Investment in New Residential Building Construction

(Work put in place)

Methodology

Investment and Capital Stock Division

Methodology

The investment in new residential building construction[1] may be divided into two major categories. The first one being the **work put in place,** which represents the value of construction for the four principal dwelling types (singles, doubles, rows and apartments) during a given period. The second category **Other new construction** regroups the investment for cottages, mobile homes and conversions[2] and also acquisition costs such as taxes, land development costs and other related costs.

This paper focuses on the first category. The following equation is used to calculate the **work put in place for new residential building construction**:

$$I_t = \sum_{i=0}^{20} (SC \times HS)_{t-i} WPIC_{i+1,t-i} \quad (1)$$

Variables are defined as follows:
I_t : Value of work put in place for new dwellings in t^{th} month
SC: starting cost of the new housing
HS: number of housing starts
WPIC: "work put in place" coefficient
i: number of months covered by the methodology.

Thus, three fundamentals are required here: the housing starts, the starting cost of the newly built homes and the "work put in place" coefficient. All three variables will be discussed in detail. For a better understanding of equation (1), we will first look at the steps in obtaining the work put in place value.

1st *Step : Building permits*

This step is based upon the monthly **Building Permits** survey which gathers building permits information provided by nearly 2,400 municipalities covering 95% of the Canadian population. The results of this survey represent the construction *intentions* of a current month, rather than the construction *investments*. It is important to note that once a permit has been issued for a new dwelling, construction may or may not proceed immediately thereafter. Investment levels for a given period are determined in accordance with the value of building permits for the current month, along with values of permits from previous months. This survey serves as the basis for the CMHC housing starts survey and as the only possible source of values which can be properly associated with construction projects.

[1] As defined by the Income and Expenditure Accounts Division
[2] **Conversions** are additional housing units created from non-residential buildings or other types of residential structures.

2nd Step: Starting cost (SC)

It is essential to determine a representative cost to be used in the work put in place calculation.

The starting cost corresponds to the average construction value assigned to the housing starts for a given month.

The following example illustrates the calculation process:

(1) Suppose we want to obtain a starting cost for a given month - July. First, the average value of building permits issued is computed for July and the four preceding months. Using a blow-up coefficient, the calculated average is then boosted. The adjustment process is required because generally the declared cost expected for a housing project is undervalued, mainly due to unexpected costs in the construction process.

(2) A **realization rate** then can be assigned to each month (in our example, from March to July). The realization rate represents the proportion of newly authorized units between March and July (from the Building Permits Survey) that will be transformed into housing starts in *July*. The sum of these proportions is equal to 100 %. The arrangement is necessary to reflect lags between construction intentions and the beginning of the projects. Usually, a housing start will take place within the five months following the issuing of a permit.

The realization rates vary by province and dwelling type so as to ensure that the diversity of construction projects and geographical areas are properly taken into account.

(3) For each month (in our example from March to July), the multiplication between the average value of the building permits and the realization rate are computed. The sum of these multiplications will lead to the **starting cost** attributed for July. The following table illustrates the previous example (fictitious values):

Table 1: A starting cost calculation

Months	Building permits average in $ (1)	Realiza-tion rate for July (2)	Multipli-cation of (1) & (2)
July	136,000	4 %	5,440
June	165,000	58 %	95,700
May	142,000	22 %	31,240
April	124,000	8 %	9,920
March	110,000	8 %	8,800
Total:		**100%**	**151,100**

As table 1 shows, the starting cost would be $151,100 in July. The whole procedure is repeated for each month, and the starting cost varies from month to month.

3rd Step: Housing starts (HS) and completed units

Two critical elements are provided by the survey from CMHC: the **housing starts** (HS) and the **completed units**. The results are used to determine, if and when the building permits issued by the municipalities, have materialized into real investment projects and to obtain a project count. The total number of housing starts is multiplied by the starting cost in the investment equation.

Second, the CMHC survey also provides the number of projects which have finished during a given month: the "**completed units**". This information can be split by construction duration. These numbers are the basic requirements for the computation of the work put in place coefficients (WPIC). The following table is an example of the "completed units" survey's result:

Table 2: Completed single dwelling units in 19XX, Ontario

Month	Construction duration					
	1	**2**	**3**	**4**	**…**	**Total (mthly)**
Jan	41	81	108	136	…	***10 47***
Feb	38	63	103	95	…	**691**
Mar	32	50	114	170	…	**967**
Apr	65	100	328	392	…	**1710**
…	…	…	…	…	…	…
Total (year)	654	2013	3921	4095	…	22860

For instance, if we consider January 19XX, 1047 units were completed in Ontario, and among them, 41 required 1 month of work, 81 required 2 months, and so on.

