Jukka Jalava, Taru Sandström

# Consumption of Fixed Capital on Roads and Other Public Infrastructure in the Finnish National Accounts

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## *Abstract*

*One of the major changes for the Finnish National Accounts in implementing ESA95, was the calculation of consumption of fixed capital (CFC) on public infrastructure, especially as this has direct implications on GDP. This paper starts by briefly describing the perpetual inventory method used in Finland, and how consumption of fixed capital is calculated. Then the data sources for central and local government GFCF are described. A comparison of length of service lives (and degree of road utilization) with Finnish, Norwegian and Swedish data is done, as well as calculations with different service lives for CFC on Finnish public roads, and the potential impacts of these calculations on GDP.*

## *PIM*

In Finland (as well as in all other OECD countries), the Perpetual Inventory Method (PIM) is used for the calculation of capital stock and consumption of fixed capital estimates. For its calculations, the PIM uses as inputs long series of gross fixed capital formation at constant prices (by industry and asset type), price indexes, and assumptions of service lives, survival functions and depreciation patterns[1].

Finnish capital stock calculations have been revised. Physically, the Dyalog APL-software was found to be optimal. While being compatible with the National Accounts new adp-environment, it still facilitates the specific demands made by capital stock calculations. Otherwise, the extension of the concept of capital formation (due to the implementation of ESA95), and the change of base year from 1990 to 1995, were the biggest changes.

## *Consumption of Fixed Capital*

Consumption of fixed capital is the valuation of capital "used up in production". Thus it e.g. is, the difference between gross national income and net national income. As the SNA93 states (p. 147): "It may be defined as the decline, during the course of the accounting period, in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage". Aging should also be added to the list (see Katz & Herman, 1997).

Consumption of fixed capital is calculated as the difference between GFCF and the change in Net Capital Stock. Equation 1 is valid at constant prices:

[1] See Lehtoranta (1995) for a more detailed account of the PIM used in Finland.

$$CFC_t = GFCF_t - (NCS_t - NCS_{t-1}) \quad (1)$$

$CFC_t$ = Consumption of Fixed Capital in year t

$GFCF_t$ = Gross Fixed Capital Formation in year t

$NCS_t$ = Net Capital Stock in year t

$NCS_{t-1}$ = Net Capital Stock in year t-1.

The Finnish capital stock model produces the capital consumption estimates (by industry and asset type) using the assumption of linear depreciation. Both SNA93 (6.193-6.197) and ESA95 (6.04) refrain from stipulating whether the "straight line" or geometric method should be used. ESA95 recommends using linear depreciation, unless we have such knowledge of a fixed assets pattern of efficiency-decline which would require using geometric depreciation. SNA93 is even more cautious. It states that, linear depreciation is possibly more realistic for structures, and geometric depreciation for machinery and equipment, but that it depends on knowledge (or assumptions) which is used.

### *GFCF[2] Data Sources: Central Government*

The basic data for central government National Accounts is from the year 1998 onwards the State Business Bookkeeping data[3], which is cross-classified by the administrative bookkeeping data (State Financial Statement and State Budget). The State Treasury receives from individual accounting offices information on receipts and expenditures monthly. Each year's State Financial Statement is completed by the State Treasury the following April. Statistics Finland's Government Finance-unit uses a bridge table to transform the Business Bookkeeping data to comply with the National Accounts definitions[4]. On these transformed figures Value Added Tax (VAT) is added[5]. What we get is the GFCF by industry and asset type for central government in current prices. The GFCF in current prices is deflated into constant prices using proper indexes (i.e. such that also take into account the addition of the VAT), so that the volumes aren't distorted. The constant prices figures thus calculated, are used, by applying the PIM, to construct estimates of Gross/Net Capital Stock, Retirements and Consumption of Fixed Capital by industry and asset type.

### *GFCF[6] Data Sources: Local Government*

The Local Government[7] Finances, which is a total survey statistics, is processed by Statistics Finland's Government Finance-unit in accordance with the Classification

[2] The central government public infrastructure GFCF contains the building of and improvement on civil engineering and other structures, e.g. roads, bridges, tunnels, waterways, airports, military civil engineering construction etc.

[3] Before 1998 the so called Chart of Revenue and Outlays.

[4] Especially concerning road maintenance the bookkeeping data must be adjusted. The problem lies in the difficulty of separating road maintenance from investment expenditure.

[5] The total of VAT paid by central government as recorded by the accounting offices.

[6] The local government public infrastructure GFCF contains the building of and improvement on civil engineering and other structures, e.g. roads, streets, sports fields, dumping grounds, parks etc.

