**Section 3**
*METHODOLOGY*

*3.1 Background*

3.1.1 The Group observed that the present data collection system as organised and updated by National Building Organization can be strengthened and fine tuned to have the requisite database for constructing a housing start-up index (HSUI) on a quarterly basis.

3.1.2 The objective of the HSUI is to track the changes in the level of construction activities in housing sector, which can identify and signal growth or reversionary tendencies in the housing sector. The housing starts in a particular quarter can be estimated from the permits issued in that quarter and the various past quarters by using the rates at which the permits have got converted into starts in the recent past. It would therefore be important to construct a series of start rates (coefficients) for the permits given during the preceding quarters based on the information on actual starts after the issuance of the permits. These coefficients are expected to be different for different quarters due to the seasonality involved in the housing starts. The data on housing starts for a two year period or eight quarters has been considered appropriate for building up the series of coefficients. For the housing starts, out of the permits given before two years, an 'aggregate coefficient' may be calculated based on the actual empirical data. Thus, there will be nine coefficients for each quarter of the year, eight for the preceding quarters, and one more for the residual permits that are two-year old. Since these coefficients are likely to be different for each of the four quarters, one would end up building up a matrix with four rows and nine columns.

3.1.3 Once the matrix of start-up rates is constructed based on survey data, the number of house construction started in a particular quarter, say A out of the permits issued in a preceding quarter, say B, can be obtained by multiplying the number of housing units authorised through issuance of permits in quarter B with the corresponding start rate (coefficient) in the matrix.

Aggregation of the nine values thus obtained would give the total number of housing starts in the quarter A.

3.1.4   The Group decided that the scope of the index should be limited to new built residential buildings in urban areas of India, whose construction is authorised through issuance of building permits. Consequently, the pilot surveys undertaken to estimate the coefficients do not include permits for non-residential buildings including commercial, institutional and industrial buildings. Furthermore, the surveys do not include the publicly owned/built residential housing units. These cover only urban areas because the residential construction activities here are likely to affect macroeconomic parameters much more than in the rural areas. Un-authorised constructions can be excluded from the scope of the analysis. It is possible to assume that the excluded components are multicollinear with the formal residential units and hence the index can signal the direction of movement for both.

3.1.5   After overviewing the results of the survey conducted by DES-TN, the Group felt about the need to conduct a comprehensive pilot surveys in few cites/town in order to generate housing start coefficients and test their sturdiness. It is only then that these numbers can be recommended for application to the information on the number of building permits for constructing HSUI. The objective of the pilot surveys should be to construct the Start up Coefficient Matrix with adequate empirical strength so that HSUI can be constructed on a quarterly basis. It should help in identifying the difficulties and challenges in this exercise as also sorting out the issues related to sampling design, selection of variables, weighting pattern, choice of base year etc.

3.1.6   The Group suggested that the pilot survey, using a common methodology and schedules, should be conducted in 3 class I cities and 3 small towns. A subgroup was constituted for designing of the schedules for data collection. The comments/suggestions on the schedules prepared by the subgroup were obtained from the members based on which the methodology for data

collection for the pilot study was also finalized. The three class-I cities identified for the survey were Mumbai, Delhi and Coimbatore. The respective Directorate of Economic and Statistics (DES) were entrusted with the data collection job. It was considered important to collect information from one small town in the states of Maharashtra and Tamil Nadu and one near the National Capital Territory of Delhi for the calendar years 2003 and 2004. The choice of two calendar years was made with a view to identify temporal differences in the start rates as it may help to fix the periodicity for conducting such surveys for generating the coefficients, to be used for constructing HSUI. The concerned DESs were requested to conduct the surveys by selecting the town as per the framework of the project and report the results to the Group.

3.1.7   The Terms and Definitions used in the study are presented in Annex 6.


### 3.2   *Data Collection*

3.2.1   The data related to housing starts were collected in two stages as per the survey schedule given in Annex-7. The survey schedule has two parts.

