Public Capital, Internal Rate of Return and Growth Accounting

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PUBLIC CAPITAL, INTERNAL RATE OF RETURN AND GROWTH ACCOUNTING

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Abstract

The note raises some methodological problems derived from the presence of public capital. It follows closely Jorgenson and Landfeld (2004) proposal of modifying Gross Value Added and Gross Operating Surplus figures provided by *National Accounts,* since public capital services are underestimated. Making use of the Spanish data we conclude that Spanish *NA* figures underestimate GVA and GOS in approximately 4% and 9% respectively with the gap increasing since the middle of the nineties. However, the rates of growth are not that different. Finally, growth accounting results show slightly higher contributions of capital and TFP to output growth when the alternative approach is applied.

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In this paper we address some issues related with publicly owned capital goods. Jorgenson and Landfeld (2004) addressed the main problems in the following terms: "While the existing accounts do treat government expenditures on capital goods as investment, they include only a partial value for the services of government capital by counting the value of depreciation on government capital (no value is included for the services of nonprofit capital)…The present treatment of government capital implicitly assumes that the net return to government capital is zero, despite a positive opportunity cost" And they continue, "the net return to the capital stock must (be) estimated and added to depreciation to develop a service value. This estimation raises conceptual issues relating to the appropriate opportunity cost and empirical issues in estimating this cost" (pg. 12).

The above paragraph summarizes the main issues, with the following important implications:

1. The Gross Operating Surplus (GOS) figures provided by National Accounts (NA) are underestimated because the value of capital services provided by public capital is not fully considered.
2. Consequently the value of output is also underestimated in *NA* figures, affecting both its level and rate of growth.
3. If the endogenous approach is used when computing the rate of return, points 1 and 2 above will have, at least potentially, consequences on:
   - The implicit rate of return
   - The input shares
   - The growth accounting results
4. If the exogenous approach is adopted, only point 2 above will have consequences on the growth accounting exercise.

In this note we explore the above issues using the Spanish data. Section 1 presents the general framework; section 2 focuses on the internal rate of return determination; section 3 sketches some growth accounting implications; section 4 summarizes the data; section 5 presents the main results; and section 6 concludes.

1. General Framework

Assuming we have information on the Volume Index of Capital Services (*VICS*) for the *n* available assets we define $K_{j,t}$ as the *VICS* of asset *j* at time *t.* Let's consider that the ownership of $K_{j,t}$ is divided between the private sector ($K^p_{j,t}$) and the public sector ($K^g_{j,t}$). Thus, $K_{j,t} = K^p_{j,t} + K^g_{j,t}$.

The value of the capital services ($CS_{j,t}$) provided by asset *j* is given by:

$$CS_{j,t} = q_{j,t}\, K_{j,t-1} = q_{j,t}\, K^p_{j,t-1} + q_{j,t}\, K^g_{j,t-1} \qquad [1a]$$

Where $q_{j,t}$ is the rental price, or user cost, of the capital services provided by asset *j* at time *t*. In [1a] we are assuming that the value of the capital services provided by the asset is independent of who owns it, the private or the public sector. This approach follows Nordhaus´ (2004) *basic principle for measuring non-market activities*. According to this principle: "Non-market goods and services should be treated as if they were produced and consumed as market activities. Under this convention, the prices of non-market goods and services should be imputed on the basis of the comparable market goods and services" (pg. 5).

Alternatively, we might wish to assume that the value of capital services provided by a given asset depends on who owns it. In that case, expression [1a] can be written as:

$$CS^*_{j,t} = q^p_{j,t}\, K^p_{j,t-1} + q^g_{j,t}\, K^g_{j,t-1} \qquad [1b]$$

In practice, the user cost expression can adopt different versions (see Harper, Berndt and Wood (1989)). For the present purpose we follow Jorgenson and Landfeld (2004) and assume that the user cost, or rental price of asset *j* at time *t*, excluding the tax treatment term (due to lack of data), is given by

$$q_{j,t} = p_{j,t-1}\, [r_t - \pi_{j,t} + (1+\pi_{j,t})\, \delta_j\,] \qquad [2a]$$

$p_{j,t}$ being the acquisition price of a new asset *j;* r_t the nominal rate of return (assumed to be common for all assets); $\pi_{j,t}$ the rate of change of $p_{j,t}$; and δ_j the depreciation rate of asset *j*.

