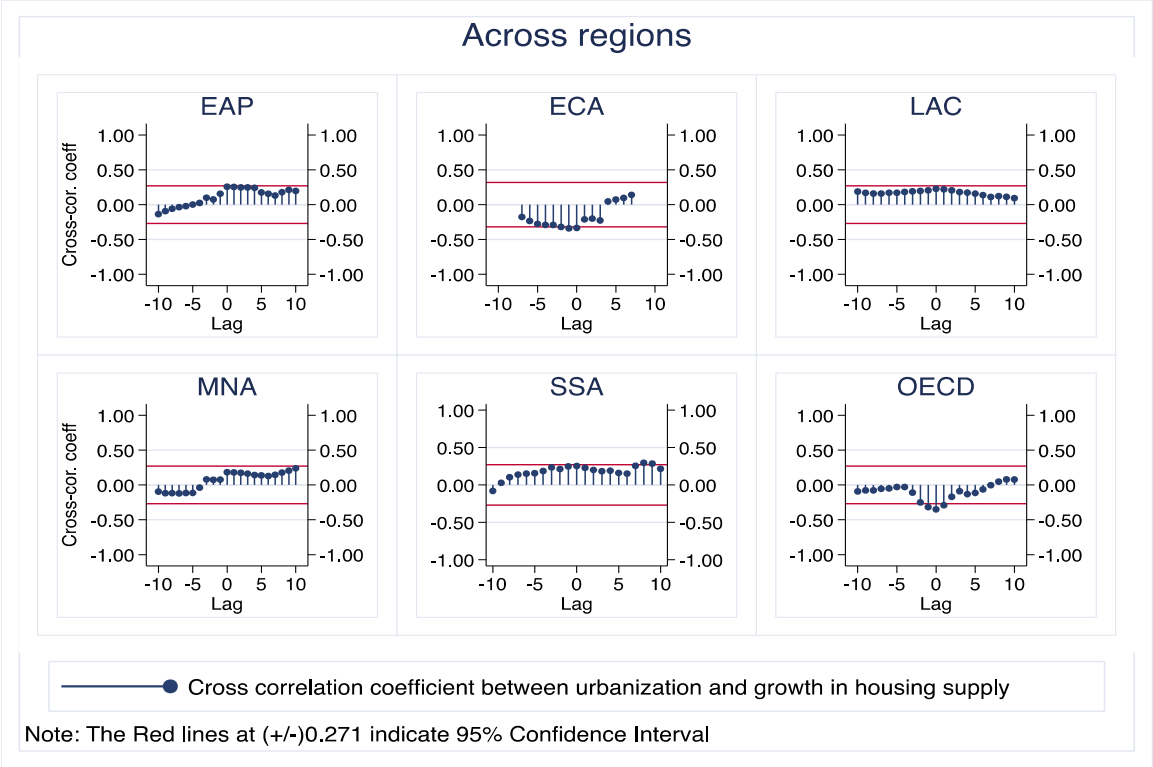
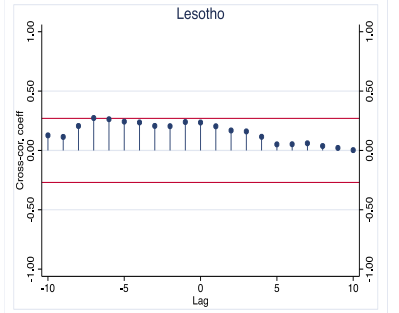
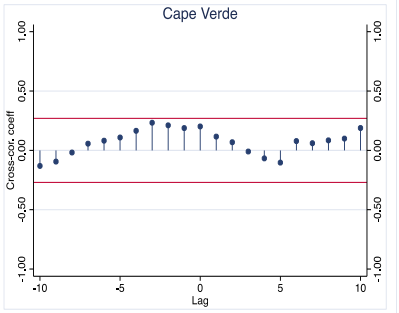
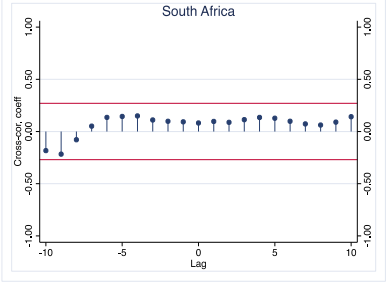


Figure 6: The timing of housing investment in Sub-Saharan Countries across income groups