4th Step: Work put in place coefficients (WPIC)

For the estimation of the investment levels, it is also important to consider how long it will take entrepreneurs to put their investment intentions into effect. To do this, the "work put in place" units are computed through a two-step process:

1) Percentage of construction added

First, a percentage of construction added is assigned to each month of construction activity (which can be extended to 21 months). More precisely, such a coefficient is a percentage value assigned to each month following the housing starts, in order to reflect the approximate completion level of the projects.

Broadly speaking, the value of these percentages are established according to the number of months required for completion, the starting month, the region where the construction project is taking place (Atlantic, Quebec, Ontario, Prairies or British Colombia), and the dwelling category in which the project falls (single, double, row or apartment). This component of the investment computation process has not been recently revised.

For instance, consider the case of a single dwelling unit starting in January, in Ontario. If the project requires only one month to be done, the percentage number assigned to the first month will be 100%. But if the project requires two months before its completion, the coefficient will be 49% for the first month and 51% for the second month, and so on. It is possible that the work time might extent to 21 months, but only a few projects reach such an extreme. In fact, **only a small proportion of construction projects require more than one year to complete**.

The following table shows the "percentage of construction added" applied in the case of a single dwelling in Ontario, in January:

Table 3: Distribution of the percentage of construction added, single dwellings in Ontario, January

Months	% of construction added					
	1	2	3	4	5	…21
1	100%	0%	0%	0%	0%	…0%
2	49%	51%	0%	0%	0%	…0%
3	35%	37%	28%	0%	0%	…0%
4	22%	29%	29%	20%	0%	…0%
5	30%	25%	20%	13%	12%	…0%
…21	1%	10%	0%	0%	0%	...11%

2) Output during the month of activity

The next step is the computation of the **output during the month of activity**, using the data of table 2 and table 3. The following example illustrates the distribution process.

Suppose we want to display the output of January 19XX, 1047 units were completed according to table 2, where 41 took one month to build, 81 took two months, 108 took three months, and so on.

For the construction projects that required only one month to complete, all 41 units will be displayed in the first month of activity. But in order to reflect the progress of work on the 81 construction projects that took two months before completion, what amount should be considered to belong to *the first month of activity*? According to the percentages of table 3, this would be $49\% \times 81 = 40$ "equivalent units". What amount for the 108 units completed within 3 months should be considered *in the first month of activity*? Also, according to table 3, this would be $35\% \times 108 = 38$ "equivalent units", and so on. This process is continued until the distribution for January's 1047 completed units have been spread over 21 months of activity.

From this example, the following table can be built:

Table 4: Physical output by duration of construction and month of activity, single dwellings in Ontario, January 19XX

Duration/ Month of activity	**1**	**2**	**3**	**4**	**…**	**Total units**
1	41	0	0	0	…	**41**
2	40	41	0	0	…	**81**
3	38	40	30	0	…	**108**
4	30	39	39	27	…	**135**
…	…	…	…	…	…	**…**
Total	265	240	185	137	…	***1047***
WPIC coefficient	**25.3**	**22.9**	**17.7**	**13.1**	**…**	**100**

Once the distribution process is completed, the computation of the WPIC can be carried out by summing the physical output for each column of table 4 and dividing these sums by the total number of completed units in January.

5th Step: Value of work put in place (I_t)

At this point, all the variables required for the computation of the work put in place by means of equation (1) – SC, HS and WPIC – have been derived by going through the preceding steps. If we assume that we have all these variables for January 19XX and the previous months, the following comprehensive table (in the case of single dwellings in Ontario) can be produced:

Table 5: Work put in place variables, single dwellings in Ontario

Month Of start	**HS**	**SC**	**WPIC (%), by progress of work**				
			1	**2**	**3**	**4**	**…21**
Jan-xx	1157	144987	**25.3**	22.9	17.7	13.1	…0.1
Dec-xx	1627	141593	26.0	**24.0**	18.0	10.2	…0.1
Nov-xx	1875	141288	24.0	27.0	**18.0**	11.1	…0.1
Oct-xx	2031	139520	24.0	28.1	22.3	**10.2**	…0.1
Sep-xx	2141	139313	23.0	29.5	20.5	10.4	…0.1
…	…	…	…	…	…	…	…

The investment for a given month (t) will depend not only on the housing starts and the starting cost of the current month, but also on the progress of the construction projects launched during the previous months. If we assume that the value of work put in place sought is the one for January 19XX, the application of equation (1) would yield the following:

$$
\begin{aligned}
I_t &= (1157 \times 144987) \times 0.253 \\
&+ (1627 \times 141593) \times 0.240 \\
&+ (1875 \times 141288) \times 0.180 \\
&+ (2031 \times 139520) \times 0.102 \\
&+ \ldots
\end{aligned}
$$