Comparison of Different Methods of Constructing Housing Start Index in the Philippines

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We investigate three methods of constructing housing start index with a fixed base year. In the Philippines, researchers and planners use data on building permits to monitor construction sites where economic activities are expected to follow. Suppliers of construction materials such as cement, lumber, steel, among others, rely on these data for planning purposes. Other businesses like banks and food chains also use these data as proximate indicators of supply and demand for investment.

A mixed model, accounting the empirical relations between the index and other economic indicators they usually lead, is used in the assessment of the index resulting from three different methods. There is a strong space-time association between the index and other indicators, confirming the relationship between the economic boom and housing start index. Likewise, there is evidence that the index is capable of leading some key economic indicators.

***Keywords**: housing start index, leading indicators, mixed models*

1. Introduction

The construction sector is a vital element for the development of any nation. In a developing country like the Philippines, construction industry has served as a catalyst for economic growth through the provision of avenues for additional employment, better standard of living, and easing up of the housing shortage (Alcaraz and Ngo, 1990). Construction activity constitutes a significant share of the economies in other countries both in terms of its contribution to gross domestic product (GDP) and total employment.

The United Nation defines construction as comprising "economic activities directed to the creation, renovation, repair or extension of fixed assets in the form of buildings, land improvements of an engineering nature, and other such engineering constructions such as roads, bridges, dams and so forth." Construction activity is volatile and highly sensitive to movements in overall business activity and the business cycle. It serves to complement other sectors since it absorbs materials and products produced by other sectors like manufacturing. Thus, construction statistics are key economic indicators that are monitored closely by analysts in government and the private sector. The government is also concerned with the access to a decent living by its citizen that necessitates the monitoring of the growth of construction industry, specifically, those of housing in nature. Housing/building construction statistics provide an indicator of the construction activity happening in an area among many other inter-related indicators.

Housing start is identified as one of the leading economic indicators in the United States of America and other countries. Real estate and non–real estate-related businesses use housing start forecasts as indicators of expected market dynamics and general business conditions. Fullerton et al. (2000) pointed out that a real estate developer monitors projections of housing starts when allocating resources for speculative building activities in anticipation of actual contract negotiations with prospective buyers. Retail chain stores selling materials, furnishings, and home appliances subscribe to regional housing forecast reports to ensure that they have appropriate staff and inventory levels. Public utilities use these forecasts to plan for additional capacity such as water and electric distribution substations. Consulting firms also use metropolitan housing activity projections to develop growth management plans for local government entities and to prepare supporting documentation for builders seeking loan approvals from financial institutions. Finally, national economic forecasts compare their own housing model extrapolations with regional market projections that more accurately simulate the impact associated with domestic migration flows.

Direct estimates of housing starts are currently not available from the construction statistics generated by the National Statistics Office (NSO) of the Philippines. NSO generates data on construction statistics from approved building permits that cover all municipalities and cities issuing building permits for the construction of residential and nonresidential structures, addition, alterations and repairs, demolition, landscaping, and putting up of signboards. Researchers and planners use these data to look at construction activity happening in an area, or monitor where there is more construction being put up. Suppliers of construction materials such as cement, lumber, steel rely on these data for future investment. Other businesses like banks and food chains also use these data to look at levels and direction of investment in the country. It also serve as a basis of estimates of the level of construction activity useful in the computation of national income accounts.

This paper propose to construct and characterize the housing start index in the Philippines using the data from the building permits issued by local governments. The index will be based on the number of residential building permits that have been issued for construction of new houses. This will track how many new residential houses or buildings were constructed throughout the month in an area, particularly the municipalities. The seasonality of the construction industry is very prominent (affected by weather conditions) hence, analysis of such will generate informative insights for planning purposes.

The housing start index is important not only because it serves as a leading indicator of overall economic growth, but also in other more specific indicators like job-generation, consumer spending, and expanded production of construction materials and equipments. According to the Department of Commerce, US Bureau of Census, building permits do not always mean a new house is going to be built, actual construction of the house can take several months after the permit was approved. In the Philippines, there are houses built without an approved building permit. These cases are not covered by the issuance of building permit and there is no way that the government or data gatherer can take measure to monitor such activity.