Lesotho: Leading	Cape Verde: Leading	South Africa: No relation



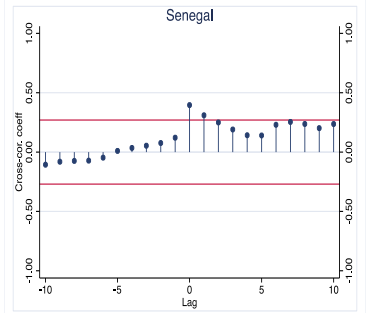


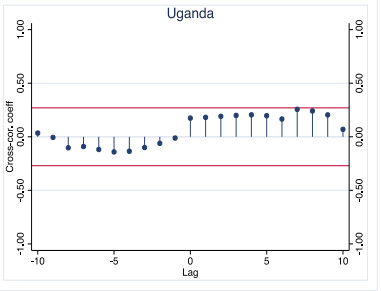


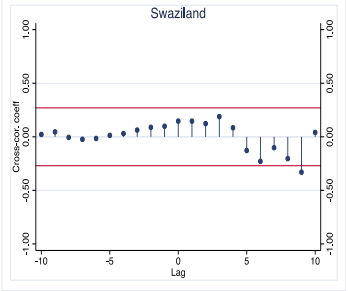
Senegal: Contemporaneous

Uganda: Lagging

Swaziland: Lagging





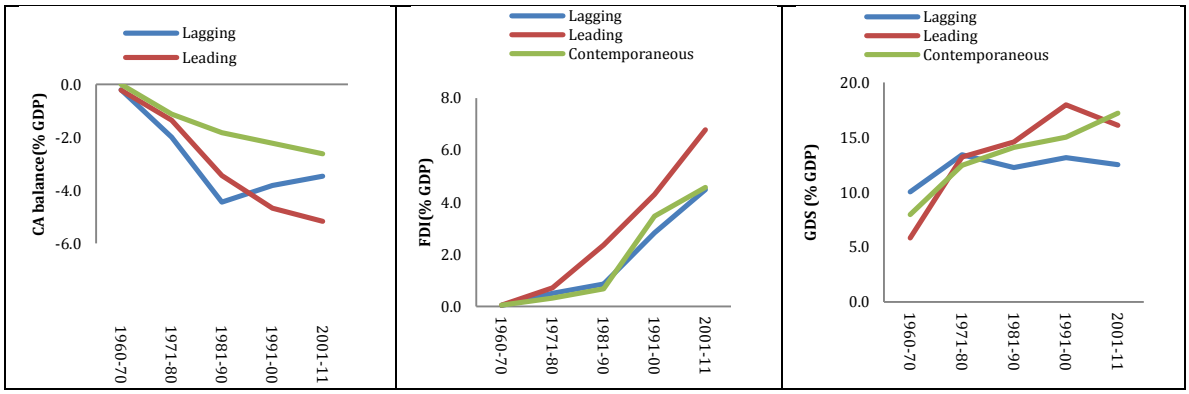


3. Financing Housing

Having examined patterns of housing investment, we now turn to examine the impacts of differences in financing capabilities of countries. A casual look at the data suggest that countries where housing investment leads urbanization have run larger current account deficits than countries where investment either lags or is synchronous with urbanization (figure 7). "Leading" countries show higher net inflows of FDI; in contrast, "lagging" countries show greater depletion of domestic savings.

Figure 7: Housing investment and macroeconomic performance

Current Account Balance (% GDP)	Net inflow of FDI (% of GDP)	Gross domestic savings (% GDP)



Data Source: Authors' calculation based on WDI data

To carefully examine a county's financing options in stepping up housing investment, we first examine the relationship between housing investment and gross domestic savings, current account balance, and domestic credit supply and government debt. The correlation between domestic savings, current account balance and investment works as an indicator of capital mobility.[6] Similarly, credit supply in a country provides an indication of the degree to which investment in housing can be leveraged.

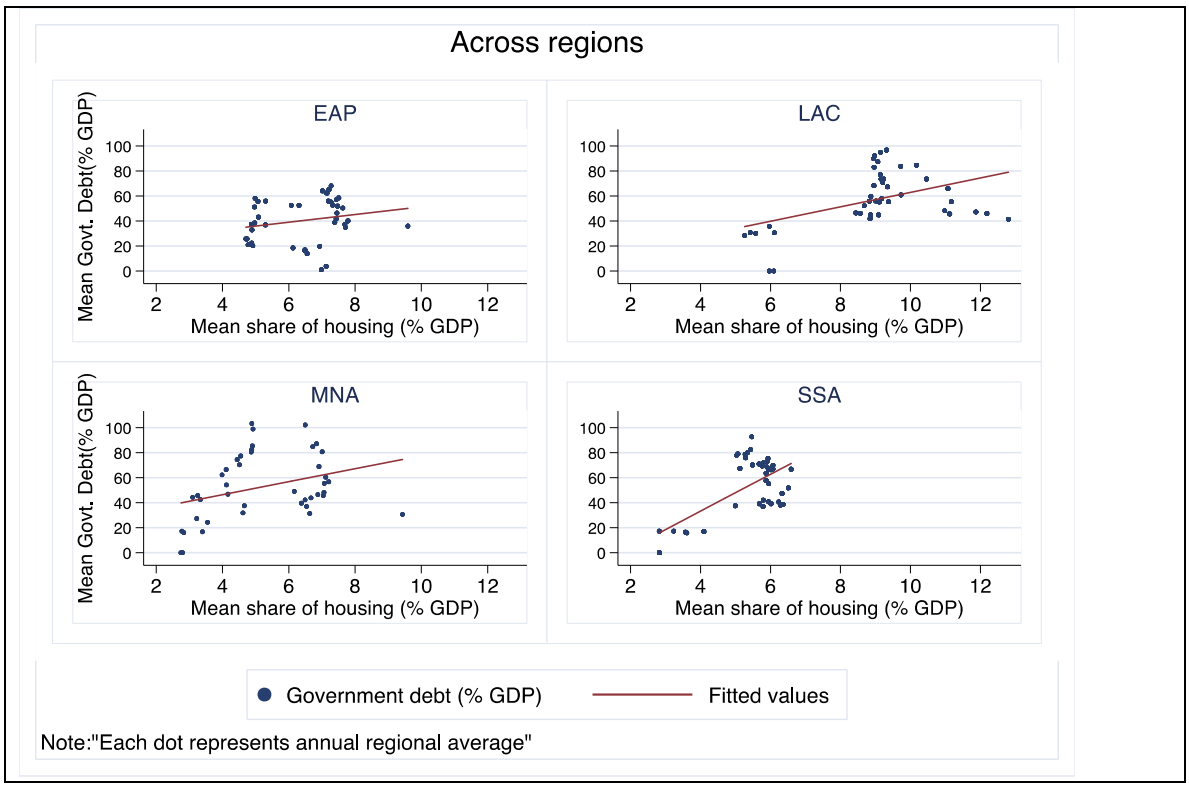
3.1 Tapping Debt and Equity

Figures 8 and 9 present the relationship between government debt and domestic credit supply with housing investment. To avoid cross country variations in price levels or inflationary dynamics, we convert each series to (percent) share in GDP. Also, to examine regional patterns, we take regional annual averages as a representative measure for all countries in a region.

While government debt can increase for many reasons, we argue that any sustained effort by the government to increase housing investment will increase government debt overall. Based on this assumption, we find that housing supply or investment has a positive relationship with government debt across regions. The relationship is much more pronounced for MNA and SSA followed by LAC and EAP.