Equation [2a] does not make any distinction between private and public capital. But, of course, other options are open. Moulton (2004), following Slater and Davies (1998), mentions four general ways of estimating the rate of return of government fixed capital: a) an econometric determination; b) the use of a pre-determined rate such as the rate set by the U.S. Office of Management and Budget (OMB); c) the rate of return for comparable private business activities; or d) the interest rate at which governments borrow. If we introduce in equation [2a] different nominal rates of return for private and public capital the corresponding user costs will also be different. For the privately owned asset *j* the rental price will be given by:

$$q^p_{j,t} = p_{j,t-1} [r^p_t - \pi_{j,t} + (1+\pi_{j,t}) \delta_j] \qquad [2b]$$

Similarly for public assets

$$q^g_{j,t} = p_{j,t-1} [r^g_t - \pi_{j,t} + (1+\pi_{j,t}) \delta_j] \qquad [2c]$$

Jorgenson and Landfeld (2004) recommend the use of the same r´s for private and public assets, as in [2a]. In pg. 35 they mention: "For government, the imputed rate of return is set equal to the average of corporate, non-corporate, and household rates of return…". When the tax treatment is ignored, as in our case, the Jorgenson and Landfeld recommendation lead us to use the same rate of return for both assets.

The next problem is to define a procedure for the rate of return calculations. This topic is addressed in the next section.

2. On the Rate of Return

As it is well known, there are two general ways of computing the rates of return in a growth accounting exercise: endogenous and exogenously. The exogenous approach assumes that the *r´s* in [2a] – [2c] should be somehow related to observed market's nominal rates of interest. On its part, the endogenous approach, making use of some additional assumptions (*i.e.* constant returns to scale, competitive markets and optimizing behavior), obtains the *r´s* through equalizing the aggregate value of capital services to the Gross Operating Surplus figures from the National Accounts (GOS^{NA}). The internal rate of return can be obtained by solving for r_t in [3]

$$GOS^{NA}{}_t = \sum_j q_{j,t} K_{j,t-1} = \sum_j p_{j,t-1} \left[r_t - \pi_{j,t} + \left(1 + \pi_{j,t}\right) \delta_j \right] K_{j,t-1} \qquad [3]$$

Here we will not go into the *pros* and *cons* of both approaches but simply notice that options a), b) and d) suggested by Moulton (2004) imply the use of an exogenous rate of return, while option c) is compatible with the endogenous approach.

Let's consider now the problems posed by the presence of public goods. Common to the exogenous and the endogenous approach is the fact that most frequently the available statistics do not allow the distinction between assets owned by the private and public sectors, being grouped under the same heading, usually "other constructions". This is not too problematic when the **exogenous** approach is adopted since in this case

$$\begin{aligned} \sum_j CSj,t &= \sum_j q_{j,t} K_{j,t-1} = \\ &= \sum_j q_{j,t} \left(K^p_{j,t-1} + K^g_{j,t-1} \right) = \sum_j p_{j,t-1} \left[r_t - \pi_{j,t} + \left(1 - \pi_{j,t}\right) \delta_j \right] \left[K^p_{j,t-1} + K^g_{j,t-1} \right] \end{aligned} \qquad [4]$$

In this case, we are implicitly following Nordhaus (2004) basic principle for measuring non-market activities since we are applying the same rental price to an asset regardless of who owns it.