The data from the NSO include new residential constructions regardless of the number of housing units the residence will be made of. For instance, unlike in housing starts, a four-door apartment is counted only as one residential building construction. A separate estimate for each housing start is not available and cannot be derived for residential constructions involving two or more housing units. Direct housing starts indicator can be generated only for residential constructions involving single houses. This paper will focus on the National Capital Region (NCR) and Region 1, representing highly urban and relatively rural areas, respectively.

2. Related Studies

Indicators are used to measure current conditions as well as a means to track trends. Indicators that quantify current economic and industry conditions are used to provide insights into the future. Index number is a device used to compare relative movement in the magnitude of a variable or group of distinct but related variables between two or more points in time (PSA, 1991). Index number also shows the relative differences in the magnitude of a variable or group of variables obtained at the same period of time in different areas. It is expressed in percentage form and its unit of measure is percentage point. The base of comparison is taken as 100, facilitating measure of change or difference relative to the base.

In the absence of a variable that lends comparison over time, many economic indicators are measured in the form of an index number. For purposes of comparison, index number is expressed in ratio, percentage or proportion form. Its advantages according to the PSA (1991) are: it provides a more comprehensive way of comparing changes in statistical series from one time (or place) to another; it provides a simple way of comparing changes in statistical series reported in different units; and allows the construction of composite series for measuring aggregate changes in prices, volume or value of economic transactions.

Some of the commonly used statistical indices and its formula according to Kenney and Keeping (1962) are: Laspeyres' Index $P_L = \frac{\sum p_n q_0}{\sum p_0 q_0}$ where *pn* is the price per unit in period *n* and q_0 is the quantity produced in the initial period; Paasche's Index, $P_P = \frac{\sum p_n q_0}{\sum p_0 q_0}$; Fischer index $P_f = \sqrt{P_L P_P}$; among others.

According to the US Department of Labor (2007), Laspeyres' Index is a weighted aggregative index showing the ratio of expenditures in the current period to the expenditure in the base period to purchase the identical market basket of items. Historical weights are employed by the Laspeyres index, while current weights are employed by the Paache index according to Bureau of Transportation Statistics [(BTS), 2007]. The Laspeyres' and Paasche's Indices are the most common type of indices. The Fisher ideal index contains features of both the Laspeyre's index and the Paache Index.

Another method of index construction is principal component analysis (PCA). PCA on time series data has been used in a wide array of study themes using different type of variables resulting to indices. PCA is a technique used to compress a large set of variables into a new set of variables, called principal components that together explain majority of the variation in the original set of variables. Each principal component or PC is a linear function of the original variables. Tabunda (2003) pointed out that usually, the first PC serves as the index.

The New Residential Construction Report, known as "housing starts" on Wall Street, is a monthly report issued by the US Census Bureau jointly with the US Department of Housing and Urban Development (HUD). The data is derived from surveys of homebuilders nationwide, and three metrics are provided: housing starts, building permits and housing completions. A housing start is defined as beginning the foundation of the home itself. Building permits are counted as of when they are granted (http://www.investopedia.com/university/releases/housingstarts.asp).

3. Methodology

Construction statistics from approved building permits is an administrative based statistics. It provides monthly data on building construction at the municipal level and aggregated up to national level. Variables generated include: number of residential and nonresidential building construction, floor area of the building being constructed, type of building and the value of construction. The National Statistics Office generates private construction statistics from approved building permits since 1977. Data are taken from original application forms of approved building permits collected from local building officials in all local government units nationwide. Building permit is a written authorization granted by the local building official to an applicant allowing him to proceed with the construction of a specific project after the blueprint and other specifications and pertinent documents have been found to be in conformity with the National Building Code.

