ECLAC
Economic Commission for Latin America and the Caribbean

First meeting of the Statistical Conference of the Americas of the
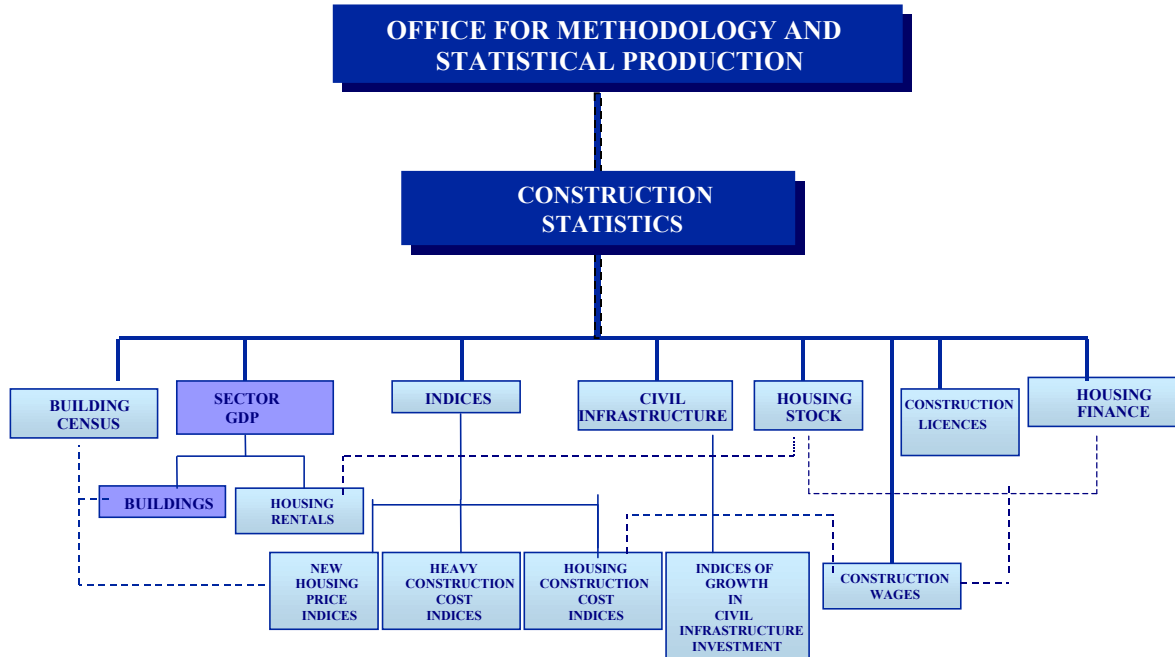Economic Commission for Latin America and the Caribbean

Santiago, Chile, 9-11 May 2001

STATISTICS ON THE CONSTRUCTION SECTOR

This document was prepared by the National Administrative Department of Statistics (DANE) of Colombia, and has been reproduced without formal editing.

01-2-183

Statistics on the construction sector –Colombia–
Statistical context

OFFICE FOR METHODOLOGY AND
STATISTICAL PRODUCTION

CONSTRUCTION
STATISTICS

BUILDING CENSUS | SECTOR GDP | INDICES | CIVIL INFRASTRUCTURE | HOUSING STOCK | CONSTRUCTION LICENCES | HOUSING FINANCE

BUILDINGS | HOUSING RENTALS

NEW HOUSING PRICE INDICES | HEAVY CONSTRUCTION COST INDICES | HOUSING CONSTRUCTION COST INDICES | INDICES OF GROWTH IN CIVIL INFRASTRUCTURE INVESTMENT | CONSTRUCTION WAGES

The statistical framework for estimating macroeconomic aggregates for the construction sector consists of eleven measurement projects which enhance the viability of their estimate and guarantee high levels of accuracy in their quarterly figures.

The complexity and development of each of the projects involved depend on their effect on gross output and are closely linked to the phenomenon being measured.
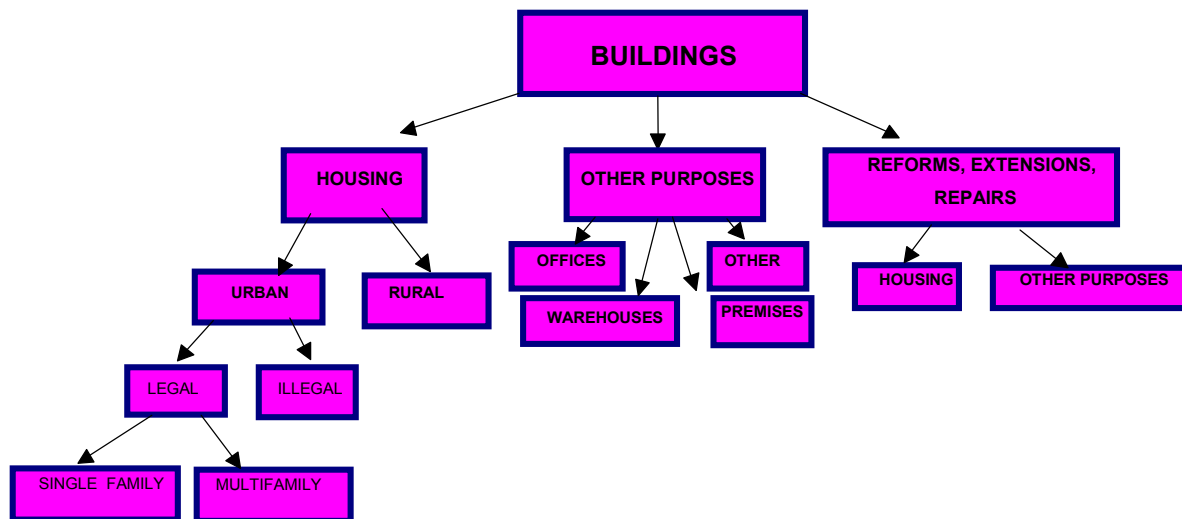
Statistics drawn from sources ranging from censuses to price and cost indices and administrative registers are combined with estimation methodologies for a statistical approach to concepts such as housing stock and average rentals.

Special emphasis will be placed, in this document, on the methodology used for estimating gross output of building and of the housing rental sector. Since the idea is to present a summary of existing sectoral statistics, following a logical method of compilation, methodological details will be given for the most important and innovative projects, such as the Building Census and the compilation and synthesis for calculating sectoral aggregates. Other studies will be analysed from this perspective.

Composition of the construction sector

Theoretically and, above all, in terms of measurement, the construction sector is, for national accounting purposes, made up of two major branches: building and civil infrastructure.

Building encompasses residential as well as non-residential structures. In addition, it includes repairs to ensure the proper physical maintenance of buildings over time and to keep up with reforms.

```
                          ┌──────────────┐
                          │  BUILDINGS   │
                          └──────────────┘
        ┌──────────────────────┼──────────────────────┐
   ┌─────────┐          ┌──────────────┐     ┌──────────────────────┐
   │ HOUSING │          │OTHER PURPOSES│     │ REFORMS, EXTENSIONS, │
   └─────────┘          └──────────────┘     │       REPAIRS        │
      │    │           ┌─────┐  │  ┌───────┐ └──────────────────────┘
  ┌──────┐ ┌───────┐  │OFFICES│    │ OTHER │        │          │
  │URBAN │ │ RURAL │  └─────┘  │   └───────┘    ┌────────┐ ┌──────────────┐
  └──────┘ └───────┘  ┌──────────┐ ┌────────┐  │HOUSING │ │OTHER PURPOSES│
    │   │             │WAREHOUSES│ │PREMISES│  └────────┘ └──────────────┘
 ┌───────┐ ┌────────┐ └──────────┘ └────────┘
 │ LEGAL │ │ILLEGAL │
 └───────┘ └────────┘
    │   │
┌──────────────┐ ┌────────────┐
│SINGLE FAMILY │ │MULTIFAMILY │
└──────────────┘ └────────────┘
```

Civil infrastructure refers to all physical infrastructure works designed to improve or increase production capacity of a given public facility. It includes bridges, tunnels, roadways, railway lines, airfields, airports, ports, water management projects, irrigation systems, sewerage systems, pipes and electrical power lines, hydroelectricity plants, oil pipelines, viaducts, aqueducts, streets, parks and sports facilities. Also included are all activities relating to the maintenance, repair, improvement and upgrading of such infrastructure.

Estimate of gross building output

Background

Given the need for additional indicators to analyse the performance of the national building sector and to calculate economic aggregates, supplementary instruments were developed for calculating gross output of the building subsector, and, thereby, value added. Various methodologies were devised for calculating the production of urban buildings, rural dwellings, illegal settlements, housing improvements and repairs and for estimating the value added of each of the above subgroups.

Building GDP is a summary indicator, based on the application of a general methodology, which consolidates the results of the different methods of measurement used for calculating urban buildings, rural dwellings, illegal settlements, housing improvements and repairs.