However, things are different when the **endogenous** approach is adopted. The difficulty lies on the treatment given to public capital by *NA* as made explicit by the above quote

from Jorgenson and Landfeld. According to *NA*, Gross Operating Surplus, GOS^{NA} (conceptually equivalent to aggregate *CS* in the endogenous approach) is computed as:

$$GOS^{NA}{}_t = \sum_j q^p_{j,t} K^p_{j,t-1} + \sum_j \delta_j p_{j,t-1} K^g{}_{j,t-1} \qquad [5]$$

Where $q^p_{j,t}$ is the rental price of the services provided by the private capital given by [2b]. Thus, the flow of capital services provided by private and government capital is valued differently according to *NA*. Private capital has a positive net return. The return of Public capital is limited to the rate of gross capital consumption. Researchers usually do not take into account the way *NA* compute *GOS*, or the distinction between private and public capital. Thus, they compute the rate of return, *r*, from an equation like [6]

$$GOS^{NA}{}_t = \sum_j q_{j,t} \left[K^p_{j,t-1} + K^g_{j,t-1} \right] = \sum_j p_{j,t-1} \left[r_t - \pi_{j,t} + \left(1 + \pi_{j,t}\right) \delta_j \right] \left[K^p{}_{j,t-1} + K^g{}_{j,t-1} \right] \qquad [6]$$

An Alternative Approach

Jorgenson and Landfeld (2004) makes two amendments to the previous presentation. First they recommend the use of both approaches, endogenous and exogenous, and secondly, they compute the endogenous rate of return once the *NA* figures have been revised.

Let's start with the first amendment (and ignoring taxes for lack of information).They define the rate of return for all sectors[1] of the economy as the weighted average of the rate of interest, i_t, and the internal rate of return, ρ_t, with weights, β_t, representing the debt/capital ratio of corporations as given by [7] [2]:

$$r_t - \pi_{j,t} = \beta_t \left[i_t - \pi_{j,t} \right] + \left[1 - \beta_t \right] \left[\rho_t - \pi_{j,t} \right] \qquad [7]$$

[1] According to tax considerations Jorgenson and Landfeld (2004) compute four different rates of return, one for each of the following sectors of the economy: 1. The non-tax sector; 2. Households; 3. Non-corporate business; and 4. Corporate business.

[2] Contrary to Jorgenson and Landfeld (2004) we let β change with time.

Equation [7] can be written as:

$$r_t = \beta_t\, i_t + [1 - \beta_t]\, \rho_t \qquad [8]$$

Transforming equation [2a] into:

$$q_{j,t} = p_{j,t-1}\, [\beta_t\, i_t + (1 - \beta_t)\, \rho_t - \pi_{j,t} + (1+\pi_{j,t})\, \delta_j\,] \qquad [9]$$

Thus, the rental price of capital depends on the nominal (exogenous) rate of interest, i_t, and the internal rate of return, ρ_t, both assumed common to all assets and sectors in the economy. With this amendment, the *standard calculation* of the internal rate of return will be computed by solving for ρ_t in equation [10].

$$GOS^{NA}{}_t = \sum_j p_{j,t-1}\left[\beta_t i_t + (1-\beta_t)\rho_t - \pi_{j,t} + (1+\pi_{j,t})\delta_j\right]\left[K^p_{j,t-1} + K^g_{j,t-1}\right] \qquad [10]$$

The second amendment concerns the computation of ρ_t in the *alternative approach.* Its implementation requires separate estimates of private and public capital. If they are available, we can subtract public capital consumption from GOS^{NA} in equation [5] and compute the internal rate of return, ρ_t from [11]

$$\begin{aligned} GOS^{NA}{}_t - \sum_j \delta_j p_{j,t-1} K^g_{j,t-1} &= \sum_j q_{j,t} K^p_{j,t-1} = \\ &= \sum_j p_{j,t-1}\left[\beta_t i_t + (1-\beta_t)\rho_t - \pi_{j,t} + (1+\pi_{j,t})\delta_j\right] K^p_{j,t-1} \end{aligned} \qquad [11]$$