[6] Current account balance=(Personal saving – investment)+(Tax- government expenditure)

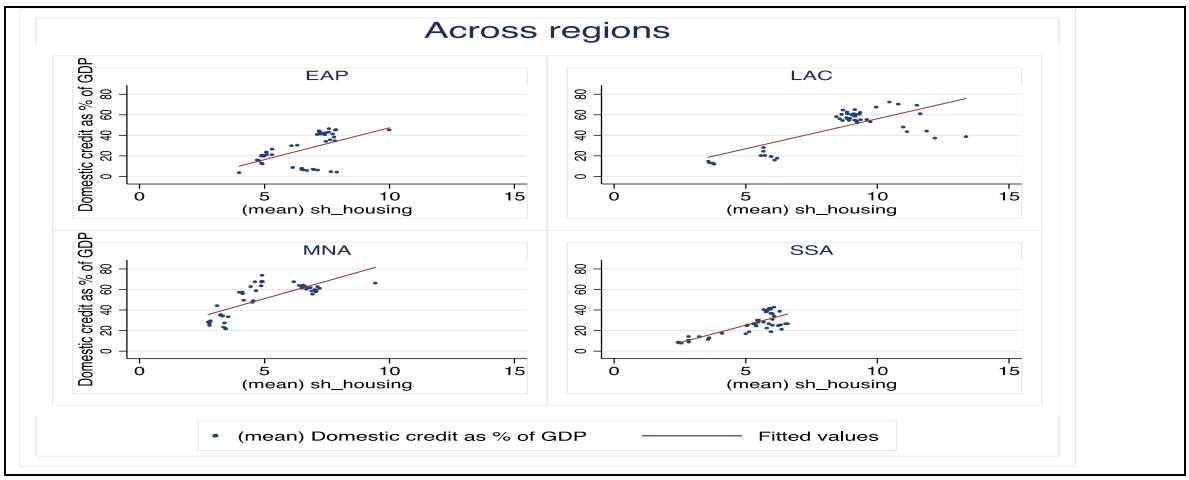
Figure 8: Government debt and housing supply (% of GDP)



Data Source: Authors' calculation based on WDI data

When stepping up housing investment, governments can either tap domestic public borrowing or tap international capital markets. To further explore the correlation between domestic borrowing and housing investment, we focus first on the domestic credit market that can be leveraged for financing housing investment. As expected, figure 9 shows a positive relationship between domestic credit and housing supply (both as % share of GDP) across regions. However, the important point here is the variation in credit supply. The figure suggests that among all regions, domestic credit, as a percent of GDP is even lower than 40 percent in SSA compared with around 50 percent in EAP and as high as 80 percent in MNA and LAC.

Figure 9: Domestic credit and housing supply



Data Source: Authors' calculation based on WDI data

3.2 Drivers of housing investment – estimation framework

We build on the descritive summaries presented in previous sections and use a panel of over 91 countries to examine the drivers of housing investment. On the demand side, we consider the following relationship:

$$H_t^D = f(u_t, a_t, i_t, y_t) \quad (1)$$

where, H_t^D represents demand for housing, u_t is urban growth. It captures natural growth of urban population, re-classification of rural settlements, and growth due to rural-urban migration. a_t represents agricultural push, i_t is the real interest rate in the economy, and $y_{t,}$ is aggregate income. Variation in real interest rate influences investment demand since lower interest rate reduces the prospects of capital gains from saving and induces investment.

On the supply side, we focus on funds from capital and financial markets. A well-developed capital market plays is important role in shaping a country's investment decisions through international capital mobilization (Sachs, 1981). Capital market development encompasses more than just foreign inflows to emerging markets. It also cultivates local investors' interest as a means of increasing the available investment sources within an economy (Applegarth, 2004). Levine (1996) points out that flourishing capital and financial markets create fluidity in the economy and accentuate private investment in assets. Countries with liquid capital markets

experience faster capital accumulation and higher productivity. The supply side equation depends on the following three identities:

$$GDP\ equation: \quad Y_t \equiv C_t + I_t + G_t + (X_t - M_t) \tag{2a}$$
$$Net\ inflow\ of\ Funds: \quad NFI_t \equiv (X_t - M_t) \tag{2b}$$
$$Current\ reserve\ assets: \quad CRA_t \equiv CA_t + NFI_t \tag{2c}$$

where, Y_t is total output in the economy or GDP, C_t is aggregate consumption, I_t is total investment, G_t is government expenditure in period t while $(X_t - M_t)$ is net export or net inflow of funds, NFI in period t. The terms CRA and CA stand for current reserve assets and curent account balance respectively. Rearranging equations (2a-2c) we get

$$\left[1 - \frac{C_t}{Y_t} - \frac{G_t}{Y_t}\right] = \frac{S_t}{Y_t} = \frac{I_t}{Y_t} + \left[\frac{CRA_t}{Y_t} - \frac{CA_t}{Y_t}\right] \tag{3}$$

Or, we can rewrite equation (3) as – $\frac{I_t}{Y_t} = f\left(\frac{S_t}{Y_t}, \frac{G_t}{Y_t}, \frac{CRA_t}{Y_t}, \frac{CA_t}{Y_t}\right)$ given that the signs of the equations will be determined from the relative position of each component for a country as compared to others. Now, housing investment, being part of total investment, will also be dependent on these factors contingent upon the demand side pressure from urbanization. Conditional on demand (equation 1), the supply equation can be written as –

$$\frac{H_t}{Y_t} = f\left(\frac{S_t}{Y_t}, \frac{CRA_t}{Y_t}, \frac{CA_t}{Y_t}\right) | H_t^D$$
$$\text{or, } \frac{H_t}{Y_t} = f\left(\frac{S_t}{Y_t}, \frac{CRA_t}{Y_t}, \frac{CA_t}{Y_t}; u_t, a_t, i_t\right) \tag{4}$$

To choose the estimation strategy, we ran the following standard tests. First, we use the *Hausman test* to find out the appropriateness of the fixed or random-effects models. With the standard null hypothesis that differences in coefficients are not systematic, the difference between fixed and random effect specification of the same model rejects the null hypothesis (with $\aleph^2$ =28.69 and $|prob|$>$\aleph^2$=0.000) and points us to use a random effect model. We also run the Breusch and Pagan Lagrange multiplier test for random effects with the hypothesis that the Var(u) = 0. The test statistics ($\overline{\aleph}^2$ = 9218.4 and $|prob| > \overline{\aleph}^2$= 0.000), reject the null hypothesis and direct us to choose a random effects model.