In general terms, the method calculates gross output through construction starts in each area of study, values the output at market prices and registers it or defers it over time in order to determine the extent to which projects have actually been executed.
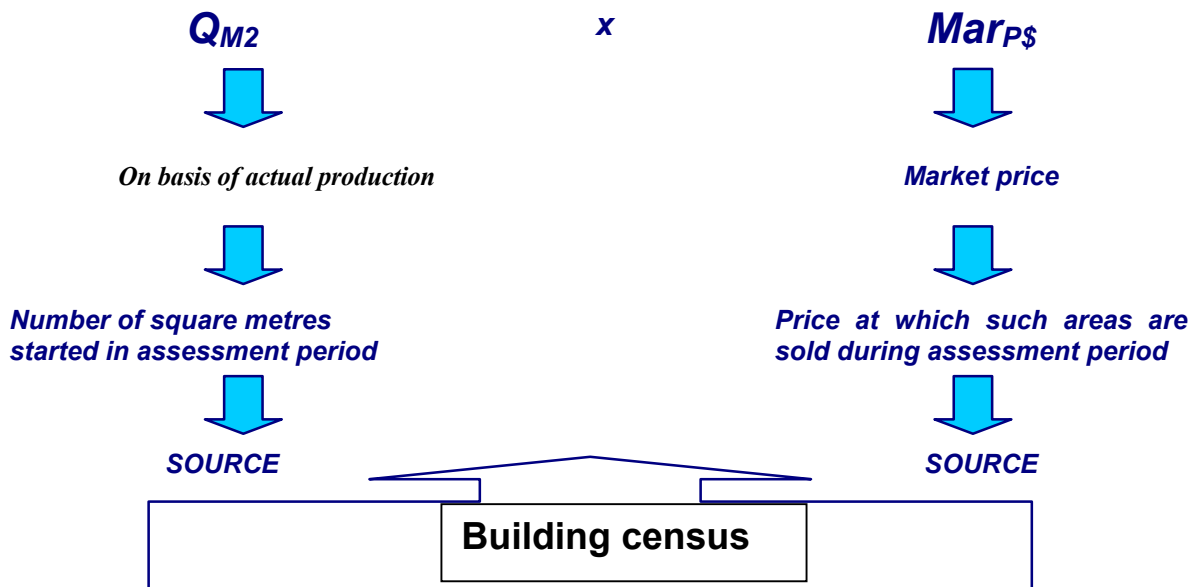
General methodology

Gross building output is estimated on the basis of what has actually been constructed for each evaluation period. Bearing in mind that construction works almost invariably take longer than average construction time, a method must be devised to calculate what has actually been done during the quarter by combining project starts and market price. This implies knowledge of the average duration of the construction works and their progress over time.

In this context, three elements are required for estimating actual production on this basis: the area in square metres for which construction has been started, the price at which these areas are sold on the market and the status of the work and how it progresses over time from the start-up date until completion of the construction.

Q_{M2}:   This refers to the variable selected to represent volume in construction. For this particular case, it represents the area under construction.

$Mar_{P\$}$:   This refers to the variable selected to represent the price in the construction activity. For this particular case, it represents the market price of the area under construction.

$$Q_{M2} \qquad x \qquad Mar_{P\$}$$

On basis of actual production   **Market price**

Number of square metres started in assessment period   **Price at which such areas are sold during assessment period**

SOURCE   *SOURCE*

Building census

The combination of these two elements is no guarantee that the estimate is carried out according to the concept of actual production. For this purpose, one must know with relative accuracy what segments of production have been completed during the assessment period. It is here that the status report on the work is useful, since what has actually been carried out during the period can be worked into the estimate.

The information may be generated in two ways: through studies whereby typical building investment maturation curves are shown or through a constant, direct follow-up of construction work in progress and through investigations on the status of the work. The first method demands a constant update of typical curves since they are more vulnerable to the economic situation affecting the sector; the second is a surer method and guarantees actual information for each construction project.

In Colombia, both methods have been used. For the period 1990-1996, typical maturation curves were used; since 1997, actual information on each project has been used by monitoring the longitudinal panel which is made to buildings during construction in the quarterly building census.

Urban structures

Urban structures account for approximately 90% of all national building activity. The main source of information is the DANE Building Census conducted in seven (7) metropolitan areas which account for 80%, more or less, of all building activity in the country. For the remaining urban structures (20%), a simulation model is used to estimate the main variables for calculating production.

The building census is a study designed by DANE in 1986 and conducted on a quarterly basis using a statistical technique —longitudinal analysis— whereby building patterns and developments can be revealed through their census operators and through its own economic agents. The technique used guarantees accuracy in estimating sector GDP, since its findings reveal precisely construction starts during the period, the prices at which such buildings are bought or sold on the market and the progress of each construction during the intercensal period. The information is available at the construction level and the information system makes it possible to carry out the cross-sectional, longitudinal and historical analyses not only at the macrodata level, but also at the level of each construction project, which provides tremendous scope statistically for computing macroeconomic aggregates.

In the quarterly follow-up, current construction works are identified and entered in the system using a form for data collection which records the main characteristics of construction in terms of area under construction, market price per square metre, status report (construction phase and progress), purpose, units sold and other variables that characterize the work.

In the following censuses, a follow-up is given through other instruments for collection which update their main variables and guarantee knowing their development until the construction process is completed. Similarly, construction projects that have come to a halt are identified and

left pending until the construction work is resumed. The diagram on the following page illustrates the process.

Up to this point, information is available on the status of the construction work and the short-term trends in the building sector can be seen, identifying the construction work underway, work started in the intercensal period and work completed; classified by degree of progress (construction phase; excavation and foundations, structure and roofing, masonry and finishing), socio-economic strata and purpose (apartments, houses, business, office, storage, education, hotels, hospitals, public administration and others). Similarly, precise data is given on the situation with respect to projects that had come to a standstill during the period covered by the previous census.
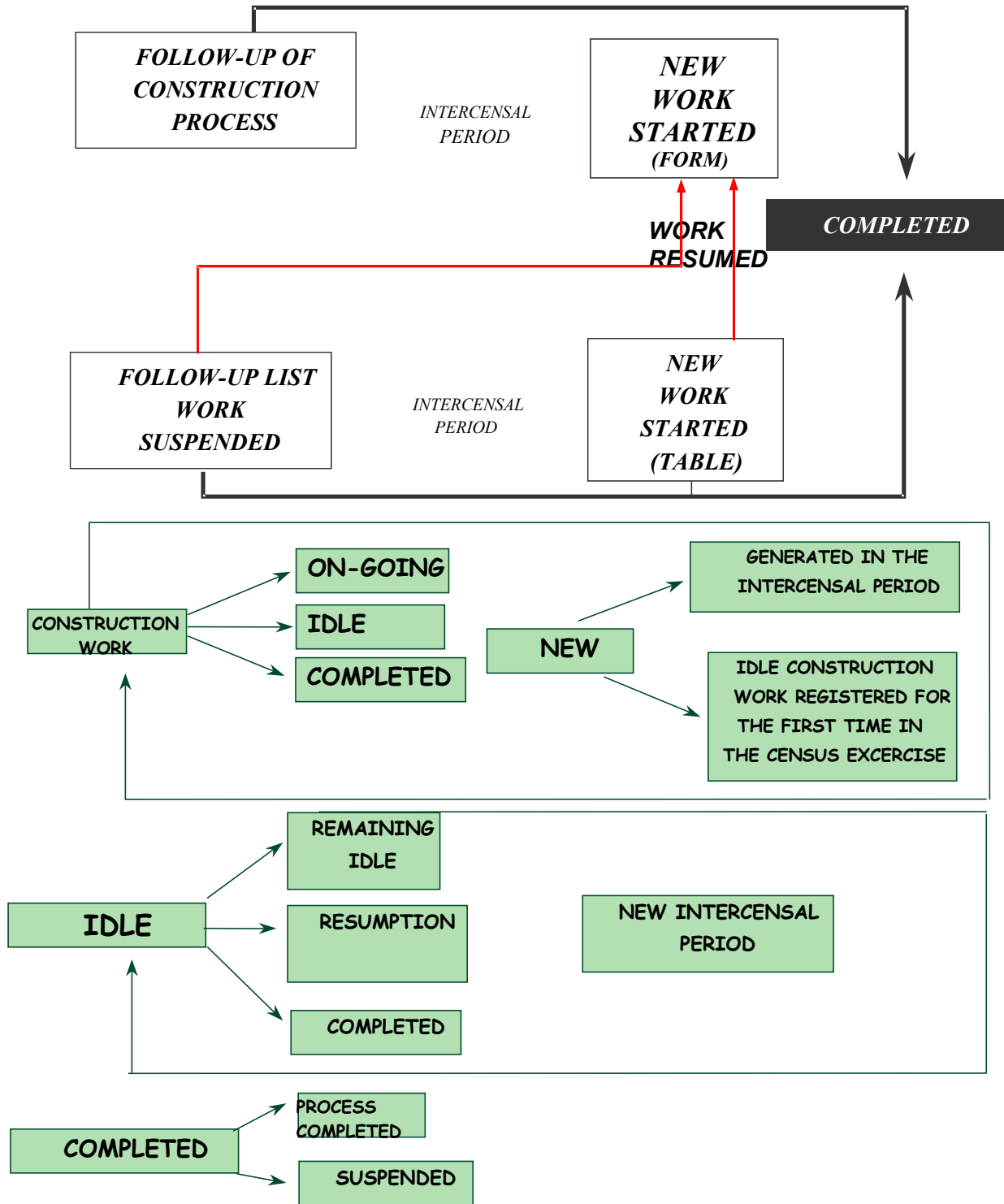
In the case of the building census, information is collected through a preliminary survey and the location of constructions is identified geographically so as to make it relatively easy to proceed

with the longitudinal panel survey in the field. The survey staff, who have links with the construction sector, comb through the cities under consideration in each census exercise. The survey zones are identified on maps and the construction sites to be surveyed in each census operation are known beforehand, except for those sites where operations are just beginning and these are recorded like births.