Although monthly data are available, reports are released quarterly by NSO and are used as data support for the quarterly national accounts. It covers all municipalities and cities issuing building permits for the construction of residential and nonresidential structures; addition, alterations and repairs; demolition; landscaping; and putting up of signboards. The classifications of residential building are single-type, duplex, or apartment. The nonresidential building permit constructions are classified as commercial buildings, industrial, institutional, agricultural and other types of construction. We consider three index construction methods in the development of housing start index.

3.1 Using average value of the base year (Method 1)

The choice of a base year is usually determined by factors like stability of the economy. The NSCB recommends for a standard base year to be used by agencies releasing official statistics. For this study, the base year to be used will be 2000 which is presumed stable. The index computation will be based on the number of residential building constructions from approved building permits by municipality, by province, and by region. The Laspeyres method of computation using the base year average value will be used as denominator. Weights for housing start index using this method will be based on the average number of residential building construction in base year 2000.

Index number for housing start in the Philippines will be computed to track how many new authorized residential houses or buildings will be constructed throughout the month. This will also show if the number of residential building is increasing.

The procedure that will be used in this study for the computation of the HSI is the simplest form of average relative, i.e., Housing Start Index (HSI) is defined as:

$$HSI_{mt} = \frac{R_{mt}}{AR_{mt}} x100$$

where HSI_{mt} = total index for area m at time t, R_{mt} = total value of all residential building construction permit in a given area at month t, AR_{mt} = average monthly residential building construction permits in a given area for base year 2000. AR_{mt} is obtained by adding the total number of all residential building construction permits in 12 months in a municipality at base year 2000 divided by 12 months. This index will be computed for the regional as well as the national level.

3.2 Based on weights of 2000 CPH (Method 2)

For this method, the weights will be taken from the result of a number of housing units by area of the 2000 Census of Population and Housing. For municipality weights, the number of housing units by municipality will be divided by the provincial total to get the municipality weights as $W_m = \frac{hs_m}{hs_p}$, where hs_m is the number of housing units in a given municipality m and hs_p is the number of housing units in a given province p. For the provincial weights, the number of housing units by province will be divided by the regional total to get the provincial weights $W_p = \frac{hs_p}{hs_r}$, where hs_p is the number of housing units in a given province p and hs_r is the number housing units in a given region r. For the regional weights, the number of housing units by province will be divided by the regional total to get the provincial weights, $W_r = \frac{hs_r}{hs_n}$, where hs_r is the number of housing units in a given region r and hs_n is the number housing units in the Philippines.

The indices for a particular area (municipality, province of region) j is the weighted sum of the area using the relative shares to the total housing units as the weights, i.e., $HSI_{jt} = R_{jt}$ x W_{jt} where HSI_{jt} refers to the index for area j at time t, W_{jt} is the relative share of area at time t (from the housing units of 2000 CPH), R_{jt} is the number of residential building permits at a given area j at time t.

3.3 Based on principal component analysis (Method 3)

The year 2000 will serve as the base period for this method where the principal component analysis will be used. Result of PCA for 2000 will be used to normalize the index based on component score. The housing start indicators that will be used as variables for the PCA includes: number of residential building construction; number of nonresidential building construction; estimated average value or cost of construction per unit; estimated average area of building for construction per unit; and ratio of residential building to nonresidential building. These variables are the data items generated by the National Statistics Office for the Construction Statistics from Approved Building Permit. The 30 municipalities and 4 district offices in NCR, and 125 municipalities and 4 provinces in Region I during the 1977-2004 period were considered.

Principal component analysis will be computed per year for all provinces and municipalities of both NCR and Region 1. Principal component analysis is used in reducing the number of indicators identified for possible inclusion as components for the computation of housing start index. The first PC is the linear function of the variables that has the maximum variance, of the form $PC_1 = a_{11}I_1 + \ldots + a_{1p}I_p$.