To identify whether there is any effect of group-wise heteroskedasticity, we test the modified Wald statistics. The null hypothesis we tested is H0: $\sigma_i^2 = \sigma^2\ for \forall\ i$. We reject the null

hypothesis based on the test statistics $|prob| > \aleph^2$=0.000. The test results suggest the presence of heteroskedasticity.

A standard assumption in panel-data models is that the error terms are independent across cross sections. This assumption is used for identification purposes rather than descriptive accuracy. We test for cross-sectional dependence following Pesaran (2004). Pesaran's statistic follows a standard normal distribution and can be applied to balanced and unbalanced panels. Pesaran's test of cross sectional independence identifies the existence of cross sectional dependence ($\sigma_u^2 =$ 3.9 and $\sigma_i^2 = 1.48$. The fraction of variance is due to u_i, $\rho = 0.87$) in our data.

We also test for serial correlation in the idiosyncratic errors of a linear panel-data model discussed by Wooldridge (2002). Drukker (2003) presents evidence based on simulations that this test has good size and power properties in reasonable sample sizes. Under the null hypothesis of no serial correlation of the residuals from the regression with the first-differenced variables, our panel data shows the existence of autocorrelation (F(1, 88) = 16.48, $|prob| > F$=0.000). The above test suggests the presence of serial correlation within the series.

Another concern of using panel data is the presence of missing values. One way to deal with it is to delete these observation. However, this can lead to biased estimates and may either reduce or exaggerate statistical power. Each of these distortions can lead to invalid conclusions (Acock, 2005). Baltagi and Wu (1999) propose a feasible generalized least squares procedure as a weighted least squares alternative to handle a wide range of unequally spaced panel data patterns. According to the authors, this procedure is simple to compute and provides natural estimates of the serial correlation and variance components parameters.

Based on the above discussion and test statistics, we use panel Feasible Generalized Least Square (*FGLS*) as the basis of our estimation strategy.[7] Hansen (2007) points out that clustering and policy autocorrelation occur in many cases when using panel data for over a long time period. The clustering problem is caused by the presence of a common unobserved random shock at the group level that will lead to correlation between all observations within each group. The policy autocorrelation problem, on the other hand, arises if the groups are followed over a long time and

[7] The use of long panel makes the empirical model vulnerable to (i) unbalanced panel with unevenly spaced data, (ii) heteroskedasticity, (iii) multicollinearity and (iv) auto correlation.

the group level shocks are serially correlated, which will result in correlation between individuals from the same group at different time periods. In general, ignoring these correlations will bias conventional estimates and will lead to misleading inference.

There are a number of methods for dealing with this problem. The most common approach is estimating a linear model with ordinary least squares (*OLS*) and then correcting the standard errors for the intra-cluster correlation (see Moulton, 1986; Arellano, 1987 among others). The alternative method is Feasible Generalized Least Squares (*FGLS*) estimation that asymptotically results in a more efficient estimator and more powerful tests than *OLS* (Hansen, 2007). The *FGLS* weighs the observations according to the square root of their variances. It is an estimation technique that is efficient in the presence of heteroskedasticity and serial auto correlation and can be applied to the linearized model.

We chose the following *Feasible Generalized Least Squares* (FGLS) model:

$$\frac{H_t}{Y_t} = h_t = \alpha + \sum_{t=1960}^{2011} \beta_j x_{jt}^c + \sum_{t=1960}^{2011} \beta_l Z_{lt}^c + \sum_{t=1960}^{2011} \beta_k D_{kt}^c + \varepsilon_t \quad (5)$$

Where, $\beta_{i,(FGLS)} = (x_i' \hat{\omega}^{-1} x_i)^{-1} x_i' \hat{\omega}^{-1} h_i$ (5a)

Where, the dependent variable $\frac{H_t}{Y_t}$ is share of housing investment in GDP. The information is reported as investment as a component of the production side accounting of GDP in National Accounts Statistics. The vector, X_{jt}^c represents the depth of capital markets. We include share of gross domestic savings, current account balance, central government debt, portfolio investments in bonds and equity, inflow of FDI. To capture the strength of the domestic capital market we also include ratio of domestic credit to GDP. It provides an illustration of the extent to which local savings are being mobilized effectively.

The cost of finance, the real interest rate, can also be indicative of financial market performance. The real interest rate reflects relative inefficiencies in banking infrastructure, and possibly the attractiveness of other investment opportunities that reduce bank incentives to lend (Applegarth, 2004). In this work we use real interest rates indexed with the consumer price index.

D_{kt}^c includes macroeconomic indicators from the real sector viz. cyclical fluctuation of GDP. We use Hodrick-Prescott filter to decompose cyclical variation in GDP from trend. The vector Z_{lt}^c

captures demand side factors such as, urban growth, and the share of agriculture and industry in GDP. All these indicators are published by the World Bank under the World Development Indicators.

The term $\hat{\omega}$ in equation (5a) is the estimated weighting matrix. One of the advantages *FGLS* is that it provides consistent estimates even if the weights used in the estimation are biased. In case of even an unknown form of heteroskedasticity, *FGLS* can be applied. Another advantage of *FGLS* model over even *GLS* is that it addresses of *multicollinearity* issues in a model since it uses the estimated covariance matrix, $\hat{\omega}$ instead ofω.