[7] Local government being municipalities and joint municipal authorities.

of the Functions of Finnish Local Government (COFOFLG). A bridge table is used to transform this data to comply with the National Accounts definitions. On these transformed figures Value Added Tax (VAT) is added, and what we get is the GFCF by industry and asset type for local government in current prices. The GFCF in current prices is deflated into constant prices using proper indexes (i.e. such that also take into account the addition of the VAT), so that the volumes aren't distorted. The constant prices figures thus calculated, are used, by applying the PIM, to construct estimates of Gross/Net Capital Stock, Retirements and Consumption of Fixed Capital by industry and asset type.

### *Background*

Even though consumption of fixed capital should in principle be calculated for all production capital defined as gross fixed capital formation, the calculation of CFC on public infrastructure like roads and dams was in the SNA68 omitted due to practical difficulties. Repair and maintenance of public roads and other infrastructure were considered sufficient to keep up their original condition.[8] Similarly, according to the ESA79, CFC must be calculated for all reproducible fixed capital goods, with the exception of capital goods for collective use with an indeterminate life time (roads, bridges etc.).[9] Accordingly, a great part of government produced fixed capital CFC was excluded from the CFC-total, due to these national accounts guidelines.

Both SNA93 as well as ESA95 require also in practice that CFC is calculated for all tangible and intangible fixed assets (except animals (ESA95, par. 6.03)) owned by producers. CFC should also be estimated for major improvements to non-produced assets, as well as costs of ownership transfer associated with non-produced assets.[10]

### *ESA95 Revision*

In Finland the ESA95 revision concerning consumption of fixed capital on public sector infrastructure was easily implemented. In our capital stock model the calculations concerning public sector infrastructure were already incorporated. Previously, the CFC on public sector infrastructure that the model produced was simply zeroed for the SNA68 based National Accounts. It was, however, separately published among the Capital Stock Data.

### *Impact on GDP*

CFC on new capital assets (e.g. software) and the calculation of CFC on public infrastructure increases the level of the CFC-total, but the implications for national economy aggregates depend on the type of the producer. In the case of market producers, changes in CFC affect only the residual items operating surplus/mixed income, net, i.e. the distribution between gross and net concepts of operating surplus and mixed income, whereas an increase in CFC of non-market producers has a direct impact on value added/GDP and further on government consumption expenditure. The effects of CFC in the case of non-market producers is based on the fact,

[8] See SNA68: par. 7.20
[9] ESA79: par. 403
[10] SNA93: par. 6.185 - 6.186, ESA95 par. 6.03

that non-market producers' value added[11] and output are calculated as sum of costs components. Table 1 shows the impact on GDP of CFC on public infrastructure.

**Table 1: Impact on GDP of CFC on Public Infrastructure, in mill. FIM, CP.**

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| GDP, at market prices | 521021 | 498067 | 487194 | 493062 | 521443 | 561387 | 587550 | 630461 |
| CFC on public infrastructure | 2625 | 2811 | 2803 | 2861 | 3198 | 3504 | 3569 | 3711 |
| % of GDP | 0,5 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 |
| of which CFC on public roads | 2143 | 2291 | 2280 | 2328 | 2616 | 2868 | 2924 | 3041 |
| % of GDP | 0,4 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 |

### *Service life*

The assumed service life for roads, bridges and other public infrastructure in Finnish capital stock calculations is 70 years. In comparison Sweden uses 40 years and Norway 75 years. Quite different assumptions for rather similar countries. In order to get evidence on road utilization in Finland, as well as Sweden & Norway, we looked into data from the Finnish National Road Administration. Table 2 summarizes some key indicators for the year 1996.

**Table 2: Comparison of Country Information in 1996.**

| | FINLAND | SWEDEN | NORWAY |
|---|---|---|---|
| Land area, 1000km2 | 338 | 450 | 324 |
| Country population, mill. | 5,1 | 8,9 | 4,4 |
| Length of public roads, km, 31.12.1996 | 77782 | 98015 | 91346 |
| Automobile stock, 1000 | 2229 | 3981 | 2053 |
| Traffic performance on public roads, bill.automobile-km | 27,6 | 45,4 | 22,6 |
| Inland passenger traffic, bill.passenger-km | 63,5 | 112,2 | 57,1 |
| of which road traffic | 59,3 | 101,3 | 49,8 |
| in percentages (%) | 93,4 | 90,3 | 87,2 |
| Inland goods transport, bill.ton-km | 36,5 | 57,9 | 19,4 |
| of which road traffic | 24,1 | 31,2 | 10,7 |
| in percentages (%) | 66,0 | 53,9 | 55,2 |

Both the automobile stock and the traffic performance are by far the greatest in Sweden. Thus validating Sweden's shortest service life. When comparing the ratio of inland passenger traffic done as road traffic the differences aren't that big (Finland: 93,4%, Sweden: 90,3%, Norway: 87,2%). But concerning goods transport Finland seems to rely more on road traffic than either Sweden or Norway (Finland: 66,0%, Sweden: 53,9%, Norway: 55,2%). These factors, combined with the fact that the National Road Administration (NRA) uses in its own calculations a service life of approximately 50 years[12], indicate that the service life used in Finnish National Accounts is probably too long.