Work suspended in the previous census period

Work under construction in previous census period
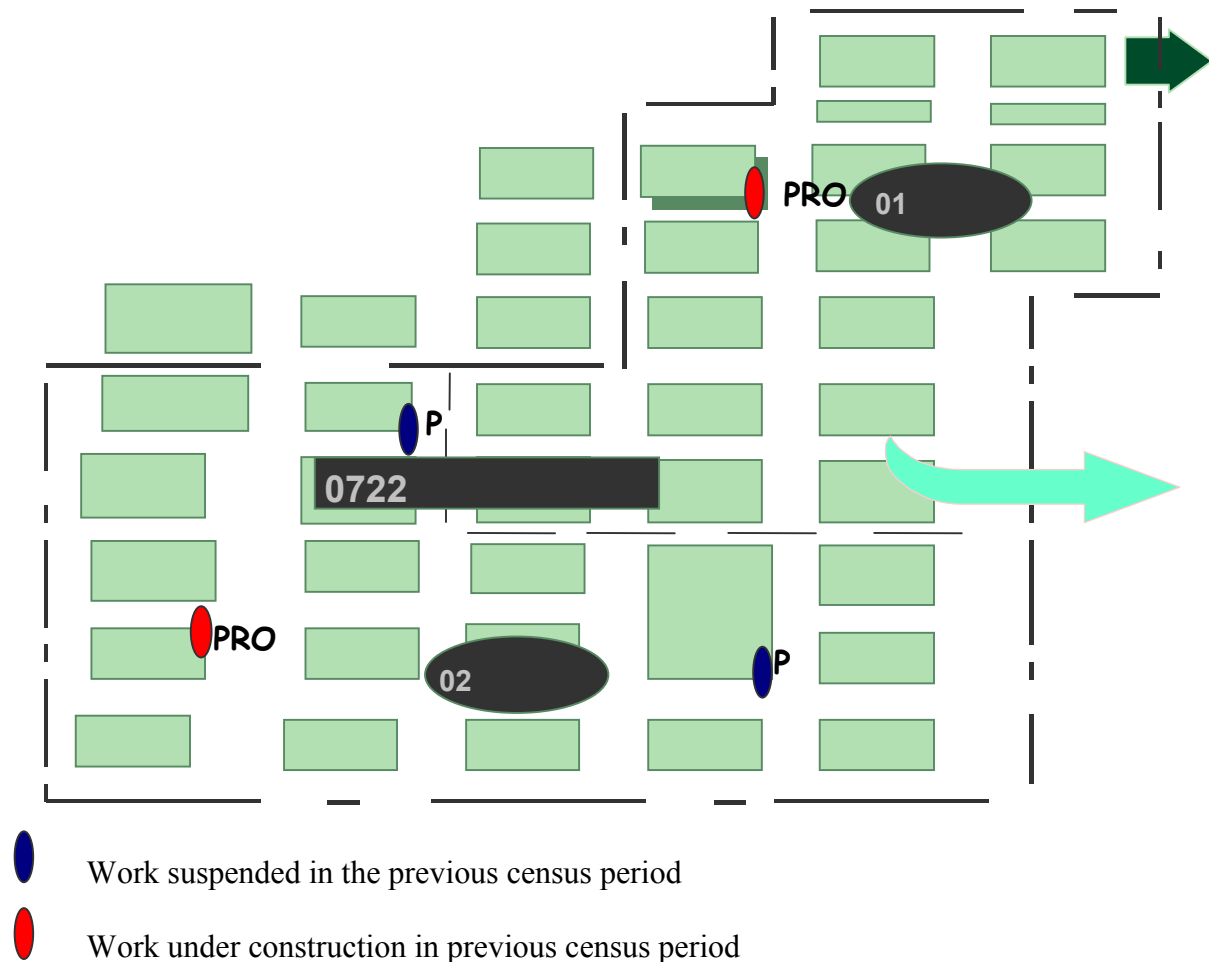
The methodological, logistical, operational and systems components of the Building Census were designed to respond directly to the requirements of the calculation of the building GDP. Currently, the Census is being redesigned to include the follow-up on variables that guarantee the estimation of gross capital formation and the development of a sales indicator for buildings under construction.

Having reviewed the method used for calculating building GDP and the statistical prospects of the Building Census, this instrument reveals accurately the three basic elements for estimation of gross output:

✓ Square metres of new construction starts for the quarter.

✓ Market prices at which buildings under construction are sold.

✓ The progress of the work or monitoring of progress of the construction work.

With these three elements, the estimate of the macroeconomic aggregate is relatively simple and is illustrated in the diagram below.
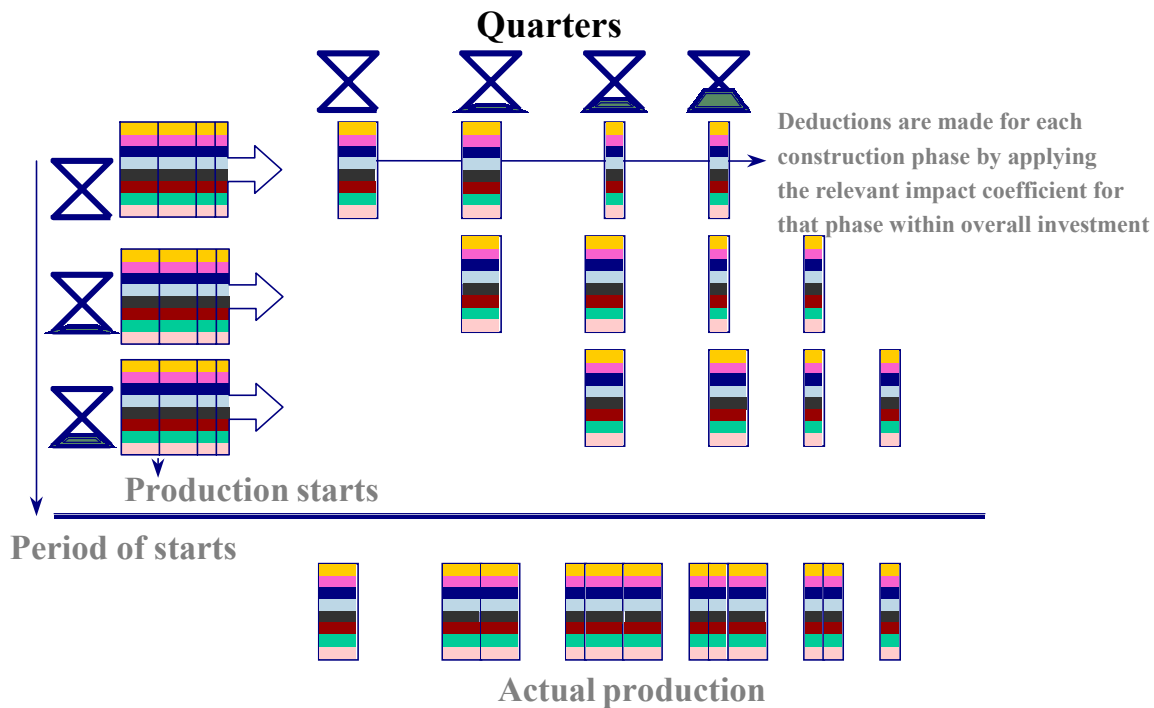

The method used is simple: a matrix is constructed where the rows represent the construction starts recorded in each census (each colour represents the work started in the intercensal period), the columns show the breakdown of information in terms of what has actually been done during the quarter. To achieve this, the system identifies the construction phase reached at the time of the census and applies the impact coefficient within the overall investment. At the end, the total per construction job of these segments must correspond to the number of square metres started.

The sum of the rows corresponds to the construction starts and the sum of the columns corresponds to actual production. The latter is what is taken to estimate gross output in terms of metres or actual area constructed during the assessment period. For the valuation, the market price of each construction is used and for each portion of square metres produced over the period, a valuation is made for the market prices recorded in the Census. Lastly, total gross output for the coverage of the Building Census (7 metropolitan areas equivalent to 80% of total construction activity in the country) is obtained by addition.