Once ρ_t has been computed in [11], and assuming the same rental price for public or private capital, $q_{j,t}$ in [9], we can revise the GOS^{NA} figures, adding the services provided by public capital and deducting its capital consumption:

$$GOS^R_t = GOS^{NA}_t + \sum_j q_{j,t} K^g_{j,t-1} - \sum_j \delta_j p_{j,t-1} K^g_{j,t-1} \qquad [12]$$

3. Growth Accounting Implications

As already indicated, the explicit recognition of the provision of capital services by public goods affect the value, and growth rates, of two of the variables involved in any growth accounting exercise: value added and capital input. In this section we detail the specific formulation for both variables. The results of the exercises are presented in section 5

Value Added

$Y^{NA}_{l,t}$ represents nominal value added of branch l at time t according to National Accounts (NA). $Y_{l,t}$ is the nominal value added according to our alternative approach. Equation [13] defines $Y_{l,t}$ as

$$Y_{l,t} = Y^{NA}_{l,t} + \Sigma q_{j,t} K^{g}_{j,t-1} - \Sigma \delta_j p_{j,t-1} K^{g}_{j,t-1} \qquad [13]$$

With $q_{j,t}$ given by [9] and ρ_t in [9] given by [11]. Real value added (y) is computed using *NA* deflators:

$$y_{l,t} = Y_{l,t} / p^{NA}_{l,t}; \qquad p^{NA}_{l,t} = Y^{NA}_{l,t} / y^{NA}_{l,t} \qquad [14]$$

$y^{NA}_{l,t}$ and $y_{l,t}$ denote real value added according to *NA* and the alternative approach respectively; $p^{NA}_{l,t}$ is the deflator for branch l value added according to *NA*.

Equation [15] below provides the growth rate of real value added for the alternative approach. Substituting for the *NA* figures gives the rate of growth for the standard approach.

$$\frac{1}{T}\left[\ln y_t - \ln y_{t-T}\right] = \frac{1}{T}\left\{\sum 0,5\left[\frac{Y_{l,t}}{\sum_l Y_{l,t}} + \frac{Y_{l,t-T}}{\sum_l Y_{l,t-T}}\right]\left[\ln y_{l,t} - \ln y_{l,t-T}\right]\right\} \qquad [15]$$

Capital Input

Lets define the Value of Capital Services (*CS*) of asset j in branch l and time t as

$$CS_{j,l,t} = p_{j,t-1}\,[\beta_t\, i_t + (1-\beta_t)\,\rho_t - \pi_{j,t} + (1+\pi_{j,t})\,\delta_j\,]\,[K^p_{j,l,t-1} + K^g_{j,l,t-1}] \qquad [16]$$

Where ρ_t is computed from [10] in the standard approach and from [11] in the alternative approach.

$$\frac{1}{T}\left[\ln\ K_t - \ln\ K_{t-T}\right] = \frac{1}{T}\left\{\sum_j \sum_l 0,5\left[\frac{CS_{j,l,t}}{\sum_j \sum_l CS_{j,l,t}} + \frac{CS_{j,l,t-T}}{\sum_j \sum_l CS_{j,l,t-T}}\right]\left[\ln\ K_{j,l,t} - \ln\ K_{j,l,t-T}\right]\right\} \qquad [17]$$

Equation [17] provides the growth rate of aggregate capital input according to both approaches. The results are presented in section 5 but, previously, section 4 describes briefly the data.

4. The data

Fundación Banco Bilbao Vizcaya Argentaria (FBBVA) and the *Instituto Valenciano de Investigaciones Económicas* (Ivie) elaborate the Spanish capital database on a yearly basis. The methodology follows the one proposed by the OECD in two Manuals: *Measuring Capital* and *Measuring Productivity*. The details can be found in Mas, Pérez and Uriel (2005a,b). The Volume Index of Capital Services, *VICS,* are constructed using a Winfrey S-3 Retirement Function and a Hyperbolic Age-Efficiency Function. The period covered is 1964-2002. The FBBVA-Ivie estimates consider 43 industries and 18 asset types. Table 1 presents the classification of industries and table 2 the 18 asset categories.