[11] Non-market producers' value added (net) equals the sum of: the compensation of employees, consumption of fixed capital and possible taxes on production and imports.

[12] The service lives the NRA uses are: for subgrades 50 years, for surfacing 10 years, for bridges 85 years and for other road structures 10 years. Their weighted (the weights used are the asset types ratios of the NRA's balance sheet totals on 31.12.1998) average is approximately 50 years.

*Calculations with different service liv*

*es*

We made calculations with differing service lives for CFC on Finnish public roads, in order to ascertain their potential effects on GDP. The service lives chosen were: 60 years, 50 years and 40 years. As the capital stock data ESA95 revision is still being implemented, the following CFC figures aren't, however, definitive. Table 3 shows the effects in real terms on GDP, government consumption expenditure and government value added (gross), that a shortening of the assumed service life for public roads would have. In table 4, the impacts are shown in percentages.

**Table 3: The impact of different service lives for public roads, mill. FIM, CP.**

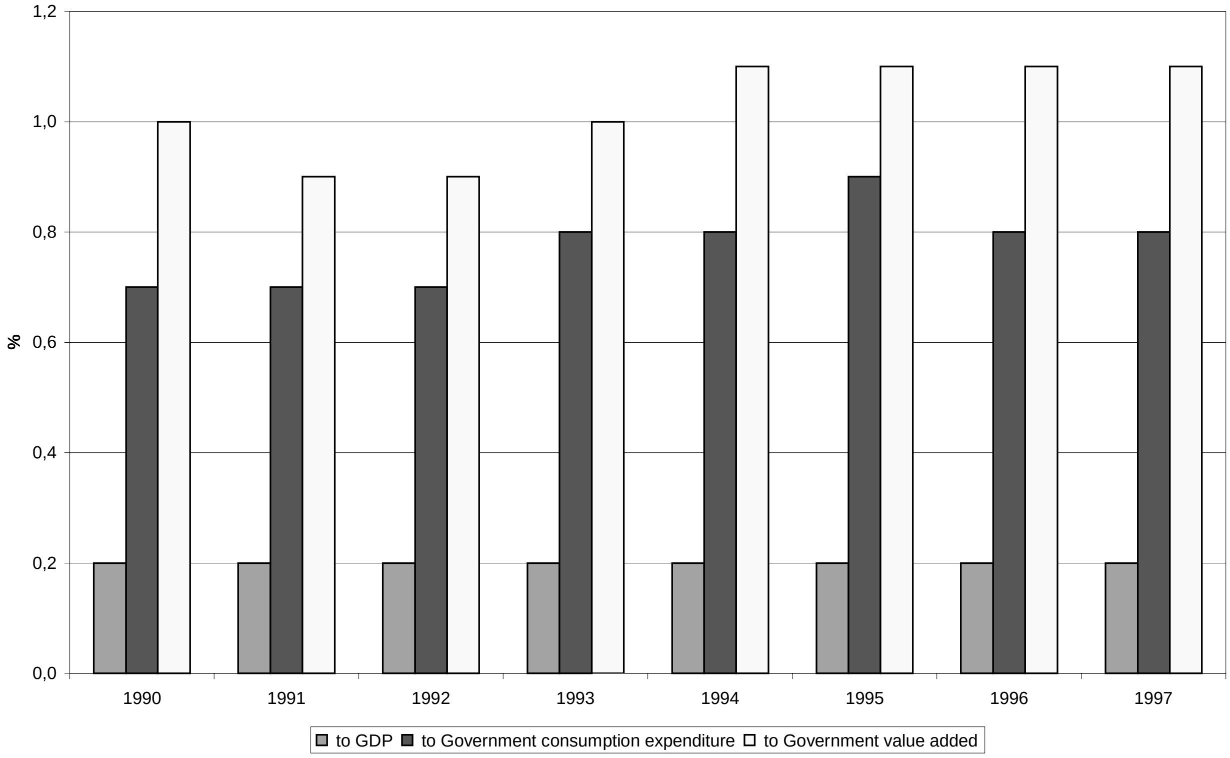
| **ESA95: Service life 70 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
|---|---|---|---|---|---|---|---|---|
| GDP at market prices | 521021 | 498067 | 487194 | 493062 | 521443 | 561387 | 587550 | 630461 |
| Government consumption expenditure | 112627 | 123369 | 123340 | 119129 | 121474 | 128178 | 134849 | 140459 |
| Government value added, gross | 86730 | 95784 | 95901 | 91269 | 92358 | 97398 | 102001 | 104421 |
| CFC on public roads | 2143 | 2291 | 2280 | 2328 | 2616 | 2868 | 2924 | 3041 |
| **Service life 60 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
| GDP at market prices | 521365 | 498436 | 487562 | 493440 | 521867 | 561855 | 588028 | 630962 |
| Government consumption expenditure | 112971 | 123738 | 123708 | 119507 | 121898 | 128646 | 135327 | 140960 |
| Government value added, gross | 87074 | 96153 | 96269 | 91647 | 92782 | 97866 | 102479 | 104922 |
| CFC on public roads | 2487 | 2660 | 2648 | 2706 | 3040 | 3336 | 3402 | 3542 |
| additions to the present figures | 344 | 369 | 368 | 378 | 424 | 468 | 478 | 501 |
| **Service life 50 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
| GDP at market prices | 521850 | 498956 | 488080 | 493968 | 522462 | 562504 | 588682 | 631635 |
| Government consumption expenditure | 113456 | 124258 | 124226 | 120035 | 122493 | 129295 | 135981 | 141633 |
| Government value added, gross | 87559 | 96673 | 96787 | 92175 | 93377 | 98515 | 103133 | 105595 |
| CFC on public roads | 2972 | 3180 | 3166 | 3234 | 3635 | 3985 | 4056 | 4215 |
| additions to the present figures | 829 | 889 | 886 | 906 | 1019 | 1117 | 1132 | 1174 |
| **Service life of 40 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
| GDP at market prices | 522508 | 499634 | 488724 | 494582 | 523093 | 563129 | 589245 | 632134 |
| Government consumption expenditure | 114114 | 124936 | 124870 | 120649 | 123124 | 129920 | 136544 | 142132 |
| Government value added, gross | 88217 | 97351 | 97431 | 92789 | 94008 | 99140 | 103696 | 106094 |
| CFC on public roads | 3630 | 3858 | 3810 | 3848 | 4266 | 4610 | 4619 | 4714 |
| additions to the present figures | 1487 | 1567 | 1530 | 1520 | 1650 | 1742 | 1695 | 1673 |