To cover the remaining 20%, an estimate is made using a model that simulates the remaining urban construction starts, applying a lag model using statistics based on construction permits.

The remaining geographical cover is classed in two groups. **Group 1**: those locations where there are already lags between authorized construction and those that have been started and **Group 2**: smaller locations, where, on account of their characteristics, it can be said that those authorized are equal to those actually started, in other words, there are no lags.
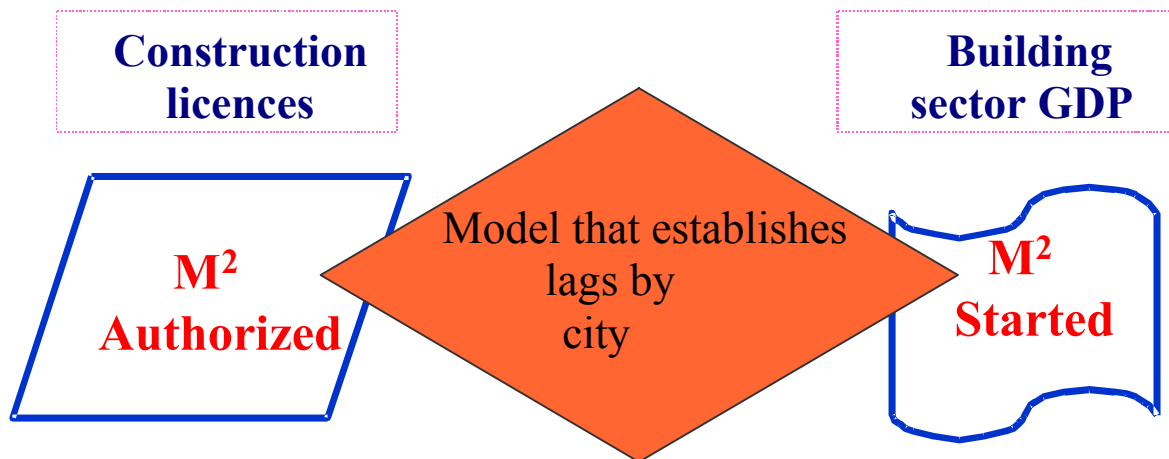
With the procedure developed, historical series are available (quarters 1990-2000) both for licenses and for construction starts for geographic coverage in the Building Census, whereby individual lags can be modeled and those localities selected where the lags are less and these are applied to **Group 1** to estimate construction starts. For **Group 2**, starts are assumed to be equal to construction permits.

As the method is the same for the whole synthesis exercise, a market price must be attributed and a status report given to determine construction starts. For the valuation, the lowest prices in the Census are taken and in order to determine production, typical investment maturation curves prepared by DANE in 1986 are examined.

Rural housing and illegal housing

From this point, methodological developments do not correspond to direct measurement but rather to methods of estimation based on assumptions which enable us to make an approximate assessment of this production. It should be noted that the logic used for the entire synthesis method is the same, that is, some construction starts are identified, recorded and valued at market prices. Where one of the elements is unavailable, methods of estimation or imputation for entering them into the system are sought.

The methodology for producing estimates of rural housing assesses the area of the housing start, based on the rural housing stock, which is converted into square metres using a method that simulates some typical dwellings with characteristics in terms of public services, structure and materials defined in the last housing census. Valuations are made from typical budgets of this type of building. To complete the series of market prices and update the value, the group of materials used are those on the Housing Construction Cost Index (HCCI).

With respect to illegal housing production, a methodology for calculating illegal dwellings based on the difference between the urban housing stock and the number of housing units handed over by the financial system and those delayed despite official approval. For the purposes of this study, illegal housing refers to housing that is constructed without a license. This process enables us to calculate illegal housing, which is converted to square metres with an established typology and is valued at market prices. For valuation, low-cost housing budgets are used. In order to extrapolate and update the original value, the Consumer Price Index (CPI) is used.
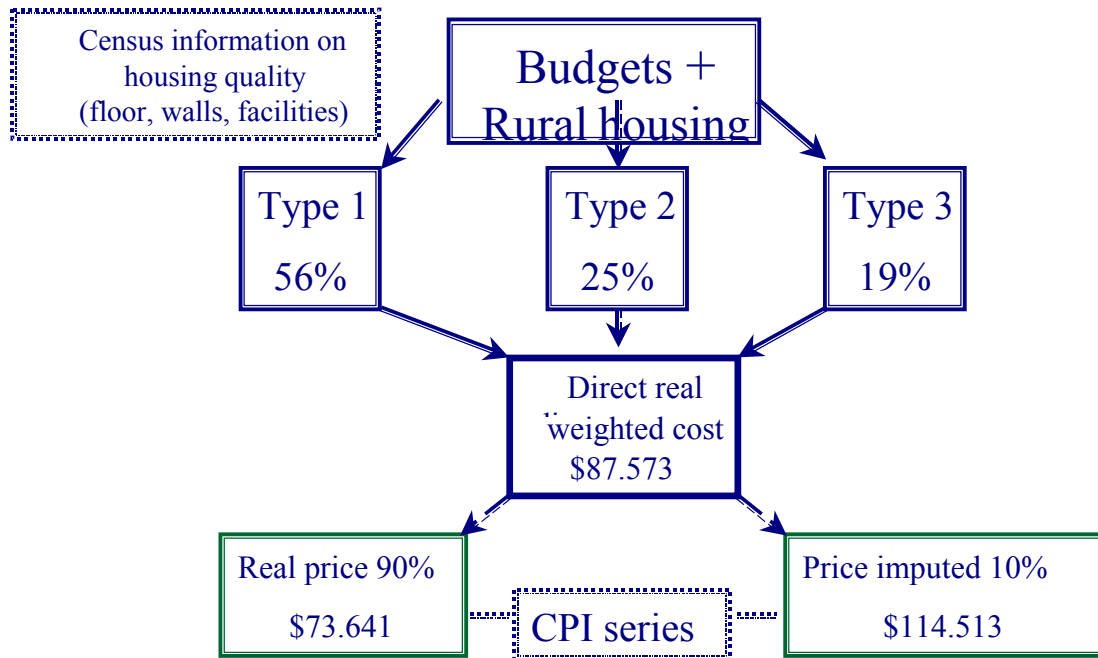
As shown above, the quarterly evaluation of housing stock is of vital importance for an estimation of the production of rural housing and illegal housing, since it is the basis for obtaining construction starts; for this reason, a method had to be devised for producing quarterly estimates for this indicator.

The housing stock estimate reveals the number of housing units constructed in each quarter. In order to convert the area to square metres, models were established of typical dwellings (both rural and illegal), used for estimating average sizes. For rural dwellings, the analysis centred on the physical characteristics of the dwellings relating to the number of bedrooms and this information was used to calculate an average size by department. With respect to illegal housing, owing to lack of information, the size is estimated by simulation.

Once the average sizes have been defined, the housing starts were calculated. The information is generated through simulated maturation curves in keeping with the average duration of this type of work.

The price used for valuation of rural and illegal housing production was estimated through the investigation of budgets relating to this type of construction. In accordance with the characteristics and heterogeneity of rural housing, three types of housing were defined and a single weighted price calculated.

Investigation on the estimation of weighted average prices per square metre started, both in rural and illegal housing is done for a particular period using the Housing Construction Cost Index —(to extrapolate back and update the price of illegal housing)— and the Consumer Price Index (CPI).

Census information on housing quality (floor, walls, facilities)

Budgets + Rural housing

Type 1
56%

Type 2
25%

Type 3
19%

Direct real weighted cost
$87.573

Real price 90%
$73.641

CPI series

Price imputed 10%
$114.513

Housing reforms and repairs

The output of housing reforms and repairs uses the results of the 1984 and 1994 income surveys and expenditure and by interpolation obtains figures for the period between the two surveys. The volume indicator used for the interpolation is the increase in households and the price indicator is the housing construction cost index (HCCI).