Table 1. Classification of industries.

Industry	Description	Code CNAE-93 = Code NACE Rev. 1
1	Agriculture, hunting and forestry	01-02
2	Fishing, fish farming and related service activities	05
3	Mining and quarrying of energy producing materials	10-12
4	Mining and quarrying except energy producing materials	13-14
5	Manufactures of food products, beverages and tobacco	15-16
6	Manufacture of textiles and wearing apparel; dressing and dyeing of fur	17-18
7	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19
8	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	20
9	Manufacture of pulp, paper and paper products; publishing, printing and reproduction of recorded media	21-22
10	Manufacture of coke, refined petroleum products and nuclear fuel	23
11	Manufacture of chemicals and chemical products	24
12	Manufacture of rubber and plastic products	25
13	Manufacture of other non-metallic mineral products	26
14	Manufacture of basic metals and fabricated metal products, except machinery and equipment	27-28
15	Manufacture of machinery and equipment n.e.c.	29
16	Manufacture of electrical and optical equipment	30-33
17	Manufacture of transport equipment	34-35
18	Manufacture of furniture; manufacturing n.e.c.; Recycling	36-37
19	Electricity, gas and water supply	40-41
20	Construction	45
21	Wholesale and retail trade; repairs	50-52
22	Hotels and restaurants	55
 23 24 25 26 27	Transport and storage and communication Road infrastructures Railways infrastructures Airport infrastructures Port infrastructures Rest of Transport and storage and communication	60-64
28	Financial intermediation	65-67
29	Real estate activities	70
30	Renting of machinery and equipment and other business activities	71-74
 31 32 33 34 35 36 37 38 39 40	Public administration Road infrastructures Water infrastructures Railways infrastructures Airports infrastructures Ports infrastructures Urban infrastructures Non-market education Non-market health Non-market social work Rest of public administration	75, 80P, 85P
41	Market education	80P
42	Market health and social work	85P
43	Other community, social and personal services	90-93

Table 2. Classification of Assets

Product	Description	Code CNPA96 = Code CPA96
1	Agricultural, livestock and fish products	01-05
2	Metal products	28
3	Machinery and mechanical equipment	29
4	Office machinery and computer equipment	30
5	Communications	313, 32, 332-333
6	Other machinery and equipment n.e.c	31 (ex. 313), 331, 334-335, 36
7	Motor vehicles	34
8	Other transport material	35
9	Dwellings (Residential Construction)	45P
10 11 12 13 14 15 16	Other constructions Road infrastructures Water infrastructures Railway infrastructures Airport infrastructures Port infrastructures Urban infrastructures Other constructions n.e.c.	45P
17	Software	72
18	Other products n.e.c.	Rest of codes

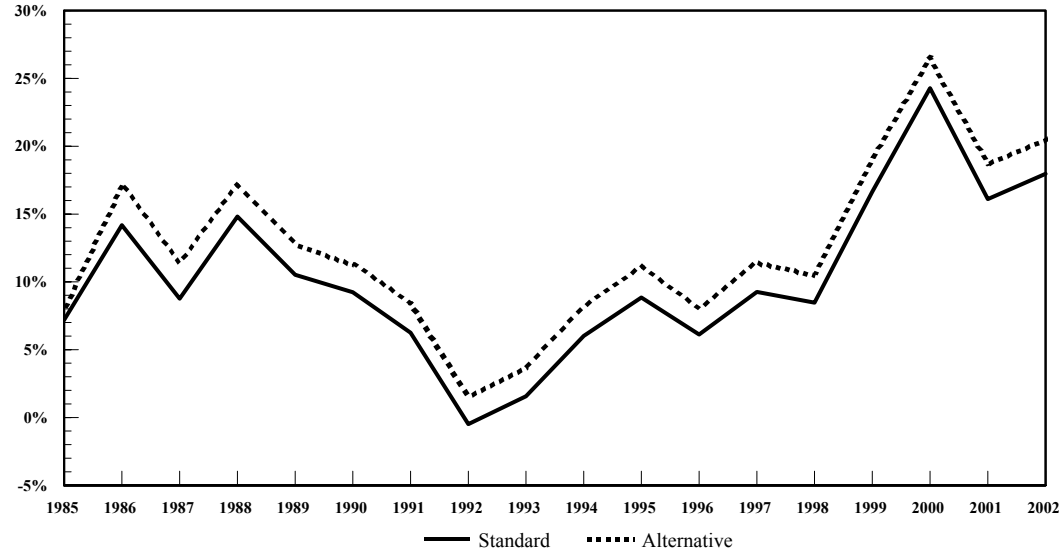
The information is available for every year in a matrix format with the values for each industry in columns and for the 18 assets in rows. The FBBVA-Ivie database makes a clear distinction between assets owned by the private sector ($K^{p}_{j,t}$) and those owned by the public sector ($K^{g}_{j,t}$). The last ones correspond to the columns under the heading "Public Administration" in table 1 which consists of ten different branches.