The index is given by

$$HSI = 100 - \frac{\sum_{k}^{m} H_k}{m}$$

where H_k are the housing start indicators with the highest loadings from the PC, m is the number of indicators with high loading. High values of the index indicate that there are more residential houses being constructed. However, the indicators or variables mentioned above are not scaled uniformly due to different units of measurements used, hence, a second index proposed by Tabunda (2003) that is considered as an average of the indicators that has been rescaled will be used for the construction of the index of housing start, i.e.,

$$HSI_{xt}^{*} = 100 \frac{v_{xt} - \min(v_{xt})}{\max(v_{xt}) - \min(v_{xt})}$$

where $max(v_{xt})$ is the maximum value of the variables or variable at a certain area (municipality, province or region at time T); $min(v_{xt})$ is the minimum value of the variables or variable at a certain area (municipality, province or region at time T); and v_{xt} is value of the variable at any time at a certain area. Note that if one or more variables resulted with high loadings in the run of the PCA, then the variables will be added.

3.4 Evaluation of the indices

One approach to evaluate the index is through fitting of a linear model which depicts the relationship between the index and other economic indicators it ought to represent over time and space. The strong space-time association between the index and relevant indicators will provide/validate the hypothesis on the relationship between the economic boom and housing start index. A linear mixed-effects model is developed which will hopefully explain the relationships between the index and the GNP and its components, and construction price index. The index that best characterizes GNP and other economic indicators can be considered as the better index.

Linear mixed model

The linear mixed model accounts for the relationship between a continuous response and the combination of continuous and categorical independent variables. The effect of some independent variables are fixed, the others are random. Fixed effects yield a constant parameter that contributes to explaining the dependent variable. The random factors, on the other hand, contribute in terms of the inherent variation in the variable.

The linear mixed model is given by $y_t = \beta_0 + \beta_1 x_{1t} + \ldots + \beta_p x_{pt} + \tau_k, \varepsilon_t$, where y_t is the dependent variable (economic indicator), $x_{1t},\ldots, x_{pt}$ are the independent variables whose effects to y_t are assumed to be fixed, $\beta_0,\ldots, \beta_p$ are fixed effect parameters, τ_k, k = 1,…, K are random variables $\tau_k \sim N\left(0, \sigma_\tau^2\right), \varepsilon_t$ is the error term.

Test for seasonality of the index

This study will investigate if there is seasonality in the housing start index since the construction sector is usually hypothesized to be affected by weather conditions and hence, expected to exhibit seasonality. Therefore, a seasonal behavior of the index can be taken as an evidence of its validity in summarizing the behavior of the construction sector.

The M7 will be used.

$$M7 = \sqrt{\frac{1}{2}\left(\frac{7}{Fs} + \frac{3F_m}{F_s}\right)}$$

where
F_s = D8 F statistic for stable seasonality
F_m = D8 F statistic for moving seasonality
Note: M7 < 1, series is seasonal

4. Results and Discussion

The outputs of the three methods of index construction are presented here. Likewise, the results of various tests on the sensitivity of the index to other economic indicators will be discussed.

4.1 Data profile

Table 4.1 compares data on residential and nonresidential construction with respect to the number, floor area and value of construction from 1977 up to 2004. More than three fourths or 75% of the construction are composed of residential building. Data on total floor area and value of construction lend some evidence on data consistency. It is more expensive to construct nonresidential buildings than residential buildings per square meter of floor area. Nonresidential buildings are commonly used for commercial, agricultural and industrial purposes such as office building, factory, or stores.

Value and totals were verified and names of the regions, provinces and municipalities were coded to facilitate processing of the data using the Geographical Standard Codes. Classification of the regions and provinces follows the 2004 geographic standard codes. All provinces in the previous years were re-classified based on the 2004 classification of regions and provinces. For example, some provinces like Abra and Benguet were included in Region I in 1989-1996. These provinces were re-classified to CAR; thus, total for Region 1 was adjusted for comparability of data for other years.

To make the result comparable for the three (3) methods, the geographic classifications were used uniformly in the three methodologies.