3.3 Main differences in housing investment - developing economies and the OECD

The evidence clearly shows an inverse relationship between the current account balance (deficits) and housing investment in OECD countries. Table 4 presents our empirical findings. They suggest that OECD countries have made use of foreign investments in expanding housing investment. The use of foreign investment to step up housing helped these countries strengthen their financial portfolios. However for developing countries (columns 1 and 2), domestic savings are the mainstay of housing investment – these are depleted as housing investment is stepped up. Neither the current account balance, nor investments in bond and equity have significant association with housing investment in developing economies. SSA follows the same pattern found in average for developing countries with domestic savings being depleted as housing investment is stepped up (Table 5).

Table 4: Results for low, middle and high income countries

VARIABLES	(1) Low and lower middle income	(2) Upper middle income	(3) High income (OECD)
Domestic savings(% of GDP)	-0.0118***	-0.0300***	0.0297**
	(0.00339)	(0.00598)	(0.0149)
Current Account balance (% of GDP)	0.00313	0.00896*	-0.0621***
	(0.00323)	(0.00515)	(0.0133)
Investment in bond and equity (% GDP)	0.00380	0.00389	-4.04e-05
	(0.0149)	(0.00359)	(0.00111)
Cyclical component of GDP growth	-0.0157***	-0.0595***	0.0155

	(0.00467)	(0.00725)	(0.0166)
Real interest rate (%)	-0.00257**	-0.00289	0.0156*
	(0.00130)	(0.00201)	(0.00805)
Net inflow of FDI (% GDP)	0.000743	-0.00128	-0.000616
	(0.00564)	(0.00166)	(0.00329)
Government debt (% GDP)	0.000842	0.00534***	-0.00284**
	(0.000795)	(0.00191)	(0.00141)
Domestic credit (% GDP)	-0.00190	-0.00220	-0.000799
	(0.00163)	(0.00156)	(0.00109)
Urban population growth	0.0280	-0.0460	0.0790
	(0.0296)	(0.0608)	(0.0786)
Agriculture value added	-0.0251***	0.0214*	0.0657**
	(0.00484)	(0.0114)	(0.0323)
Dummy for legal strength	0.226	-0.735**	-0.248
	(0.171)	(0.286)	(0.593)
Countries leading in housing investment	-2.019***	2.192***	-2.837***
	(0.551)	(0.438)	(0.509)
Countries contemporaneous in housing investment	1.250***	0.293	-1.943***
	(0.476)	(0.402)	(0.590)
Countries where no clear relation	-2.311***	2.372***	-0.371
	(0.635)	(0.518)	(0.980)
Region Dummies: Europe and Central Asia	-6.222***	4.186***	
	(0.581)	(0.815)	
Region dummy: Latin America and Caribbean	-5.054***	5.947***	
	(0.288)	(0.468)	
Region dummy: Middle East and North Africa	-5.303***	7.588***	
	(0.362)	(0.876)	
Region dummy: Sub-Saharan Africa	-4.109***	0.292	
	(0.439)	(0.503)	
Constant	9.302***	4.215***	6.574***
	(0.516)	(0.636)	(0.850)
Observations	965	736	925
Number of countrycode1	34	26	31

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

Table 5: Results for SSA and by income group

VARIABLES	(1) Low and lower middle income	(2) Upper middle income	(3) All SSA
Domestic savings(% of GDP)	-0.0290***	-0.0411*	-0.0249***
	(0.00741)	(0.0211)	(0.00590)
Current Account balance (% of GDP)	0.00616	-0.0166	0.00527
	(0.00826)	(0.0192)	(0.00573)
Investment in bond and equity (% GDP)	-0.0148	0.00663	0.00424

	(0.262)	(0.00573)	(0.00375)
Cyclical component of GDP growth	-0.0513***	-0.0637*	-0.0370***
	(0.0104)	(0.0343)	(0.00779)
Real interest rate (%)	0.00272	-0.0142	-0.000229
	(0.00482)	(0.0149)	(0.00393)
Net inflow of FDI (% GDP)	0.0296*	0.0460	0.0203
	(0.0174)	(0.0391)	(0.0136)
Government debt (% GDP)	0.00239	0.0159**	0.00684***
	(0.00215)	(0.00798)	(0.00201)
Domestic credit (% GDP)	-0.0231***	0.00947*	-0.00584*
	(0.00525)	(0.00536)	(0.00303)
Urban population growth	0.188***	-0.791***	0.109**
	(0.0582)	(0.214)	(0.0481)
Agriculture value added	-0.0540***	0.0802**	-0.0247***
	(0.00935)	(0.0334)	(0.00866)
Dummy for legal strength	0.347	3.172**	0.549*
	(0.262)	(1.378)	(0.291)
Countries leading in housing investment	1.007	-1.004	3.304***
	(0.887)	(1.084)	(0.952)
Countries contemporaneous in housing investment	-1.426		-0.0767
	(0.990)		(0.869)
Countries where no clear relation	4.053***		2.919***
	(1.193)		(1.003)
Constant	6.783***	5.706***	5.276***
	(0.764)	(1.126)	(0.876)
Observations	359	115	474
Number of countrycode1	13	4	17

Standard errors in parentheses

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

The evidence here corroborates findings of earlier studies for OECD countries showing that high international capital mobility helped step up investment in housing (Feldstein and Horioka (1980); Sachs (1981)). However, there is no existing evidence for developing countries, and this analysis makes a new contribution. The evidence clearly suggests that in the absence of internationally mobile capital and the depletion of domestic savings lies at the core of housing investment in low and middle-income countries. SSA follows the same pattern found in average for developing countries.