Income and expenditure survey Chapter on reforms and repairs

Volume indicator
Increase in households

Price indicator
HCCI

Income and expenditure survey Chapter on reforms and repairs

Volume indicator
Increase in households

Price indicator
HCCI

1984

INTERPOLATION

1994

Projection
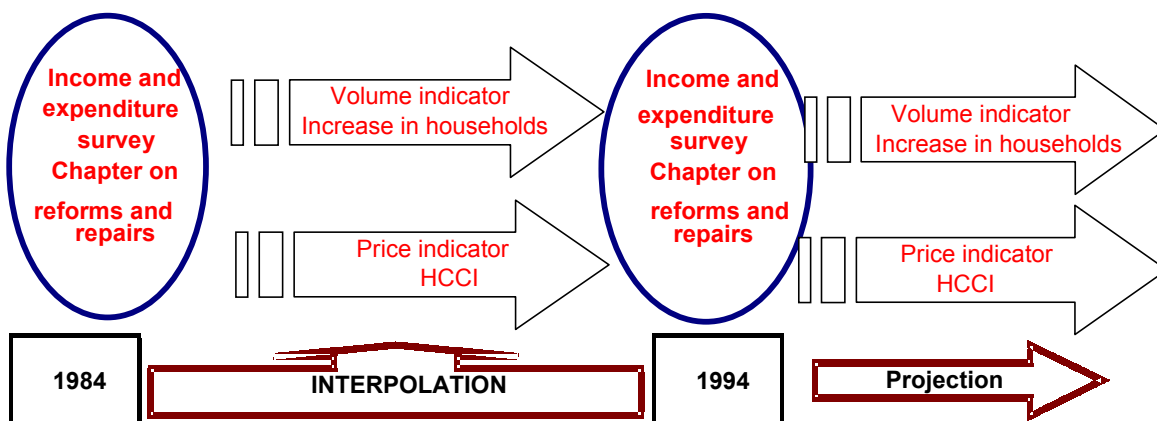
Estimation of the value added of buildings

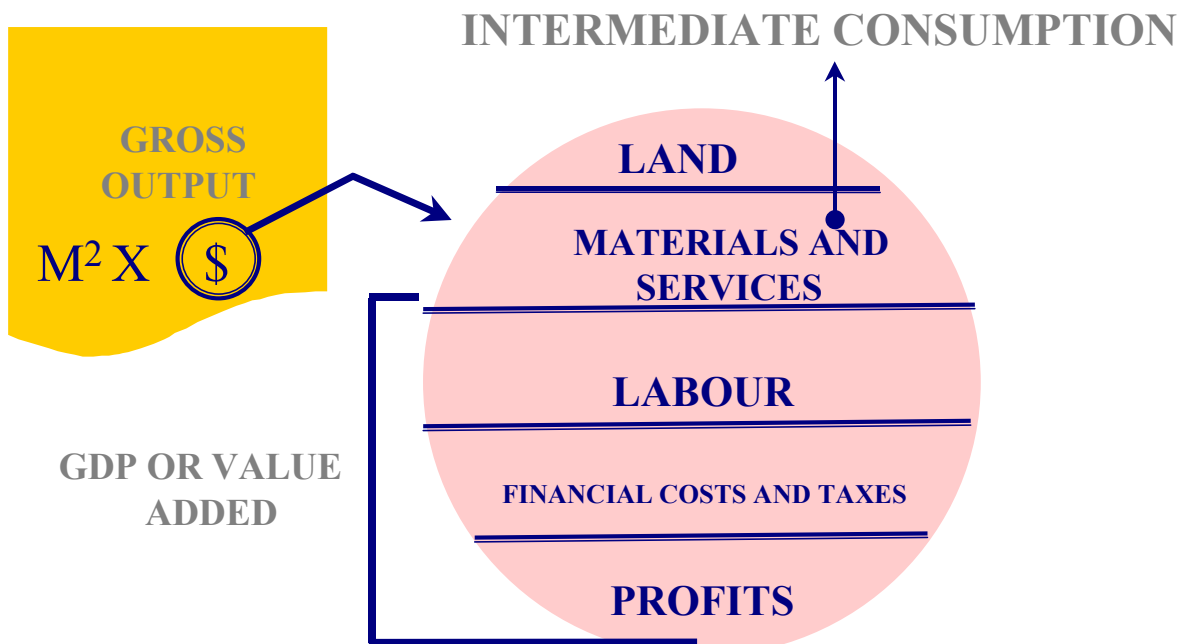For estimating value added or sector GDP, a method has been established that guarantees the breakdown of gross output between intermediate consumption and value added (wages, financial costs, taxes and profits). To succeed in this purpose, a base period was taken and a structural study carried out which gave rise to the following:
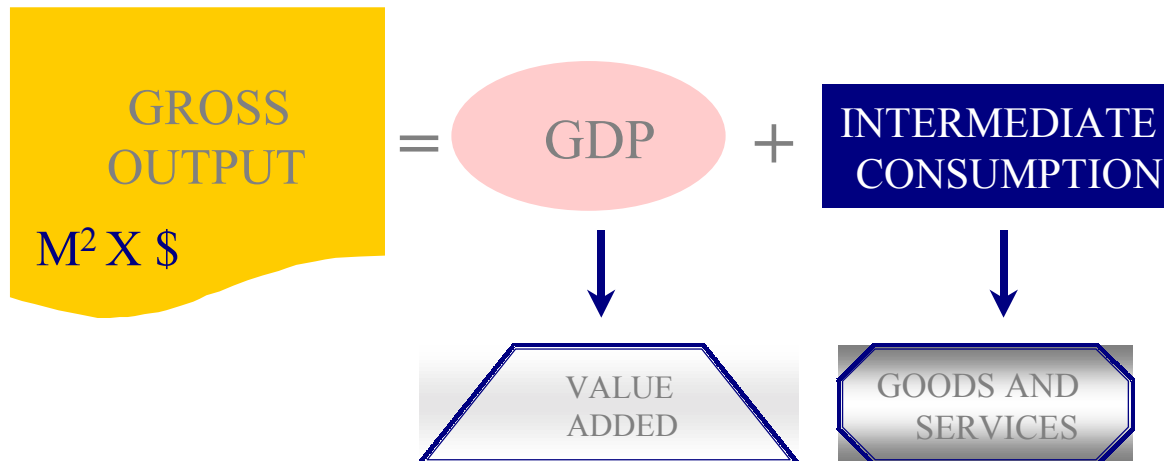
GROSS OUTPUT $M^2 X \$$ = GDP + INTERMEDIATE CONSUMPTION

VALUE ADDED

GOODS AND SERVICES

The study focused on a series of 189 investment flow charts on building construction. The information collected was used to calculate the coefficients relating to the share of the components of gross production in terms of land, materials or goods and services, wages, financial costs, taxes and profits. Once this structure was obtained, it was feasible to break down gross output and obtain the estimate of value added in current pesos for the base period.

Given the vibrancy of the construction sector and considering how dangerous it can be statistically to have fixed coefficients in times of crisis, a methodology has been designed for estimating it on a quarterly basis.

INTERMEDIATE CONSUMPTION

GROSS OUTPUT

$M^2 X$ $\$$

LAND

MATERIALS AND SERVICES

LABOUR

GDP OR VALUE ADDED

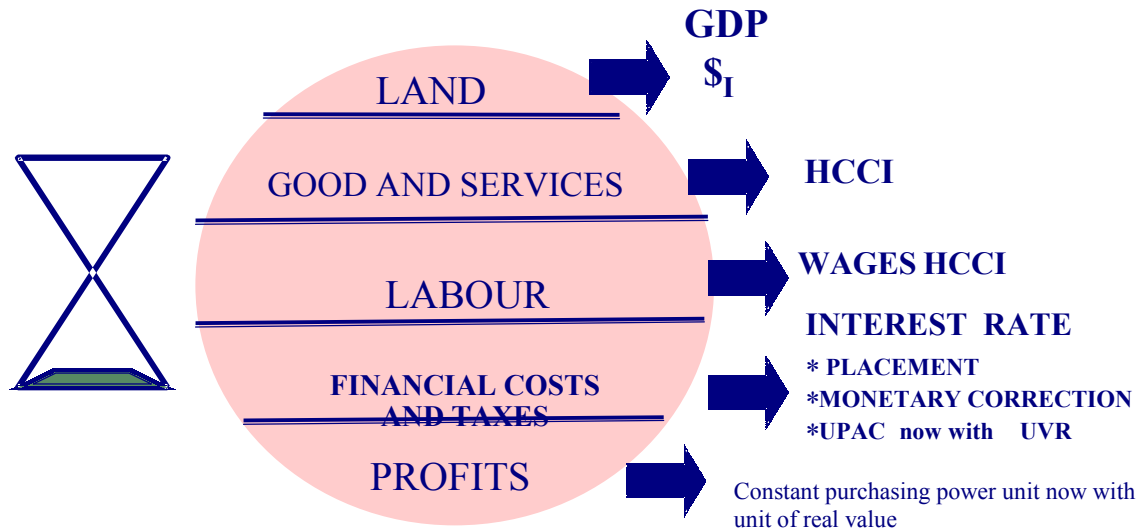**FINANCIAL COSTS AND TAXES**

PROFITS

In order to identify changes in the structure of gross output in terms of its components and to guarantee flexible statistics, the implicit unit price per square metre was taken, multiplied by the coefficients and broken down into its components. In addition, since the number of actual square metres was known for each measurement period, an estimate was obtained for each component for the base period in terms of gross output.

With respect to calculations for the following periods, a price indicator was identified for each component to cater for its variation over time and to obtain in this way outputs for the following periods.