The information for the variables GOS^{NA} and Y^{NA} comes from the Spanish National Accounts released by the Spanish *Instituto Nacional de Estadística* (INE). The Bank of Spain provides the data for the nominal interest rates, i_t, and the ratio β_t. For the first one we have used the medium and long-term loans to enterprises rates, and for the second the ratio external funds/(external funds+equity) from a survey published every year.

5. Results

Graph 1 compares the internal rates of return computed according to the standard approach (equation [10]) and the alternative approach (equation [11]). While the time profiles are practically the same the level is, as expected, higher in the alternative than in the standard approach.

GRAPH 1.
Internal Rate of Return [*p*]. Standard vs. Alternative Approach

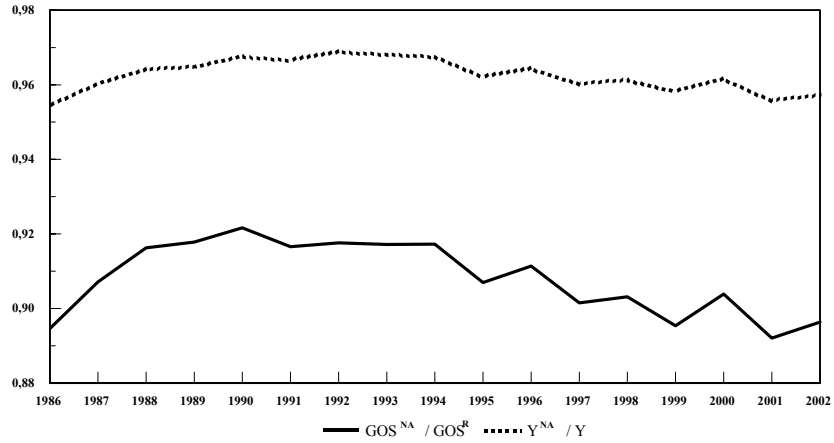


Sources: INE, FBBVA-Ivie and own calculations

Graph 2 plots the ratios between the *GVA* and *GOS* figures according to the two approaches. The GVA data for the alternative approach is obtained from equation [13] and those for GOS from [12]. As can be seen the *NA* underestimate the GVA figures by approximately 4%, and the GOS figures by 9%. In both cases the gap has increased since the middle of the nineties.