The degree of macroeconomic stability, such as short term cyclical fluctuations in GDP growth is used in the analysis to control for country specific variations in the economic environment. Our results also show that housing investment in developing countries is significantly affected by adverse cyclical fluctuations in GDP growth. This suggests that performance of the economy in the short run plays an important role in (dis) investment decisions of the government, households, and other private sector entities in the housing sector across developing countries. Further, on one hand there is a positive and significant relationship between housing investment and government debt for developing countries, in particular for those in the upper middle income bracket. On the other hand, this relationship is negative for OECD countries. With rapid urbanization in developing countries, overdependence on government for housing investment may present a challenge.

The extent of domestic credit identifies the effectiveness of monetary policy. It also shows the level of competitiveness in the banking sector to use credit as a lever for increasing housing investment. The evidence in our results however suggests no significant influence of credit supply on housing investment.

4. Implications of Alternate Approaches to Finance Housing Investment

How a country finances housing investment has a bearing on its development outcomes. The evidence from our regression analysis shows that the OECD countries leveraged foreign savings without depleting savings to finance housing investment. As a result, domestic savings grew. Recall from our analysis on "leading" and "lagging" housing response that housing supply in most OECD countries is either contemporaneous or leads urbanization. By contrast, the same regression analysis shows that developing countries significantly deplete their savings and use government debt to step up investment in housing. Again, the "leading" and "lagging" analysis shows that housing investment lags urbanization in most developing countries.

In reality however, the relationship becomes much more complex due to the interaction of fiscal and monetary policies. To keep up with increasing demand, when governments step up housing supply through public investment, many potential scenarios may arise based on the way money supply, interest rate and GDP interact. Domestic credit is the main vehicle through which changes

in money supply are regulated, with central bank lending to the government often playing the most important role (Mankiw, 2000). Suppose that investment is to be leveraged through credit or other debt channels to comply with demand. The central bank can regulate lending to the private sector in several ways –for example, by adjusting the cost of the refinancing facilities, by changing market interest rates through open market operations, or by controlling the availability of credit through changes in the reserve requirements imposed on banks and ceilings on the credit provided by banks to the private sector.

Now if the monetary authority regulates money supply in the economy (e.g., credit supply decreases) then it will increase the interest rate. Higher interest rates and lack of money in the economy will lead to a decline in aggregate income which may potentially create a vulnerable middle class.

Lower disposable incomes, particularly for the middle class, exacerbates the problem of insufficient funds to invest. And as a result, actual investment will lag required (planned) investment. Since, we assume in the beginning that urbanization is the cause behind increasing demand this dynamic will create a situation when investment in housing will lag urbanization. Or, alternatively, households will make a trade-off between investment in housing with other expenditures such as consumption. This is however an empirical question. We now examine if there are any such trade-offs between housing investment and aggregate household consumption.

4.1 Short-run consumption trade-offs

The following empirical strategy provides robust empirical support to establish the trade-off between housing investment and aggregate consumption. We use an error correction model to find the causal relationship between these two time series. Error Correction Models (ECMs) are a category of multiple time series models that directly estimate the speed at which a dependent variable returns to equilibrium after a change in independent variable. Say for example, housing investments made by a household at any point will create an adverse shock to its consumption pattern because of binding budget constraint. Over that period of time, the household may or may not overcome this shock in consumption. Error correction models measure the speed at which household return (or not) to its original consumption schedule. The main advantage of ECMs is that it is useful for estimating both short term and long term effects of one time series on another.

ECM is theory driven approach to estimating integrated data, but can also be used with stationary data.

We use panel cointegration tests developed by Westerlund (2007). The underlying idea is to test for the absence of cointegration by determining whether there exists error correction for individual panel member countries or for the panel as a whole. Following Westerlund (2007), we consider the following error correction model, where all variables in levels are assumed to be I(1):

$$\Delta C_{it} = \partial_i' d_t \quad + \sum_{j=1}^{n} a_{ij}.\Delta C_{it-j} + \sum_{j=1}^{n} b_{ij}.\Delta H_{it-j} + a_i\left(C_{it-j} - b_{ij}H_{it-j}\right)$$

where, $[\Delta. C_{it}]$ and $[\Delta. H_{it}]$ indicate first differences in consumption and housing of ith country between period t and t-1. The term d_t generates the trend components and the constant. The terms a_i provides an estimate of the speed of error-correction towards the long run equilibrium C_{it} = -(b_{ij}/a_i) * H_{it} for that series i. The methodology used by Westerlund provides four test statistics, Ga, Gt, Pa and Pt. Ga and Gt tests the null hypothesis that H0: $a_{ij} = 0$ vs. $a_{ij} < 0$ for at least one country. The other two test statistics, Pa and Pt test pool information over all the cross-sectional units to test H0: $a_{ij} = 0$ Vs. $a_{ij} < 0$ for all countries. Rejection of H0 should therefore be taken as evidence of cointegration for the panel as a whole. All 4 test statistics provide information of cointegration between consumption and housing investment at individual country as well as the region as a whole. We used 2 lags to comply with Average AIC selected lag length[8].

Table 6 shows the evidence of trade-offs between housing investment and aggregate consumption expenditures. There is no evidence of a long term relationship across income groups but there is a short run adjustment for all income groups. And this result is significant.

Table 6: Estimated long run trend and short run adjustment across income groups

	LICs and LMICs	UMICs	HICs
Estimated long-run relationship			
Share of housing in GDP	-1.05	1.12	-0.51
Constant	178.86	-511.45	147.51

[8] Aggregate household consumption data is available since 1960 for most of the countries. However, for some countries the series contains missing values. We extrapolated these missing values based on the share of consumption in the nearest years.

Long term trend	-0.05	0.28	-0.04
Short run adjustment	-0.46***	-0.51***	-0.41***

5. Summary

The empirical research on urbanization, housing, and economic development highlights that investment in housing follows an S-shaped trajectory with housing investment taking off around national development levels of about $3,000 (2005 USD). Given rapid urbanization at lower income levels across countries in Africa and parts of Asia, urbanization will be a messy process where population density in cities may not be supported by the necessary capital investments.