The indicators used for each component are shown in the diagram below and the difference represents the profits. In order to guarantee the consistency of results, various reconciliation procedures had to be carried out to ensure consistency of profits in keeping with the sector's performance or short-term trends.
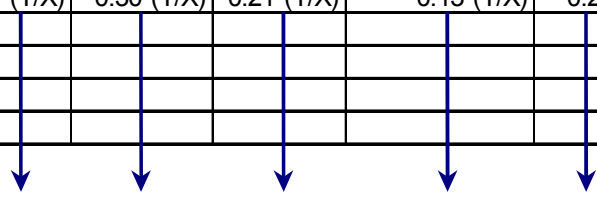
ESTIMATE OF INDICATORS FOR DEVELOPING INDICES

GDP
$_I$

LAND

GOOD AND SERVICES — HCCI

LABOUR — **WAGES HCCI**

INTEREST RATE
FINANCIAL COSTS AND TAXES
* PLACEMENT
*MONETARY CORRECTION
*UPAC now with UVR

PROFITS

Constant purchasing power unit now with unit of real value

In this way, sector value added was estimated in a dynamic way and does not react to the application of fixed coefficients, which enables us to show actual variations in this indicator, which depends basically on the sector's economic performance, since the main variables (wages, profits and financial costs) are highly vulnerable to the business cycle as it affects the sector.

It is important to note that although the general method is the same, different indicators are chosen to develop the price components of rural and illegal housing. Similarly, some variants have been introduced into the system in terms of what is deemed to constitute actual output (that produced by economic agents) and that which must be ascribed as not responding to market conditions (self- or own-account construction) in these two types of building.

PERIOD	M2	$I	OUTPUT	LAND	GOODS AND SERVICES	WAGES	FINANCIAL COSTS AND TAXES	PROFITS
I/90	X	Y/X		Y 0.11*(Y/X)	0.30*(Y/X)	0.21*(Y/X)	0.13*(Y/X)	0.25*(Y/X)
II/90								
III/90								
IV/90								
I/91								

FORMAL CONSTRUCTIONS
RURAL HOUSING
ILLEGAL HOUSING

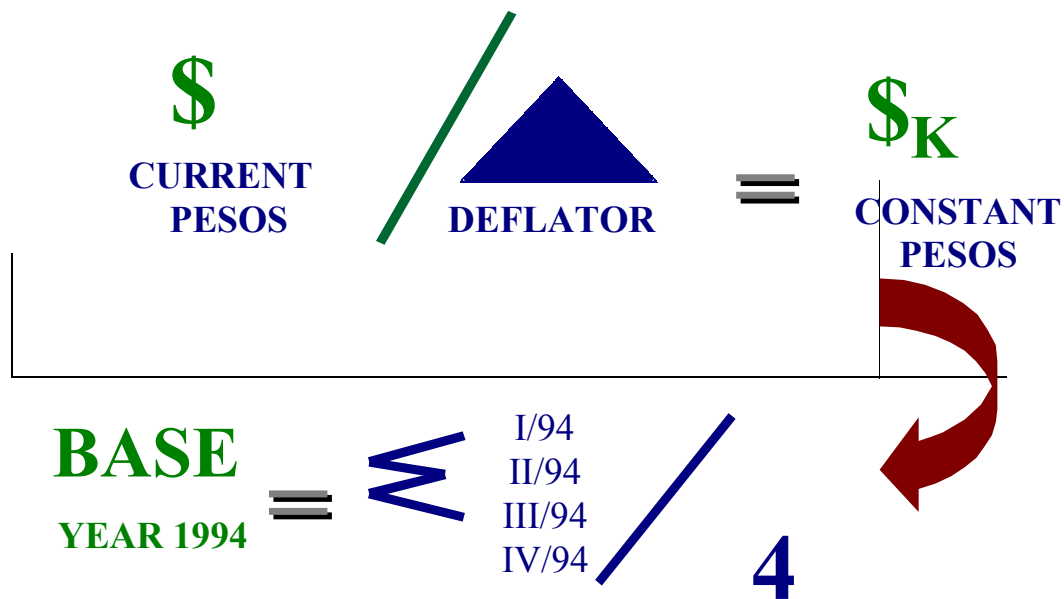| PERIOD	M2	OUTPUT	$I		GOODS AND SERVICES		WAGES	FINANCIAL COSTS AND TAXES	PROFITS
I/90	X	Y/X	Y				0.21*(Y/X)	0.13*(Y/X)	0.25*(Y/X)
II/90									
III/90									
IV/90									
I/91									

REFERENCE

INTERMEDIATE CONSUMER ITEMS

VALUE ADDED

Conversion to constant pesos

To date, gross output and value added are available in current pesos. These macroeconomic aggregates have been converted to constant pesos using the housing price index as a deflator.

The housing price index is a Paasche type chain index, which shows the relationship between the weighted average of prices of the reference period and the base period, these being the weightings of square metres constructed for each work corresponding to the reference period. Based on prices and areas reported in the Building Census, the indicator allows an accurate assessment of trends in building prices.

As the base period is one quarter, base year quarters must be adjusted to obtain the equivalent between the base year for the annual accounts (1994) and the sum of the quarters of this year, of the quarterly indicator.

$$ \frac{\$}{\text{CURRENT PESOS}} \Big/ \text{DEFLATOR} = \$_K \text{ CONSTANT PESOS} $$

$$ \text{BASE YEAR 1994} = \frac{\sum \begin{array}{l} \text{I/94} \\ \text{II/94} \\ \text{III/94} \\ \text{IV/94} \end{array}}{4} $$

Availability and disaggregation of information

Quarterly statistics have been available since 1990. For the period 1990-1996, sources of information included new construction areas started and market prices, and the Supply and Demand Censuses carried out by the Colombian Chamber of Construction – CAMACOL. To assess the status of construction works, a typical study on investment maturation curves was designed and applied to the available information to obtain production.

Since 1997, the findings of the DANE Building Census has been taken as source of information.

The levels of disaggregation of information depend on the availability of basic statistics and are shown in following diagram.
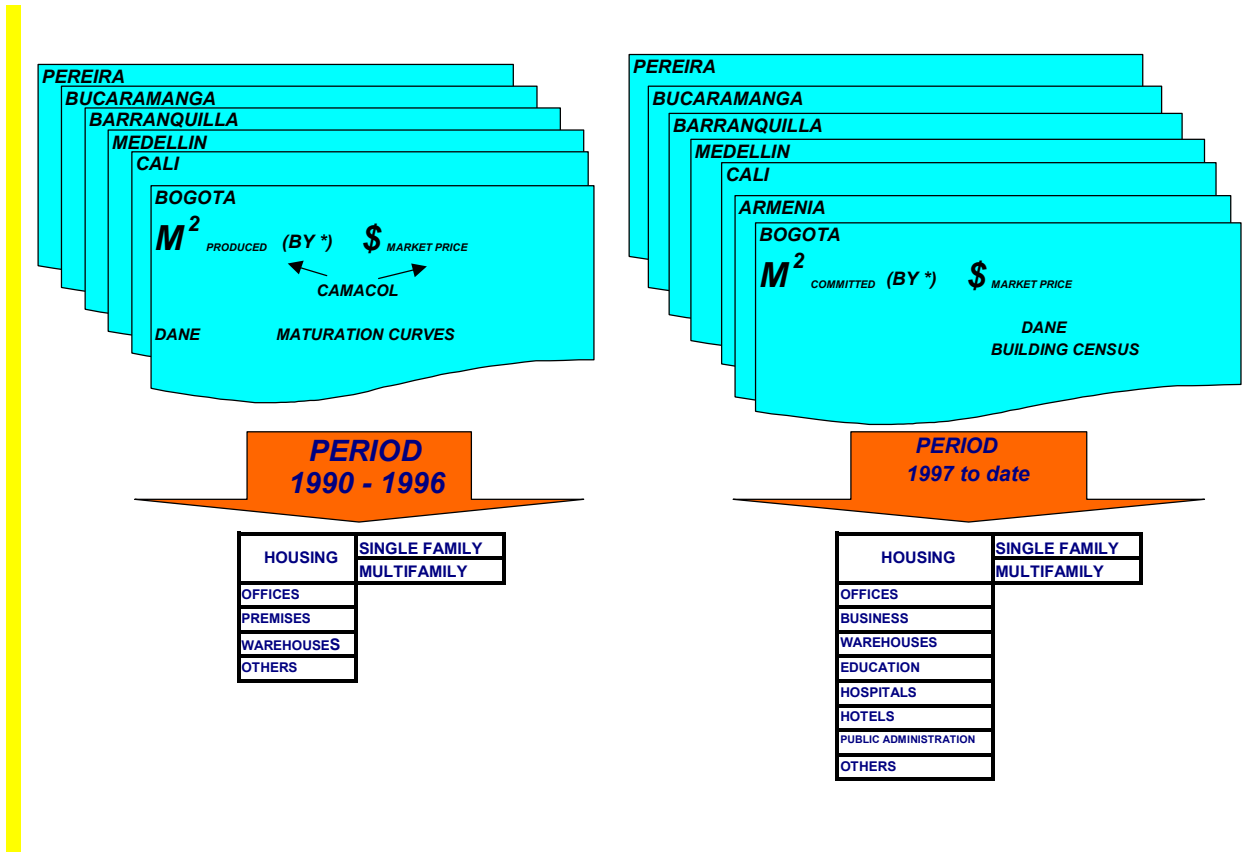
Estimation of production of the branch of housing rentals

The method used to estimate housing rent output relies on the availability of relatively precise information on the number of dwellings existing in each period and for its valuation statistics are required on the rentals for each housing unit. Output is no more than the multiplication of the number of dwellings by the average rent for each study segment.