Table 4.1. Number, Floor Area and Value of Residential and Nonresidential Building Construction, 1977 – 2003: Philippines

	TOTAL			RESIDENTIAL			NONRESIDENTIAL		
	Number	Floor Area	Value	Number	Floor Area	Value	Number	Floor Area	Value
1977	28,033	3,621	1,796,535	23,216	2,052	939,276	4,817	1,569	857,259
1978	18,889	3,748	2,574,677	14,909	1,828	1,154,954	3,980	1,920	1,419,723
1979	27,095	5,508	4,689,199	21,753	2,689	2,107,209	5,342	2,819	2,581,990
1980	27,419	5,360	5,141,885	21,966	2,554	2,339,109	5,453	2,806	2,802,776
1981	29,544	5,182	5,802,851	23,922	2,477	2,496,442	5,622	2,705	3,306,409
1982	30,555	4,907	5,506,710	26,352	2,748	2,967,680	4,203	2,159	2,539,030
1983	37,328	6,849	7,837,292	32,883	3,575	4,114,569	4,445	3,274	3,722,723
1984	31,524	5,043	7,606,655	28,094	3,131	4,213,689	3,430	1,912	3,392,966
1985	23,594	4,294	7,675,216	20,244	2,122	3,101,321	3,350	2,172	4,573,895
1986	23,227	3,688	5,642,100	19,582	2,105	3,317,099	3,645	1,583	2,325,001
1987	32,313	5,488	9,940,367	27,809	3,118	5,832,035	4,504	2,370	4,108,332
1988	35,248	6,708	14,322,958	30,181	3,486	6,933,824	5,067	3,222	7,389,134
1989	36,584	9,536	28,272,342	31,220	5,272	17,488,113	5,364	4,264	10,784,229
1990	36,254	7,641	22,349,165	30,787	3,728	9,816,969	5,467	3,913	12,532,196
1991	37,955	6,520	21,100,229	32,339	3,675	10,302,354	5,616	2,845	10,797,875
1992	42,488	7,555	27,391,555	36,063	3,862	13,952,546	6,425	3,693	13,439,009
1993	45,237	8,282	35,987,727	38,894	4,232	17,024,276	6,343	4,050	18,963,451
1994	58,146	10,140	50,087,853	50,277	5,529	21,523,340	7,869	4,611	28,564,513
1995	63,775	12,239	61,496,554	53,777	5,876	25,294,430	9,998	6,363	36,202,124
1996	78,027	15,759	94,371,756	67,251	7,042	31,166,502	10,776	8,717	63,205,254

Note: Value in thousand pesos, floor area in thousand square meters. Details may not add up to total due to rounding.

4.2 Computed indices

The computed indices indicate the movement of aggregated number of residential buildings being proposed for construction. A high value of the index indicates higher number of residential buildings is to be constructed while a low number indicates a lesser number of residential buildings proposed for construction. This will also indicate the area (region, province or municipality) with higher or lower housing start index.

The period from 1989 to 1991 (Aquino Administration) shows intermittent slight increases and decreases in the total number of residential building construction in the whole country. There was a slight decrease in the number of residential building starting August 1991 after the earthquake in July 1991 from 3,351 to 2,750, and continuously decreasing until December 1991 with 1,843 residential building constructions. But starting January 1992, it has recorded an abrupt increase to 8,864 in the whole country. This is true even for NCR and its districts and also for Region 1 and its provinces. Note that even if there was a power crisis in 1992-1993 (Lim and Bautista, 2002), the number of residential building construction are noticeably high. The total for the Philippines recorded 9,747 especially in July of 2002.

In 1997-1999, the period of Asian currency crisis, the number of residential buildings is still high. The year 1998 is further affected by severe El Nino phenomenon; the number of residential building construction has decreased from 10,405 in December 1997 to 5,414 in January 1998. The number of building constructions is high during the middle of the year; this is because prices of construction materials are low (particularly cement) during this period. In addition, the last quarter has recorded a decreasing trend in every year especially towards the last month. This is due to priorities to the holiday seasons, Christmas and New Year; hence, construction of houses is set-aside during these months.