The urgent priority for public policy is to strengthen the institutions for urban planning and service delivery to ensure that planning for land use integrates future investments in housing, industry, and infrastructure, and access to basic services is expanded to maintain urban livability. Urban planning early on will also help in preparing for 'orderly' urban development when capital investment steps up.

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Annex 1: Ranking of Housing Elasticities

Ranking of countries based on decadal average of Elasticity of housing supply to urban growth

		1970-1980		1980-90		1990-00		2001=2011	
Country name	Region	Elasticity of housing supply to urban growth	Ranking	Elasticity of housing supply to urban growth	Ranking	Elasticity of housing supply to urban growth	Ranking	Elasticity of housing supply to urban growth	Ranking
Mauritius	SSA	8.6	2	-3.3	49.0	5.3	21	22.0	1
Iran, Islamic Rep.	MNA	5.0	7	0.6	35	5.9	19	17.7	2
Sweden	OECD	4.0	12	2.5	12	17.4	3	16.2	3
Tajikistan	ECA							15.9	4
Guyana	LAC	-3.7	32	-14.4	53	-22.7	77	14.5	5
Jamaica	LAC					14.4	5	12.7	6
Mozambique	SSA					-0.5	60	11.8	7
Montenegro	ECA							11.1	8
Morocco	MNA	2.2	23	0.7	32	2.1	34	10.6	9
Madagascar	SSA			0.9	27	1.3	40	9.5	10
United Kingdom	OECD			-11.3	52	-1.7	68	9.2	11
Mongolia	EAP					-9.2	76	8.7	12
Kiribati	EAP					3.8	25	8.4	13
Tuvalu	EAP							8.1	14
China	EAP	0.7	26	1.8	16	3.1	28	8.1	15
Eritrea	SSA					-0.8	63	8.0	16
Venezuela, RB	LAC			-2.8	48	6.2	16	7.5	17
Senegal	SSA			0.9	28	-0.2	56	6.9	18
Peru	LAC					0.3	51	6.9	19
Denmark	OECD			1.8	17	10.3	9	6.6	20
Palau	EAP					0.2	53	6.4	21
Belize	LAC	4.0	13	3.5	9	1.8	37	6.4	22
Brazil	LAC					6.0	18	6.3	23
Egypt, Arab Rep.	MNA	2.4	22	0.8	30	3.6	26	6.2	24
Germany	OECD			4.5	6	18.1	2	6.0	25
Canada	OECD	3.5	17	3.9	8	-0.3	57	5.9	26
Tonga	EAP					-4.5	73	5.9	27
Turkey	ECA					8.6	10	5.6	28
Finland	OECD	0.6	28	3.0	11	5.9	20	5.6	29
Chile	LAC	4.6	9	-3.3	50	8.4	12	5.6	30
Indonesia	EAP	3.8	14	1.1	23	0.8	49	5.4	31
South Africa	SSA	2.8	19	-1.3	44	-0.6	61	5.4	32
Belgium	OECD					-0.7	62	5.3	33
Switzerland	OECD					-6.0	74	5.3	34
Norway	OECD	4.4	11	0.9	24	3.9	24	5.0	35
Antigua and Barbuda	LAC	-14.2	33	-5.0	51	10.6	8	4.8	36
Philippines	EAP	1.1	25	0.1	37	4.5	22	4.8	37
Yemen, Rep.	MNA					0.9	48	4.6	38
Ethiopia	SSA			0.6	34	-1.1	66	4.5	39
Cambodia	EAP					-0.3	58	4.3	40
Luxembourg	OECD					0.2	52	4.1	41
Korea, Rep.	OECD	3.0	18	4.5	7	2.2	33	4.1	42
Cape Verde	SSA			0.8	31	0.0	55	4.1	43
Vanuatu	EAP			0.9	26	1.0	45	3.8	44
St. Kitts and Nevis	LAC	21.5	1	-2.3	47	15.0	4	3.2	45
Hungary	OECD					-6.4	75	2.9	46
Italy	OECD	2.5	21			-1.0	65	2.8	47
Argentina	LAC					1.2	41	2.6	48
Australia	OECD	5.3	6	1.4	20	3.2	27	2.6	49
Dominican Republic	LAC			-1.2	43	6.6	15	2.5	50
St. Vincent and the Grenadines	LAC	3.7	15	0.8	29			2.5	51

Ghana	SSA							2.4	52
Namibia	SSA					1.1	44	2.2	53
Rwanda	SSA					-0.8	64	2.2	54
Honduras	LAC	0.5	29	0.1	36	1.4	39	2.2	55
Lesotho	SSA			-1.5	46	1.9	35	2.2	56
France	OECD	4.9	8	-0.8	42	0.3	50	1.8	57
Israel	OECD	6.1	4	-0.3	40	1.0	46	1.7	58
Bolivia	LAC			-1.4	45	-0.3	59	1.6	59
Lao PDR	EAP			6.6	3	1.8	36	1.6	60
Grenada	LAC	-2.4	31	0.6	33			1.6	61
Togo	SSA							1.5	62
Jordan	MNA					1.1	43	1.4	63
Kenya	SSA			0.1	38	-1.2	67	1.2	64
Panama	LAC					-2.3	71	1.2	65
Gambia, The	SSA							0.9	66
Paraguay	LAC	3.6	16	0.9	25			0.8	67
Netherlands	OECD			0.0	39	2.7	30	0.6	68
Austria	OECD			2.0	15	6.1	17	-0.2	69
St. Lucia	LAC			2.1	13			-0.2	70
Thailand	EAP	0.7	27	1.7	18	2.3	32	-0.4	71
New Zealand	OECD	-1.9	30	6.2	4	4.0	23	-1.0	72
Japan	OECD			6.1	5	-3.4	72	-2.8	73
Dominica	LAC	2.8	20	1.2	22	-56.2	78	-2.9	74
United States	OECD	4.5	10	3.0	10	3.1	29	-3.0	75
Spain	OECD							-3.6	76
Samoa	EAP					1.0	47	-3.7	77
Swaziland	SSA			1.3	21	8.5	11	-5.4	78
Portugal	OECD	7.7	3	2.1	14	2.3	31	-6.0	79
Greece	OECD	6.0	5	1.4	19	-2.0	69	-7.2	80
Ireland	OECD					13.6	6	-7.4	81
Slovak Republic	OECD							-28.2	82
Georgia	ECA					0.1	54		
Armenia	ECA								
Kyrgyz Republic	ECA					19.6	1		
Czech Republic	OECD					1.6	38		
Estonia	OECD					-2.2	70		
Iceland	OECD					1.1	42		
Poland	OECD								
Slovenia	OECD								
Uruguay	LAC			8.3	2	12.9	7		
Seychelles	SSA			28.3	1				
Tanzania	SSA					6.9	14		
Uganda	SSA	1.7	24	-0.5	41	7.4	13		

