Improvements to estimates of quarterly fixed asset depreciation

Group of Experts on National Accounts
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Background: why improvements were needed

- Annual capital stock program:
  - Investment flows by industry, asset and region were not consistent with the SUT, nor that of GFCF in expenditure-based GDP,
  - Consistency at the aggregate level, where the difference was pro-rated among the dimensions,
  - Depreciation profiles were not based on reported services lives;

- Quarterly CFC for income-based GDP estimate:
  - CFC for the year divided by 4 from the annual capital stock program,
  - Beyond the annual program, projected using the growth rate of investment.

It was decided to redesign the capital stock program, where compilation would start with quality estimates at the lowest level which would permit robust estimates of stock and depreciation.

First step: Improve annual capital stock program

- **Investment** series to be linked to the final demand from the SUT by industry (54), asset (91) and region (13) dimensions;

- Beyond and prior to the SUT years, use annual capital investment from expenditure-based GDP estimate, with dimensions from the Annual Survey of Capital and Repair Expenditures (CAPEX);

- **Prices** consistent with those from the capital investment for GDP;

- Integrate both non-residential and residential investment in the **Perpetual Inventory Method** (PIM);

- Update the **depreciation profiles** using estimates derived from survey responses.

Develop a robust depreciation profile

- Depreciation profiles by asset were developed based on responses from the annual CAPEX survey;

- Survey asks respondents the expected useful life of new acquisitions and age of asset (and value) for disposal and sales;

- Use of both ex-ante and ex-post gives a more reliable estimate of service life of an asset.

| Asset code	New Assets including financial leases (include used fixed assets if imported)	Purchase of Used Canadian Assets	Renovation Retrofit Refurbishing Overhauling Restoration	Total Capital Expenditures (sum of columns 2, 3 and 4)	Expected Useful Life of Assets in Column 2
Columns (1)	(2)	(3)	(4)	(5)	(6)
	CAN$ '000				Years
a)	,000	,000			

New assets

Disposals and sales of fixed assets			
NON-RESIDENTIAL CONSTRUCTION/MACHINERY AND EQUIPMENT Please provide a breakdown by Asset code for the following: (Please refer to the reporting guide for codes)			
Asset Code	Selling Price	Gross Book Value	Age (Years)
c)	,000	,000	

Old assets
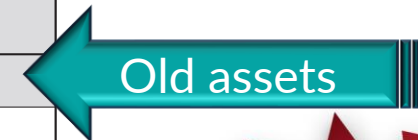
Updated service lives

	Indust build	Comml build	Institu build	Marine eng	Transportation	Mining eng	Oil & gas eng	Electric pwr eng	Comm eng	Waterwrks	Sewage	Aircraft	Trucks	Ships, boats	Metalwrk	Computers	Comm equip	Furniture
1961	35	40	43	41	37	20	27	48	31	42	37	17	10	21	19	9	20	13
2012	26	28	34	28	28	14	17	31	17	31	26	15	7	17	14	4	9	9
new SL	28	27	35	28	30	14	30	40	20	39	36	16	10	20	11	4	9	9