The same observation is seen in NCR with the highest number of residential building constructions recorded during the period of Asian crisis (Lim and Bautista, 2002). The number decreases during the middle part of 1999 but increases towards the latter part of the year. Region 1 also displays a higher number of residential building construction starting 1996. However, neither the Asian Financial Crisis nor the El Nino phenomenon influenced the movement of residential building construction.

Method 1

For Method 1, data points for every municipality were averaged using the 12-month period for the year 2000, which was used as the denominator of the index. The index computed shows the increase/decrease in the number of residential buildings relative to 2000, the base year. The computed index indicates at what time and specific area is the number of residential buildings highest or lowest. The index of 100 indicates that the number of residential building construction is the same as the average values for the year 2000. An index of zero (0) indicates that there is no construction during that particular period and place.

In method 1, the highest index of 337 was recorded in July 1997 for the Philippines while the lowest was in December 1989 with an index of 44.18. This indicates that the number of residential houses in July 1997 is more than 200 times higher than that in 2000 of the same month, while that of December 1989 is less than half of the December 2000 level.

In NCR, the highest recorded index was in August 1997 with 309.49. This indicates that the residential houses to be constructed during this period are higher by 200 times compared to 2000. The lowest was 35.79 in December 1998. In NCR District 1, index as low as 1.2 in December 1990. The highest recorded index was observed in the municipality of Paco with index of 654.54 in March 1992 and in October 1996.

In NCR District 2, the highest index was recorded in San Juan with an index of 323.07 reported on May and January 1990. The lowest was in Pasig with an index of 1.498. Caloocan City has the highest recorded index in August 1997 with a value of 5144.88 indicating that there are more than 5000 times proposed residential constructions compared to the year 2000. The lowest was in May 1996 in Malabon with 6.70 only. In NCR District 4, Makati recorded the highest index of 698.08, while the lowest was 5.79 on December 2000 and February 2001, respectively.

In Region 1, the indices show that more residential buildings are being proposed to be constructed in La Union and Pangasinan compared to Ilocos Sur and Ilocos Norte.

Method 2

We also used 2000 as the base year. The weights were taken from the 2000 Census of Population. The number of existing housing units during the year was used as basis for weights. Municipality weights were computed by dividing with the total for the province in which the municipality belongs. Observations pertaining to the result of the housing start index computed using this method is consistent with that in Method 1.

Method 3

Method 3 uses principal component analysis in identifying the indicators to be included in the index. PCA was computed separately for each year from 1989 to 2003. The variables considered were:

DETRATIO – ratio of the details to the totals. For example the ratio of the municipality is taken by dividing the number of residential buildings of a particular municipality with the total value of the province to where the municipality belongs. The ratio of the provinces is taken by dividing the number of residential buildings of the provinces with the total for the region.

RESNRTIO – ratio of the number of residential buildings to the nonresidential buildings

AVEFLOOR – average floor area in a municipality.

VALUE – total value of construction divided by the number of residential building construction.

RES – total number of residential houses/building

NONRES – is the total number of nonresidential houses/building

RESTOT – ratio of the number of residential houses/building to the total construction of all types of buildings.

Table 4.2 shows that the first 4 PCs explain about 81.5 % of the total variation.

Table 4.2. Loadings of the 7 Principal Components

	Component						
	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6	PRIN7
detratio	0.254	0.624	-.062	-.052	0.068	-.731	0.020
resnonresratio	0.157	0.401	0.211	-.146	-.806	0.314	-.012
aveflrarea	0.660	-.242	0.068	-.024	0.043	0.004	-.706
value	0.662	-.242	0.030	-.000	0.022	0.043	0.707
res	0.172	0.571	-.122	0.041	0.514	0.603	-.013
nonres	0.008	0.078	0.504	0.859	0.003	-.035	-.000
RES/TOT	-.079	0.010	0.823	-.485	0.281	-.027	0.035
Variance (%)	28.205	24.685	14.432	14.164	12.577	5.048	.888
Cumulative Variance (%)	28.205	52.890	67.322	81.487	94.063	99.112	100

Variables with high loading on the first PC are AVEFLRAREA and VALUE. Thus, these variables were used for the computations of the housing start index. The index was adjusted to have values between 0 and 100.