Note: Housing supply elasticity to urban growth is calculated as the ratio of % change in housing supply to urban growth.

Annex 2: Housing investment and urbanization -- Lead, lags or synchronous

Ranking of countries based on lead, lag or contemporaneous growth in housing supply

Region	Country name	Lead or lag	Ranking (1960-2011)
Countries with lead in growth in housing supply			
Latin America & Caribbean	St. Kitts and Nevis	10	1
Latin America & Caribbean	St. Lucia	10	1
Latin America & Caribbean	Antigua and Barbuda	10	1
Latin America & Caribbean	Grenada	10	1
High income: OECD	Canada	10	1
Latin America & Caribbean	St. Vincent and the Grenadines	10	1
High income: OECD	Austria	8	2
High income: OECD	Australia	8	2
Sub-Saharan Africa	Mauritius	7	3
Sub-Saharan Africa	Lesotho	7	3
High income: OECD	United Kingdom	6	4
High income: OECD	France	5	5
High income: OECD	Denmark	5	5
High income: OECD	Netherlands	4	6
Sub-Saharan Africa	Kenya	4	6
High income: OECD	Italy	3	7
High income: OECD	Luxembourg	3	7
High income: OECD	Belgium	3	7
Sub-Saharan Africa	Cape Verde	3	7
High income: OECD	Japan	2	8
High income: OECD	Poland	1	9
East Asia & Pacific	Samoa	1	9
Countries with contemporaneous growth in housing supply			
High income: OECD	Estonia	0	10
High income: OECD	Ireland	0	10
Sub-Saharan Africa	Rwanda	0	10
Sub-Saharan Africa	Eritrea	0	10
East Asia & Pacific	Vanuatu	0	10
High income: OECD	United States	0	10
High income: OECD	Germany	0	10
Latin America & Caribbean	Bolivia	0	10
Latin America & Caribbean	Chile	0	10
East Asia & Pacific	China	0	10
Latin America & Caribbean	Belize	0	10
High income: OECD	Slovenia	0	10
East Asia & Pacific	Palau	0	10
East Asia & Pacific	Tonga	0	10
High income: OECD	Portugal	0	10
Middle East & North Africa	Yemen, Rep.	0	10
High income: OECD	Slovak Republic	0	10
Sub-Saharan Africa	Senegal	0	10

Latin America & Caribbean	Peru	0	10
East Asia & Pacific	Cambodia	0	10
High income: OECD	Switzerland	0	10
High income: OECD	Hungary	0	10
High income: OECD	Iceland	0	10
Latin America & Caribbean	Panama	0	10
Latin America & Caribbean	Honduras	0	10
Latin America & Caribbean	Venezuela, RB	0	10
High income: OECD	Finland	0	10
High income: OECD	Greece	0	10
Countries with lag in growth in housing supply			
Europe & Central Asia	Armenia	-1	11
Sub-Saharan Africa	Togo	-1	11
Latin America & Caribbean	Jamaica	-1	11
Sub-Saharan Africa	Ethiopia	-2	12
East Asia & Pacific	Philippines	-2	13
High income: OECD	Spain	-2	12
Europe & Central Asia	Georgia	-2	12
High income: OECD	Sweden	-2	12
Sub-Saharan Africa	Madagascar	-2	12
Europe & Central Asia	Turkey	-3	13
High income: OECD	New Zealand	-3	13
East Asia & Pacific	Mongolia	-3	13
Europe & Central Asia	Tajikistan	-3	13
Middle East & North Africa	Morocco	-4	14
High income: OECD	Israel	-4	14
Latin America & Caribbean	Brazil	-4	15
High income: OECD	Korea, Rep.	-5	16
East Asia & Pacific	Kiribati	-5	16
Latin America & Caribbean	Argentina	-5	16
Europe & Central Asia	Kyrgyz Republic	-5	16
Latin America & Caribbean	Dominica	-5	16
Middle East & North Africa	Jordan	-6	17
High income: OECD	Norway	-7	18
Sub-Saharan Africa	Uganda	-7	18
Sub-Saharan Africa	Swaziland	-9	19
Latin America & Caribbean	Guyana	-9	19
Latin America & Caribbean	Dominican Republic	-10	20
Countries with no clear trend			
East Asia & Pacific	Thailand		
East Asia & Pacific	Lao PDR		
Sub-Saharan Africa	Tanzania		
Middle East & North Africa	Egypt, Arab Rep.		
Sub-Saharan Africa	Seychelles		
Sub-Saharan Africa	Gambia, The		
East Asia & Pacific	Indonesia		
Sub-Saharan Africa	Ghana		

Middle East & North Africa	Iran, Islamic Rep.
East Asia & Pacific	Tuvalu
Latin America & Caribbean	Paraguay
High income: OECD	Czech Republic
Europe & Central Asia	Montenegro
Sub-Saharan Africa	Mozambique
Latin America & Caribbean	Uruguay
Sub-Saharan Africa	Namibia
Sub-Saharan Africa	South Africa

Note : Countries with no clear trends means that the cross correlation between urbanization and growth in housing supply is close to zero due to erratic pattern.