Range of service lives, previous range vs new
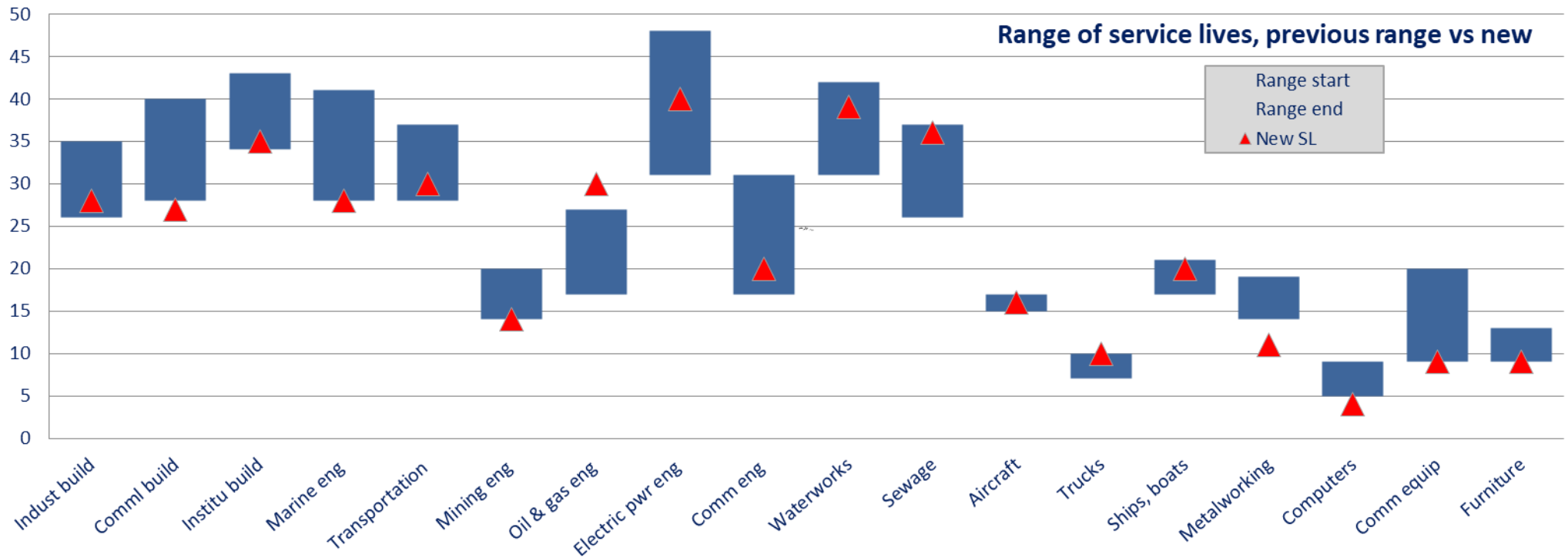
Next step: Development of a quarterly PIM

- Replicate the annual program to a quarterly space (geometric method only) for 1981Q1 onward;

- Required: quarterly investment flows, prices, starting stock, depreciation rate:
  - **starting stock** was the end-year estimate by industry, asset and region from the annual capital stock program for 1980;
  - use compound of **depreciation rate** in annual capital stock system where annual depreciation rate is R = declining balance rate/service life, then the quarterly rate would be **r= 1-(1-R)^(1/4)**
    - *assuming the asset depreciates at a constant rate each quarter*

Quarterly investment estimation

- Quarterly capital investment available from quarterly expenditure-based GDP program
  - however quarterly sources do not have the region, asset and industry dimension required to estimate a full PIM;
- For GFCF components with certain dimensions, for example non-residential building has a proxy industry that can be used whereas residential investment has region, use those as the benchmark;
- Use SUT weights for any missing dimensions to assign the full breadth of dimensions (by asset, industry and region).
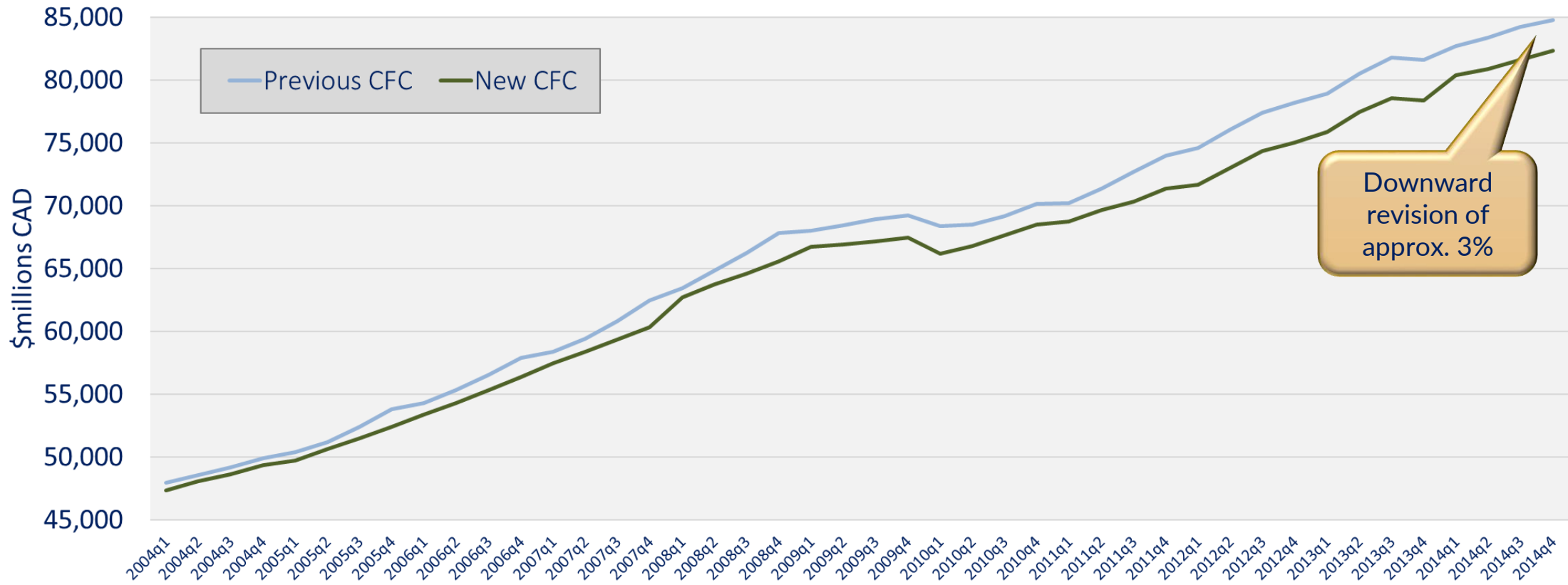
Quarterly prices