4.3 Assessment of seasonality of the indices by area

Seasonality is the periodic fluctuation of the series within a year, governing the rise and fall of the series at specific months of the year. This study checks the seasonality of the indices computed from 1989 to 2004 of the Philippines, NCR, and Region I by the three (3) index construction methods. Because of the presence of zero (0) values in the data of some areas in Region 1, additive seasonality was assumed.

The seasonal indices reported in Table 4.3 are the proportion of moving seasonality present relative to the stable seasonality. We can see that NCR, and NCR District 2 have values less than 1 which means that housing start in these two (2) areas have stable seasonality. The NCR District 1, NCR District 3, NCR District 4, Region 1 and its provinces have moving seasonality.

4.3.1 Philippines

There is a remarkable increase in housing start in 1991, the year when construction in the whole country suddenly peaked. Monthly index values for the month of January, April, July and October are noticeably high for all years from 1989 to 2004, consistently among the three methods used. This is attributed to the low cost of cement and construction supplies during these months.

Table 4.3. Values of Seasonal Indices

AREA	Method 1	Method 2	Method 3
Philippines	1.246	2.115	1.205
NCR	0.832	0.832	0.885
NCRDistrict 1	1.09	1.09	1.103
NCRDistrict 2	0.72	0.72	0.755
NCR District 3	2.322	2.322	2.358
NCR District	1.002	1.002	1.033
Region 1	1.093	1.187	1.06
Ilocos Norte	1.61	1.61	1.637
Ilocos Sur	2.418	2.418	2.469
La Union	1.295	1.295	1.242
Pangasinan	1.716	1.716	1.719

M7 Test for Stable Seasonality

The result of the seasonality test indicates that for Method 1, there is seasonality present at one percent level of confidence and moving seasonality is also present. M7 value of 1.246, indicates presence of moving seasonality.

For Method 2, there is also seasonality and moving seasonality present at one percent level of confidence, M7 is higher with 2.115.

For Method 3, moving seasonality is also present but M7 is only 1.205.

4.3.2 National Capital Region

Moving seasonality was also observed for NCR. During the months of February, March, July and October, housing start is high from 1989 to 2004. Housing start usually decreases in August and September, due to the rainy seasons, and peak again in October. However, December is a lean month for housing start because expenses during this period are prioritized for the Christmas festivities.

The result of the seasonality test indicates that for Method 1, there is seasonality present; seasonality is stable shown by M7 value of 0.832.

Seasonality is also present for the result of Method 2 with M7 of 0.832 indicating stable seasonality. Similarly, is true for Method 3 with stable seasonality (M7 = 0.0885).

4.3.3 Region I

Moving seasonality was observed for Region I, in fact, there is no clear seasonal pattern for Region I series. In 1989 to 1993, the months of January, June, April and October have high values of indices based on the three methods. However, in 1994 and up to 2004, the months of January, February, March, April, May, July and October show high index values. Noticeably, index for the month of April is unusually high where it registered index values more than 100. But the months of July, August and September display a rather low housing start index values, due to the rainy season.

4.4 Evaluation of the different methods

The usefulness of the index depends on how good it predicts the phenomenon it ought to represent. The three indices were evaluated based on a linear model with some important economic indicators as the dependent variable. The goal is to verify if the index indeed predict economic growth and movement of some price indices. Mixed model was fitted with economic growth/price indices as the dependent and the housing start index as the explanatory variable. The index that is most sensitive to the economic indicator is deemed more useful.

The mean absolute percentage error (MAPE) measures the accuracy of prediction of the model in forecasting. A lower MAPE suggests better prediction of the economic indicator. A dummy variable was added to account for the spatial effects of the regions. The model includes the index and the dummy variable as predictors. The six (6) response variables considered are: CPI, GNP, GDP, GRDP, RPICM and CMWPI.