3.2.2   <u>Collection of Information on Building Permits:</u>  Information on the  permits issued for new residential construction was collected from the permit issuing authorities in all cities and towns through Schedule –Part I given in Annex-7. The permits for alterations of the existing building were not included in their survey. However, the permits given for additional housing units in the existing building; construction of new building by demolishing the old existing building were included. The survey excluded all non-residential buildings, as noted above. However, mixed-use houses like residential cum commercial, residential cum industrial units etc. were included.

3.2.3   <u>Survey conducted for determining the coefficients of Housing Starts</u>:  The data on housing starts were collected by drawing a sample from the permits issued for new residential buildings in city during the four quarters in certain reference year. The reference year was assumed to be two or three years old,

generally coinciding with the period of validity of the license. The survey tracked these sample permits in order to ascertain in which quarter and year during the subsequent period, the owner or the builder who obtained the permit actually started the construction. The information was obtained using the Schedule –Part II, given in Annex 7.

3.2.4 <u>Sampling method:</u> The sample selection for the survey was based on a stratified sampling method in which the units in each stratum were randomly selected. In each administrative/tax zone/ward, the data on permits were further stratified based on the type of the building (Single Housing Unit (SHU) or Multiple Housing Unit (MHU)). For example, if a particular centre had 5 zones, each zone was further stratified into 2 strata. i.e. in total 10 strata. In each such stratum, 5 per cent sample of the total building permits for new residential construction was selected based on systematic sampling procedure. If the 5 per cent of the total happens to be fraction, the next integer was taken as the sample size. If total number of permits in a stratum was less than 10, then all permits were taken to constitute the sample. If 5 per cent of the total number of permits in a stratum turned out to be less than 10, then the sample size was taken as 10.

### 3.3 *Housing Start Rates (coefficients)*

3.3.1 The data collected on permits using Schedule –Part I, pertain to four periods of the reference year (2003 - from the first quarter to the fourth quarter). These were taken as the starting observations for the survey. It tried to estimate the number of house constructions started in all the succeeding quarters out of the sample, staring from the quarter in which the permits were issued till the latest period. Following international practice, all the house constructions started after the lapse of two years of issue of permits till two years further were added together. The last coefficient would indicate the house starts taking place over a period of another two years after the lapse of two years. This may be taken to reflect the coefficient of start ups in a quarter out of all

two year old permits till two years further. All houses started beyond 4 years of permit issued were assumed as not started. Based on this data corresponding to different quarters of the years, 9 start-up rates (1 for the quarter in which permits were issued, 7 for the 7 succeeding quarters and 1 for all the starts after 2 years till two years further) were computed. This produces a 4x9 matrix of start rates (coefficients) (*see (1) and (2)*). This matrix (HSRM) is used for estimating the number of housing starts in each quarter, using the methodology described below.

$$HSRM = \begin{bmatrix} \dfrac{s_{(11,1)}}{p_{(1)}} & \dfrac{s_{(12,1)}}{p_{(1)}} & \dfrac{s_{(13,1)}}{p_{(1)}} & \dfrac{s_{(14,1)}}{p_{(1)}} & \dfrac{s_{(21,1)}}{p_{(1)}} & \dfrac{s_{(22,1)}}{p_{(1)}} & \dfrac{s_{(23,1)}}{p_{(1)}} & \dfrac{s_{(24,1)}}{p_{(1)}} & \dfrac{s_{(..,1)}}{p_{(1)}} \\[2ex] \dfrac{s_{(12,2)}}{p_{(2)}} & \dfrac{s_{(13,2)}}{p_{(2)}} & \dfrac{s_{(14,2)}}{p_{(2)}} & \dfrac{s_{(21,2)}}{p_{(2)}} & \dfrac{s_{(22,2)}}{p_{(2)}} & \dfrac{s_{(23,2)}}{p_{(2)}} & \dfrac{s_{(24,2)}}{p_{(2)}} & \dfrac{s_{(31,2)}}{p_{(2)}} & \dfrac{s_{(..,2)}}{p_{(2)}} \\[2ex] \dfrac{s_{(13,3)}}{p_{(3)}} & \dfrac{s_{(14,3)}}{p_{(3)}} & \dfrac{s_{(21,3)}}{p_{(3)}} & \dfrac{s_{(22,3)}}{p_{(3)}} & \dfrac{s_{(23,3)}}{p_{(3)}} & \dfrac{s_{(24,3)}}{p_{(3)}} & \dfrac{s_{(31,3)}}{p_{(3)}} & \dfrac{s_{(32,3)}}{p_{(3)}} & \dfrac{s_{(..,3)}}{p_{(3)}} \\[2ex] \dfrac{s_{(14,4)}}{p_{(4)}} & \dfrac{s_{(21,4)}}{p_{(4)}} & \dfrac{s_{(22,4)}}{p_{(4)}} & \dfrac{s_{(23,4)}}{p_{(4)}} & \dfrac{s_{(24,4)}}{p_{(4)}} & \dfrac{s_{(31,4)}}{p_{(4)}} & \dfrac{s_{(32,4)}}{p_{(4)}} & \dfrac{s_{(33,4)}}{p_{(4)}} & \dfrac{s_{(..,4)}}{p_{(4)}} \end{bmatrix} \quad ....\ (1)$$