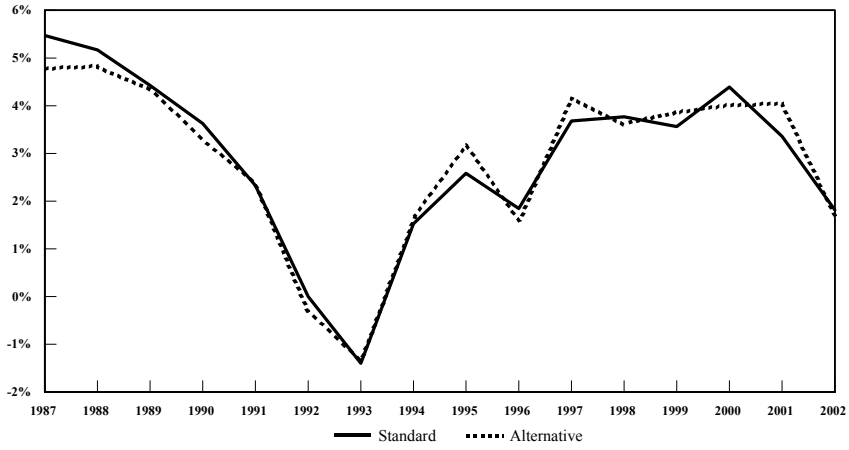
However, these differences in levels are lower in terms of growth rates (see graphs 3 & 4). As a consequence, table 3 shows the different estimates that we get from carrying out the growth accounting exercise from each approach. Table 4 makes explicit the underestimation of GVA growth, the contribution of capital and of TFPR. These differences appear to be larger during shorter periods of time.

GRAPH 2.
Gross Value Added and Gross Operating Surplus Ratio. National Accounts / Alternative Approach



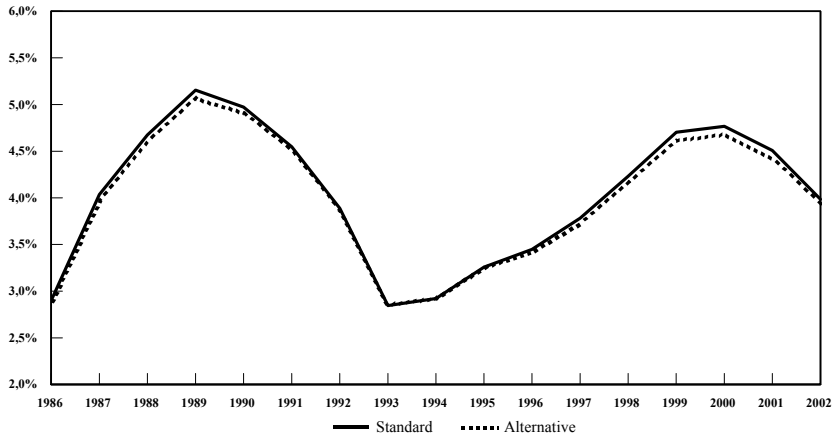
Sources: INE, FBBVA-Ivie and own calculations