Using indices generated from Method 1, it can predict fluctuations in CPI ($p < 0.0001$), GRDP ($p < 0.0001$), GNP ($p < 0.0001$), CMWPI ($p < 0.0001$), RPICM ($p < 0.0001$), GDP ($p < 0.0006$). The predictive ability of the index from Method 1 on the economic indicators is summarized in Table 4.4.

For housing start index using Method 1, low MAPE mean values (less than 10 percent) are displayed in CPI with 6.47, CMWPI with 7.95, GDP with 7.97, GNP with 8.46, GRDP with 5.13 and RPICM with 5. The overall MAPEs computed are less than 10 indicating that the overall fit of the mixed regressions in Method 1 are adequate.

Indices generated from Method 2 cannot predict fluctuations in CPI ($p = 0.4666$), GRDP ($p = 0.8609$), GNP($p < 0.1953$), CMWPI ($p < 0.8094$), RPICM ($p < 0.7283$), GDP ($p < 0.1687$). The predictive ability of the index from Method 2 on the economic indicators is summarized in Table 4.4.

Likewise, indices generated from Method 3 cannot predict fluctuations in CPI ($p = 0.9299$), GRDP ($p < 0.0001$), GNP ($p = 0.2786$), CMWPI ($p = 0.1741$), RPICM($p = 0.2738$), GDP ($p = 0.1892$). The predictive ability of the index from Method 3 on the economic indicators are summarized in Table 4.4.

The index computed using Method 1 is better because it predicts well the variables CPI, CMWPI, RPICM, GNP, GDP and GRDP. In addition, the MAPEs are small indicating that the housing start index explains some key economic indicators very well.

Table 4.4. p-values and MAPE for Method 1, 2 and 3

Method 1		MAPE				
variables	p values	N	Mean	Std Dev	Minimum	Maximum
CPI	<.0001	7272	6.468	4.350	0.001	16.182
CMWPI	<.0001	7272	7.948	5.145	0.103	19.598
GDP	0.0006	7272	7.974	5.678	0.022	20.245
GNP	0.0001	7272	8.461	6.008	0.024	21.799
GRDP	<.0001	7272	5.137	2.991	0.008	11.600
RCIPM	<.0001	7272	5.267	4.065	0.004	16.555
Method 2		**MAPE**				
variables	**p values**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
CPI	0.4666	7272	6.480	4.361	0.001	14.341
CMWPI	0.8094	7272	7.978	5.142	0.744	19.140
GDP	0.1687	7272	7.981	5.676	0.010	20.424
GNP	0.1953	7272	8.468	6.011	0.004	20.785
GRDP	0.8609	7272	5.158	2.986	1.030	9.324
RCIPM	0.7283	7272	5.285	4.073	0.110	16.268
Method 3		**MAPE**				
variables	**p values**	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
CPI	0.9299	7272	6.480	4.361	0.000	13.980
CMWPI	0.1741	7272	7.980	5.139	0.481	19.145
GDP	0.1892	7272	7.979	5.679	0.007	20.027
GNP	0.2786	7272	8.467	6.013	0.001	20.339
GRDP	0.0886	7272	5.157	2.986	0.611	9.500

5. Conclusions

The study proposed to construct three housing start indices. The indices are computed at the municipal level in two regions in the Philippines. Region I represents a relatively rural area while NCR represents a highly urban area. The three indices were compared and analyzed by examining its behavior and capability of leading key economic indicators.

There is stable seasonality exhibited by the housing start index in NCR and NCR District 2. Moving seasonality, on the other hand, is present in some areas of NCR and in the Philippines as a whole. Likewise, for Region I and the provinces of Ilocos Norte, Ilocos Sur, La Union and Pangasinan, moving seasonality is also present.

Certain months of the year like April, May, July and October are observed to manifest highest values of the index for all provinces of NCR and Region I.

Mixed regression models confirm that the index resulting from Method 1 is capable of predicting economic indicators like CPI, GNP, GDP, GRDP, CMWPI and RPICM are significant.

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