Housing census and finance

HOUSING

STOCK

BY TYPE OF OCCUPATION

National household survey

AVERAGE RENTAL

$
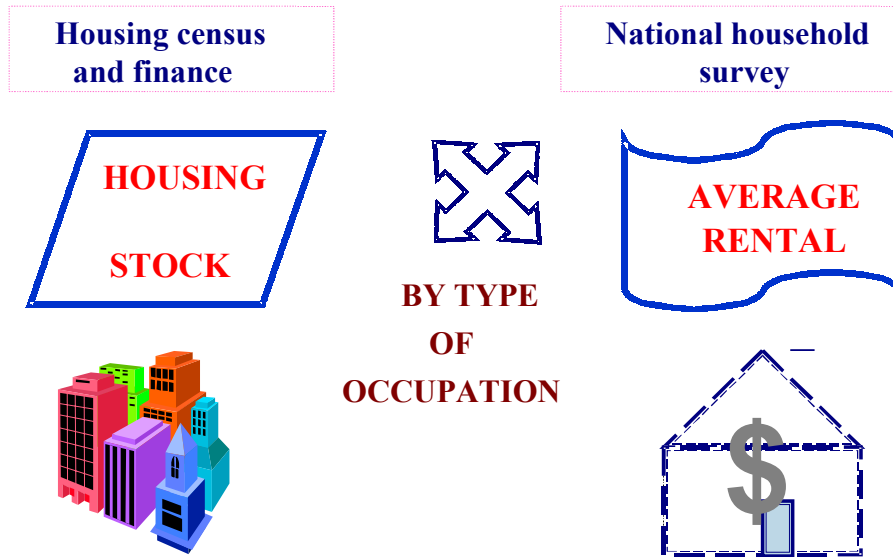
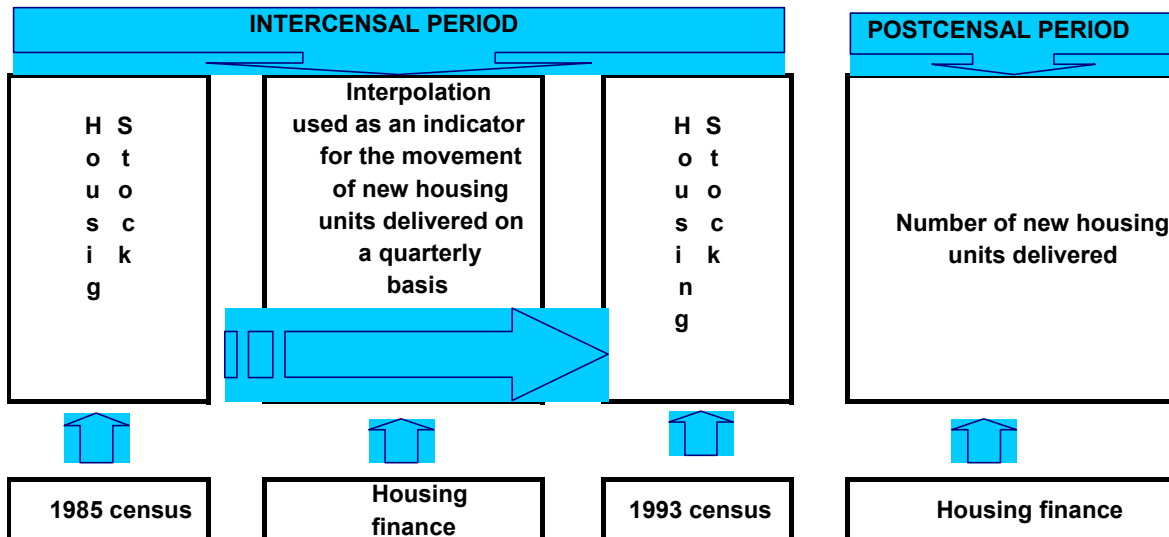In order to dispose of statistics relating to the number of dwellings, a methodology was developed and implemented to provide up-to-date quarterly housing stock figures. The housing stock is the total number of dwellings existing in the country, which are recorded in the housing censuses held each decade. In order to estimate housing stock on a quarterly basis, in intercensus as well as post-census periods, a methodology was designed which by interpolating census results, disaggregates dwellings located in the chief town and elsewhere, by type of occupation (owner-occupied, rented and other categories of occupation). The information was obtained from the 1985 and 1993 housing censuses and the number of housing units delivered as reported by the quarterly investigation on "housing finance" conducted by DANE was used for the interpolation.

INTERCENSAL PERIOD

POSTCENSAL PERIOD

Housing Stock

Interpolation used as an indicator for the movement of new housing units delivered on a quarterly basis

Housing Stock

Number of new housing units delivered

1985 census

Housing finance

1993 census

Housing finance

For the breakdown per type of occupation, the results of the housing censuses were taken into account and these coefficients interpolated.
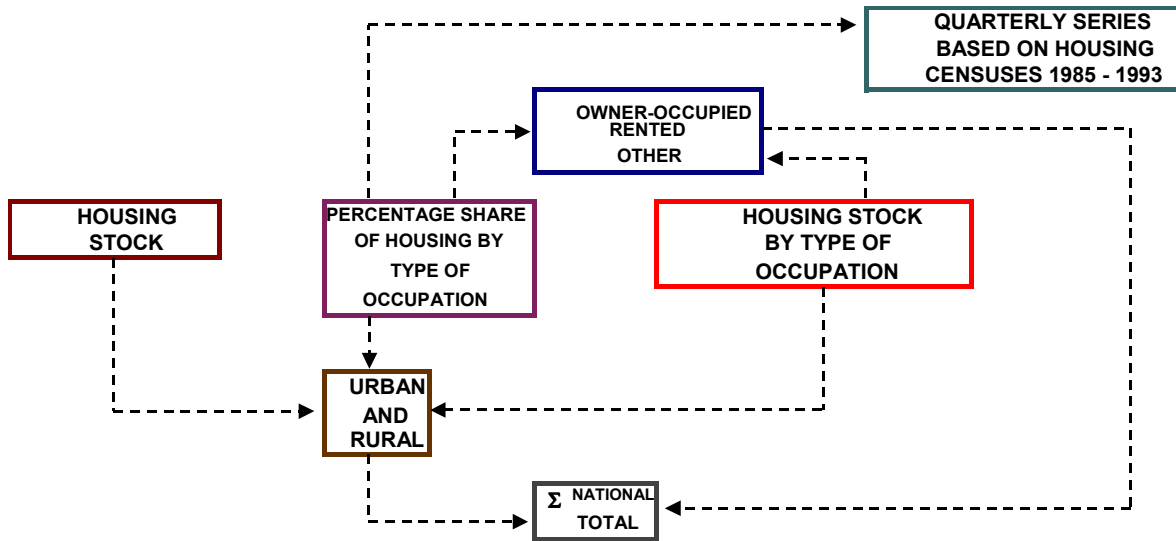
The average rentals are estimated from the results of the housing module of the National Household Survey, where the rent paid by households for their housing unit is investigated