3.3.2    The number of housing starts during the $j^{th}$ quarter of the $i^{th}$ year, for which permits are issued in the $k^{th}$ quarter of the calendar year is denoted by ($s_{(ij,k)}$). The sample number of housing units authorised by building permits in the $k^{th}$ quarter of the calendar year is ($p_{(k)}$). Now $\dfrac{s_{(ij,k)}}{p_{(k)}}$ represents the corresponding housing start coefficient. $\dfrac{s_{(..,k)}}{p_{(k)}}$ represents the ratio of number of house constructions started after 8 quarters (including the quarter in which permit is issued) till two years further out of the total number of permits issued in $k^{th}$ quarter of the calendar year to the sample number of housing units authorised by building permits in the $k^{th}$ quarter of the calendar year.

3.3.3    The first start rate coefficient that is to be applied for estimating the housing starts in a quarter is computed by dividing the number of constructions started in that quarter for which permits are issued in that quarter itself.

Understandably, many more house constructions would start during this quarter for which permissions have been obtained in pervious quarters. But the coefficients in the first row of the matrix *HSRM* show how the permits given in the first quarter got converted into housing start in the subsequent quarters. The second row gives the corresponding coefficients for the second quarter. To estimate the number of starts in a quarter, therefore the matrix *HSRM* is to be transformed. The transformed matrix *HSRM$_{transformed}$* is obtained by rearranging *HSRM*.

$$HSRM_{transformed}=\begin{bmatrix} \frac{S_{(11,1)}}{P_{(1)}} & \frac{S_{(21,4)}}{P_{(4)}} & \frac{S_{(21,3)}}{P_{(3)}} & \frac{S_{(21,2)}}{P_{(2)}} & \frac{S_{(21,1)}}{P_{(1)}} & \frac{S_{(31,4)}}{P_{(4)}} & \frac{S_{(31,3)}}{P_{(3)}} & \frac{S_{(31,2)}}{P_{(2)}} & \frac{S_{(..,1)}}{P_{(1)}} \\[6pt] \frac{S_{(12,2)}}{P_{(2)}} & \frac{S_{(12,1)}}{P_{(1)}} & \frac{S_{(22,4)}}{P_{(4)}} & \frac{S_{(22,3)}}{P_{(3)}} & \frac{S_{(22,2)}}{P_{(2)}} & \frac{S_{(22,2)}}{P_{(1)}} & \frac{S_{(32,4)}}{P_{(4)}} & \frac{S_{(32,3)}}{P_{(3)}} & \frac{S_{(..,2)}}{P_{(2)}} \\[6pt] \frac{S_{(13,3)}}{P_{(3)}} & \frac{S_{(13,2)}}{P_{(2)}} & \frac{S_{(13,1)}}{P_{(1)}} & \frac{S_{(23,4)}}{P_{(4)}} & \frac{S_{(23,3)}}{P_{(3)}} & \frac{S_{(23,2)}}{P_{(2)}} & \frac{S_{(23,1)}}{P_{(1)}} & \frac{S_{(33,4)}}{P_{(4)}} & \frac{S_{(..,3)}}{P_{(3)}} \\[6pt] \frac{S_{(14,4)}}{P_{(4)}} & \frac{S_{(14,3)}}{P_{(3)}} & \frac{S_{(14,2)}}{P_{(2)}} & \frac{S_{(14,1)}}{P_{(1)}} & \frac{S_{(24,4)}}{P_{(4)}} & \frac{S_{(24,3)}}{P_{(3)}} & \frac{S_{(24,2)}}{P_{(2)}} & \frac{S_{(24,1)}}{P_{(1)}} & \frac{S_{(..,4)}}{P_{(4)}} \end{bmatrix} \quad …(2)$$