- Prices are used at the start of the calculation to deflate the investment flows, once the PIM is calculated on the constant dollar estimates, the K$ depreciation must be re-inflated with current period prices to replicate a replacement cost;

- Numerous price series have significant detail which permits deflation/re-inflation at a very low level, for example, some machinery prices are available monthly, by type of asset, by industry and by region.

Revision to quarterly depreciation

Legend: Previous CFC — New CFC

Y-axis: $millions CAD (45,000 to 85,000)

X-axis: 2004q1 through 2014q4

Callout: Downward revision of approx. 3%

▪ Improved quarterly valuation resulted in lower levels of depreciation

Uses of the quarterly capital stock program

- Given the robustness of the quarterly capital stock program, estimates can be used to fulfill:
  - Income-based GDP: CFC
  - Sequence of accounts by sector: CFC by sector
  - Financial and wealth accounts: balance sheet
  - GFS
  - Multi-factor productivity

- This ensures consistency within the Canadian Macro-economic Accounts – all the programs use the same capital stock and depreciation estimate.

Quarterly estimation challenges

Integration of new SUT (year t-3):

- Revised investment flows from benchmark SUT year at detailed level (often switching assets) can significantly change the resulting stock and CFC, especially if the price and depreciation profile are quite different;

- Such complexities are difficult for users to understand as FWA and NDP would be revised.

Consistency with quarterly capital investment:

- Quarterly PIM calculation must benchmark to the aggregate value and volume of capital investment that flows into GDP;

- Given the required detail of the PIM, this results in a certain level of proration to the lowest level of the calculation.

Estimation challenges, continued

Seasonality:

- GDP estimates are adjusted for seasonality; however National Balance Sheet and GFS are not;

- PIM calculation run on raw investment, stock and prices;

- Final CFC for GDP was seasonally adjusted using X-12 Arima.

Should CFC be seasonally adjusted given the result would reflect more the seasonality in the investment series rather than the rate of depreciation in the asset?

Reconcilation of annual and quarterly PIM

- Linear and hyperbolic methods are calculated only in the annual capital stock;

- Given equivalent details in the two programs, the quarterly PIM is used for the annual geometric method;
  - End-year stock is the 4th quarter estimate from the quarterly PIM, whereas the annual CFC is the sum of the four quarters of the quarterly program.

Additional information

Estimates:

Annual program -

Flows and stocks of fixed non-residential capital, by industry and type of asset, Canada, provinces and territories (statcan.gc.ca)

Flows and stocks of fixed non-residential capital, by sector of industry and type of asset, Canada (statcan.gc.ca)

Average age measures of non-residential capital stock by industry, by asset, Canada, provinces and territories (statcan.gc.ca)

Quarterly program -

Flows and stocks of fixed non-residential and residential capital, by sector and asset, provincial and territorial (statcan.gc.ca)

Depreciation rate project:

An Update on Depreciation Rates for the Canadian Productivity Accounts (statcan.gc.ca)