GRAPH 3.
Growth Rates of Gross Value Added. Standard vs. Alternative Approach



Sources: INE, FBBVA-Ivie and own calculations

GRAPH 4.
Growth Rates of Capital. Standard vs. Alternative Approach



Sources: INE, FBBVA-Ivie and own calculations

Table 3. Growth Accounting. Alternative vs. Standard Approach.
Percentages

	1985-2002		1985-1990		1990-1995		1995-2002	
	Standard	Alternative	Standard	Alternative	Standard	Alternative	Standard	Alternative
1.GVA growth (=2+8+16+17)	2,94	3,12	4,49	4,87	1,01	1,13	3,18	3,26
2. Capital Contribution (=3+7+17+18)	1,57	1,62	1,67	1,72	1,39	1,46	1,64	1,72
3. ICT (=4+5+6)	0,33	0,33	0,41	0,41	0,21	0,21	0,43	0,42
4. Software	0,11	0,10	0,11	0,11	0,05	0,05	0,10	0,10
5. Communications	0,10	0,10	0,12	0,12	0,07	0,07	0,13	0,13
6. Hardware	0,13	0,13	0,18	0,18	0,09	0,09	0,19	0,19
7.Other Constructions (=8+13)	0,53	0,56	0,44	0,47	0,61	0,66	0,59	0,64
8.Public (=9+10+11+12)	0,11	0,12	0,09	0,09	0,18	0,19	0,12	0,13
9.Road Infrastructures	0,06	0,07	0,05	0,05	0,09	0,10	0,07	0,07
10.Water Infrastuctures	0,02	0,02	0,02	0,02	0,06	0,07	0,02	0,02
11.Port Infrastructures	0,00	0,01	0,00	0,00	0,01	0,01	0,01	0,01
12.Urban Infrastructures	0,02	0,02	0,01	0,02	0,02	0,02	0,02	0,02
13.Private (=14+15+16)	0,42	0,45	0,35	0,37	0,43	0,47	0,47	0,51
14.Railway Infrastructures	0,02	0,02	0,01	0,01	0,02	0,02	0,03	0,03
15.Airport Infrastructures	0,01	0,01	0,00	0,00	0,00	0,00	0,01	0,01
16.Other constructions n.e.c.	0,40	0,42	0,33	0,35	0,41	0,44	0,44	0,47
17.Dwellings	0,34	0,36	0,38	0,40	0,29	0,32	0,30	0,34
18.Other assets	0,36	0,36	0,44	0,44	0,27	0,27	0,31	0,32
19. Labor (hours worked) Contribution	1,11	1,08	1,86	1,82	-0,36	-0,35	1,67	1,60
20. Labor Force Qualification	0,85	0,82	0,58	0,57	0,20	0,19	1,47	1,41
21. *TFPR*	-0,58	-0,40	0,37	0,77	-0,21	-0,18	-1,60	-1,47
22. Qualification + *TFPR* (=20+21)	0,26	0,42	0,96	1,34	-0,01	0,01	-0,13	-0,05

Sources: INE, FBBVA-Ivie and own calculations

Table 4. Growth Accounting Results Differences. Standard minus Alternative.
Percentage points

	1985-2002	1985-1990	1990-1995	1995-2002
1.GVA growth (=2+8+16+17)	-0,18	-0,39	-0,11	-0,08
2. Capital Contribution (=3+7+17+18)	-0,06	-0,05	-0,07	-0,08
3. ICT (=4+5+6)	0,00	0,00	0,00	0,00
4. Software	0,00	0,00	0,00	0,00
5. Communications	0,00	0,00	0,00	0,00
6. Hardware	0,00	0,00	0,00	0,00
7.Other Constructions (=8+13)	-0,04	-0,03	-0,05	-0,05
8.Public (=9+10+11+12)	-0,01	-0,01	-0,01	-0,01
9.Road Infrastructures	0,00	0,00	-0,01	-0,01
10.Water Infrastuctures	0,00	0,00	0,00	0,00
11.Port Infrastructures	0,00	0,00	0,00	0,00
12.Urban Infrastructures	0,00	0,00	0,00	0,00
13.Private (=14+15+16)	-0,03	-0,02	-0,03	-0,04
14.Railway Infrastructures	0,00	0,00	0,00	0,00
15.Airport Infrastructures	0,00	0,00	0,00	0,00
16.Other constructions n.e.c.	-0,03	-0,02	-0,03	-0,03
17.Dwellings	-0,02	-0,02	-0,03	-0,04
18.Other assets	0,00	0,00	0,00	0,00
19. Labor (hours worked) Contribution	0,03	0,04	-0,01	0,07
20. Labor Force Qualification	0,02	0,01	0,01	0,06
21. *TFPR*	-0,18	-0,40	-0,03	-0,13
22. Qualification + *TFPR* (=20+21)	-0,15	-0,38	-0,03	-0,07

Sources: INE, FBBVA-Ivie and own calculations

6. Conclusions

The note raises some methodological problems derived from the presence of public capital. It follows closely Jorgenson and Landfeld (2004) proposal of modifying Gross Value Added and Gross Operating Surplus figures provided by *National Accounts,* since public capital services are underestimated. As a consequence, the internal rate of return computed by the standard endogenous approach is also underestimated. Making use of the Spanish data we conclude that Spanish *NA* figures underestimate GVA and GOS in approximately 4% and 9% respectively with the gap increasing since the middle of the nineties. However, the rates of growth are not that different. Finally, growth accounting results show higher output growth and also higher contributions of capital and TFP to output growth when the alternative approach is applied.

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