In accordance with the results of the housing module in the National Housing Survey, dwellings are classified as follows: owner-occupied, rented and other type of occupation as reported by the households surveyed
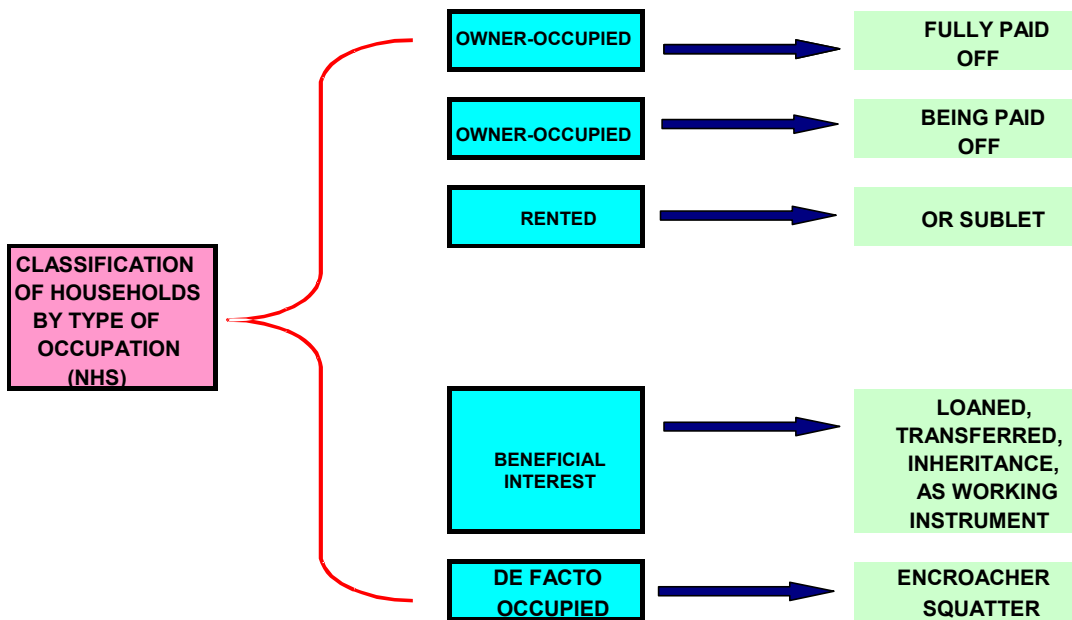
Since the information relating to rents reported by owner-occupiers is skewed compared with the economic reality, it was necessary to seek a method of estimation based on actual rentals. For this purpose, the average rent per room was calculated and this was applied to estimate the rent of housing units. The foregoing was done on the assumption that the difference between actual rentals and those ascribed is based fundamentally on the size of the dwelling. It would have been use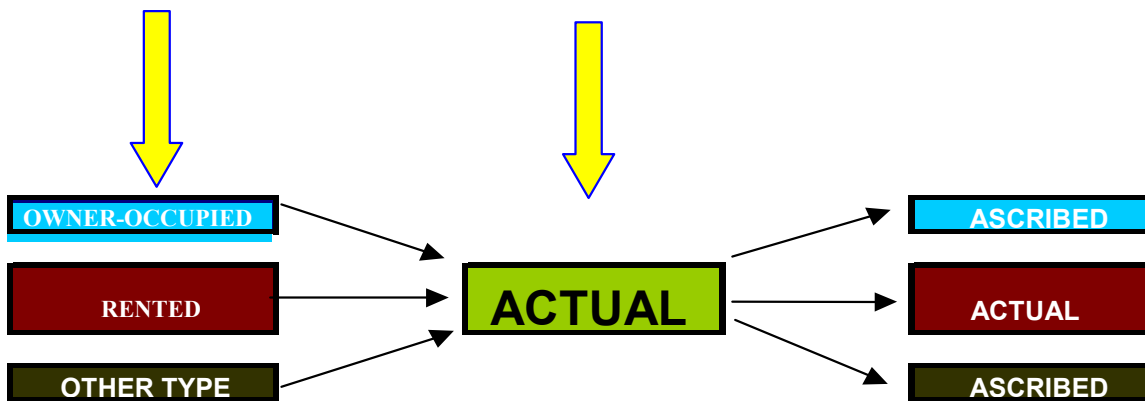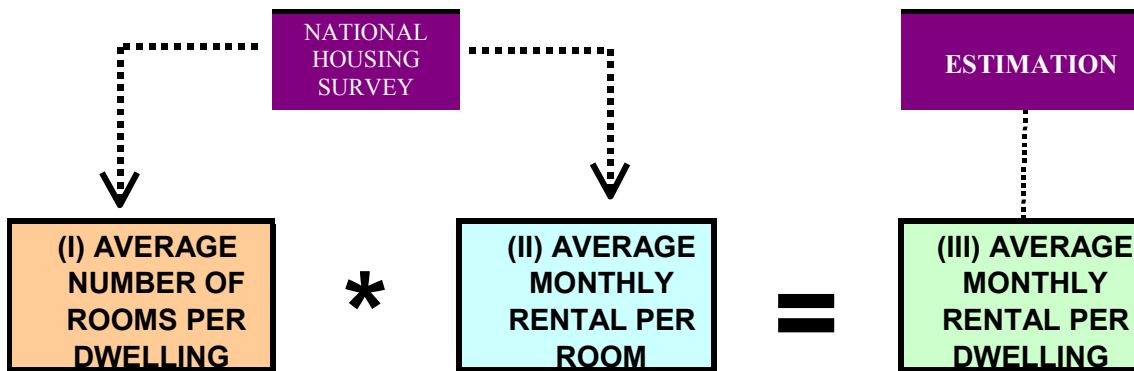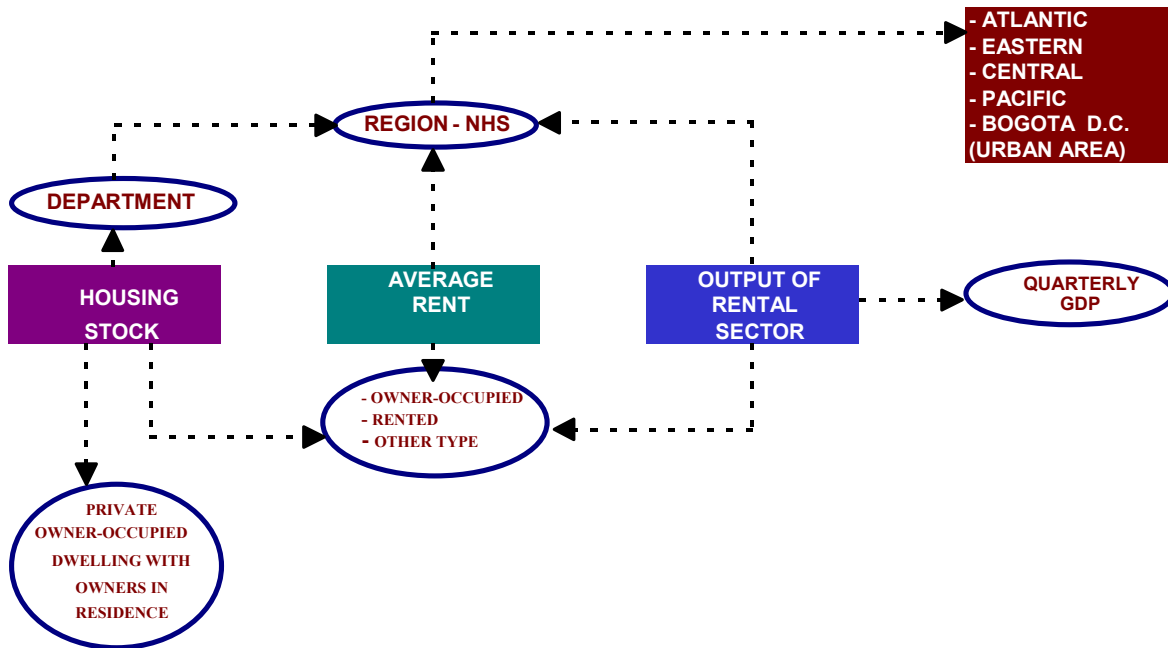ful to combine this analysis with an indicator of quality of the dwellings, but the results of the available information did not allow this.

```
          NATIONAL                          ESTIMATION
          HOUSING
           SURVEY

   (I) AVERAGE        (II) AVERAGE         (III) AVERAGE
    NUMBER OF          MONTHLY               MONTHLY
   ROOMS PER    *    RENTAL PER    =       RENTAL PER
    DWELLING             ROOM               DWELLING


   OWNER-OCCUPIED                            ASCRIBED

      RENTED            ACTUAL               ACTUAL

    OTHER TYPE                               ASCRIBED
```

Since the housing module of the National Household Survey is held in September, the rental CPI is used for the quarterly estimate of rentals. Once information is available on the housing stock for the chief town and other urban areas by type of occupancy (rented, owner-occupied and others) and on the average rental for each group, the output of the housing rental market is obtained by multiplication.

```
                                                              ┌──────────────────┐
                                                              │ - ATLANTIC       │
                                              ┌ ─ ─ ─ ─ ─ ─ ─▶│ - EASTERN        │
                                              ┊               │ - CENTRAL        │
                                              ┊               │ - PACIFIC        │
                                              ┊               │ - BOGOTA  D.C.   │
              ┌ ─ ─ ─ ─▶(  REGION - NHS  )◀─ ─┊─ ─ ┐          │ (URBAN AREA)     │
     (          )        ▲                        ┊          └──────────────────┘
     ( DEPARTMENT)       ┊                        ┊
     (          )        ┊                        ┊
              ▲          ┊                        ┊
    ┌─────────┊──┐  ┌──────────────┐  ┌──────────────┐        (            )
    │  HOUSING   │  │   AVERAGE     │  │  OUTPUT OF   │─ ─ ─ ─▶(  QUARTERLY )
    │            │  │    RENT       │  │   RENTAL     │        (    GDP     )
    │  STOCK     │  └──────────────┘  │   SECTOR     │
    └────────────┘         ┊         └──────────────┘
          ┊         ( - OWNER-OCCUPIED )◀─ ─ ─ ─ ─ ─ ┘
          ▼         ( - RENTED          )
    (            )  ( - OTHER TYPE      )
    (  PRIVATE   )
    (OWNER-OCCUPIED)
    (DWELLING WITH )
    ( OWNERS IN   )
    ( RESIDENCE   )
```

Availability and break-down of information

Quarterly housing stock statistics have been available since 1985. Statistics on average rentals and the output of housing rentals are available for the period 1990-2000.

Data on housing stock, average rentals and output are presented for the chief town and other urban areas and within each group, detailed statistics are available per type of occupancy (owner-occupied, rented and other). The break-down is given for the major geographic zones in the country.