**Table 4: The impact of different service lives for public roads, %, CP.**

| Service life 70 years (ESA95) | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| % of GDP | 0,4 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 |
| % of Government consumption expenditure | 1,9 | 1,9 | 1,8 | 2,0 | 2,2 | 2,2 | 2,2 | 2,2 |
| % of Government value added | 2,5 | 2,4 | 2,4 | 2,6 | 2,8 | 2,9 | 2,9 | 2,9 |
| **Service life 60 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
| % of GDP | 0,5 | 0,5 | 0,5 | 0,5 | 0,6 | 0,6 | 0,6 | 0,6 |
| % of Government consumption expenditure | 2,2 | 2,1 | 2,1 | 2,3 | 2,5 | 2,6 | 2,5 | 2,5 |
| % of Government value added | 2,9 | 2,8 | 2,8 | 3,0 | 3,3 | 3,4 | 3,3 | 3,4 |
| **Service life of 50 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
| % of GDP | 0,6 | 0,6 | 0,6 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 |
| % of Government consumption expenditure | 2,6 | 2,6 | 2,5 | 2,7 | 3,0 | 3,1 | 3,0 | 3,0 |
| % of Government value added | 3,4 | 3,3 | 3,3 | 3,5 | 3,9 | 4,0 | 3,9 | 4,0 |
| **Service life of 40 years** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** |
| % of GDP | 0,7 | 0,8 | 0,8 | 0,8 | 0,8 | 0,8 | 0,8 | 0,7 |
| % of Government consumption expenditure | 3,2 | 3,1 | 3,1 | 3,2 | 3,5 | 3,5 | 3,4 | 3,3 |
| % of Government value added | 4,1 | 4,0 | 3,9 | 4,1 | 4,5 | 4,6 | 4,5 | 4,4 |

Graph 1 shows in percentages how much the change of service life for public roads from 70 years to 50 years would increase GDP, government consumption expenditure and government value added.

**Graph 1: The additions to ESA95 figures resulting from a change of service life for public roads from 70 years to 50 years, %.**




## *Conclusion*

It has been the objective of this paper to discuss the impacts of CFC on public infrastructure on GDP. Our results raise an important question: Do we need to reconsider and harmonize service lives between countries? Especially since increases/decreases in CFC has direct impacts on GDP, thus with important implications for the financing of the EU budget.

The on-going development work on capital measurement done by the Canberra-group[13] is also relevant. The group is working on a manual on capital measurement, which is to be published by the OECD in the year 2000. Especially of interest is, whether the manual will contain specific recommendations on the type of mortality and survival functions to be used.

[13] The Expert Group on Capital Measurement

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