3.3.4   This matrix *HSRM$_{transformed}$* is to be used for estimating the housing start figure for a particular quarter. The first row of *HSRM$_{transformed}$* gives the coefficients of housing start for the first quarter of the calendar year, based on permissions given in previous quarters. Similarly the second, third and fourth rows correspond to the second, third and fourth quarters of the calendar year respectively. The four series of start rates (coefficients) corresponding to the four quarters are estimated to incorporate the factor of seasonality.  This matrix of start rates can be obtained separately for SHU and MHU and can be used for estimating the housing start in each quarter separately for SHU and MHU.

## 3.4    Compilation of Housing Starts

3.4.1   The number of SHU or MHU house constructions started in a particular centre during a particular quarter can be obtained by multiplying the start rates (coefficients) in the *HSRM$_{transformed}$* matrix with the corresponding total

number of housing permits issued (in the current as also the preceding quarters). The choice of the row or the set of start rates depends on the quarter for which the housing starts are to be estimated. For example, if we are interested in estimating the number of housing starts in the third quarter of the calendar year then the third row of the *HSRM~transformed~* matrix should be used along with the corresponding figures for housing permits.

3.4.2    This procedure is represented in mathematical form as follows. Let $P_t^{vector}$ is a 9x1 vector of which the first eight elements are the number of housing permits issued in the $t^{th}$, $(t-1)^{th}$, $(t-2)^{th}$ …$(t-7)^{th}$ quarter. The ninth element is the sum total number of the number of housing permits issued in the $(t-8)^{th}$ to $(t-15)^{th}$ quarters.

$$P_t^{vector} = [P_t \quad P_{t-1} \quad P_{t-2} \quad P_{t-3} \quad P_{t-4} \quad P_{t-5} \quad P_{t-6} \quad P_{t-7} \quad P_{(t-8)\rightarrow(t-15)}]' \quad \text{... (3)}$$

Let $Q$ be a 1x4 vector of seasonal dummies.

$$Q = [q_1 \quad q_2 \quad q_3 \quad q_4] \quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad \text{... (4)}$$

Where        $q_i$   =   1      if t corresponds to $i^{th}$ quarter

                  =   0      otherwise      for i = 1, 2, 3, 4

The number of housing starts in the quarter t which is a scalar is given by

$$S_t = Q \times HSRM_{transformed} \times P_t^{vector} \quad\quad\quad\quad\quad\quad \text{... (5)}$$

3.4.3    The number of housing starts can be estimated by two methods: i) by adding the number of housing starts corresponding to SHU and MHU giving equal weights; ii) by adding the number of housing starts corresponding to SHU and MHU giving weights proportional to the average Floor Space Area (FSA) corresponding to each category.

## 3.5    *Compilation of Housing Start-Up Index*

3.5.1    As the number of urban centers in India is quite large, compiling housing starts for each and every center and thereby obtaining an All India figure on a quarterly basis is difficult. As an alternative, a few centers can be chosen and

an index can be developed at All India level using the information obtained from these selected centers.

3.5.2   The Group proposes that the HSUI may be computed using the housing starts coefficients estimated for select centres using methodology, as explained in sections 3.3 and 3.4.

3.5.3   The HSUI is estimated using the formulae given below

$$HSUI_t = \frac{\sum_{i=1}^{n} A_{i0} S_{it}}{\sum_{i=1}^{n} A_{i0} S_{i0}} \qquad \ldots (6)$$

Where **n** is the number of centres, **Ai0** is the average FSA in the $i^{th}$ centre in the base period; $S_{it}$ is the number of housing starts in the $t^{th}$ quarter in $i^{th}$ centre; $S_{i0}$ is the number of housing starts in the base period in $i^{th}$ centre.