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Astrid Oline Ervik, Erling Holmøy and Torbjørn Hægeland

A Theory-Based Measure of the Output of the Education Sector

Abstract:
The paper estimates the output of the Norwegian higher education sector based on a modification of the methodology introduced by Jorgenson and Fraumeni (JF) (1989). JF measure output in the education sector by the increase in the total discounted lifetime income that can be attributed to the education "produced" in a given year. As opposed to JF, our output measure excludes the value of non-market labour activities. We provide a theoretical rationale for this modification of the JF-methodology, which has a great negative impact on the output estimates. Our baseline estimate of value added in the Norwegian higher education sector is still more than 8 times higher than the corresponding figure in the Norwegian National Accounts (NA). Replacing the standard NA figures by our estimate raises the share of higher education in GDP from 1.0 to 7.3 percent.

Keywords: Human capital formation, Measurement of the education sector

JEL classification: H11, H52, I21, J24

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Address: Erling Holmøy (corresponding), Statistics Norway, Research Department. E-mail: erl@ssb.no.
Astrid Oline Ervik, Univversity of Cambridge, UK. E-mail: aoe22@hermes.cam.ac.uk.
Torbjørn Hægeland, Statistics Norway, Research Department. E-mail: thd@ssb.no.

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1. Introduction

Policy makers have long considered investments in human capital as a source of economic growth. The renewed academic interest in growth theory over the last two decades has provided additional intellectual support to such a priority. Norway may serve as an example of an economy giving high priority to education. In 1960, the average educational attainment in Norway was among the lowest in the OECD area. In 2000, however, OECD (2002) ranks Norway as one of the OECD countries with highest educational attainment. 85 percent of the Norwegian population aged 25 to 64 years, had attained at least upper secondary education, i.e. 12 years of schooling. By contrast, the average share for the OECD countries was 64 percent in 2001.[1] Moreover, 29 percent of the Norwegian population aged 25 to 64 years had attained tertiary education in 2000 (13 years or more), whereas the corresponding share for all OECD countries was 23 percent.

A large number of studies provide estimates of private returns to education, see e.g. Card (1999) for an overview. However, in most countries, including Norway, estimates of individual returns to education have so far not been followed up by output estimates for the education sector, which captures the economic importance of this sector in a way that is more consistent with the ambitions of the National Accounts (NA). Whereas information on the number of students in various fields of education, public expenses, educational attainments and several other variables are readily available in official statistics, the economic contribution of the education sector to GDP is not appropriately quantified in the traditional National Accounts (NA). NA measures the output from the education sector by observed costs. A methodology based on economic theory, as well as empirical estimates of the output of the U.S. education sector, was presented in a series of pioneering papers by Jorgenson and Fraumeni (JF), see JF (1989, 1992a, and 1992b). Ahlroth, Bjørklund and Forslund (1997) apply the JF-methodology to estimate the total input and output of the Swedish education sector. The purpose of the present paper is to apply a modification of the JF-methodology to estimate the output and input in the Norwegian higher education sector.[2]

The JF-methodology is based on human capital theory and can be summarised as follows:

1. The output of the education sector in a year is the increment in human capital stock of the population.
2. The increment in the human capital stock for each individual after completing a year of education is expected to contribute to higher productivity and learning capabilities over the

[1] The corresponding shares were 88 percent in US and Switzerland, and 86 percent in the Czech Republic.

[2] The results presented in this paper draws on Ervik (2000).

lifetime. The distribution of individual productivity is measured by the corresponding wage differentials. Thus, the accuracy of the output measure relies heavily upon the assumption that market wages reflect the productivity gains attributable to education. The social return to market labour activities should be measured by the pre-tax wage rate. This specific measure does, however, not capture any possible externalities from investment in education.

3. According to standard consumer theory an acquired productivity and wage premium raises the value of the total time endowment, which can be allocated to labour market and non-market labour activities. Based on this argument, JF insist that also the value of non-market labour activities should be included in the output measure.
4. Based on estimated age-earnings profiles for persons with different education, projected discounted lifetime market and non-market income for all students can be computed. The output of the education sector in a given year, is measured by the sum over all students of increments in this lifetime income concept due to one more year of education.

Whereas JF and Ahlroth et al. (1997) estimate output of the entire formal schooling sector, the estimates in this paper is confined to the Norwegian *higher education* sector, because we believe that market work is rather unlikely to be an alternative to more education for most of the pupils engaged in primary and secondary education in Norway. Moreover, more than 90 percent of Norwegians in the age group 15 - 19 complete upper secondary education, see OECD (2002). Only a small fraction of the remaining minority gets market work. Selection effects are likely to make the wages observed for these individuals a biased estimate of the opportunity income facing the students that complete upper secondary education.

In addition to presenting new measures for output in the Norwegian *higher education* sector, the present study also includes a methodological contribution of general interest to the existing literature. We provide a theoretical rationale for excluding the value of time allocated to non-market labour activities from the calculations. This conclusion contrasts JF (1992b) who writes (p. 313): *"In order to capture trends accurately, both market and non-market activities must be included in estimates of the value of investment in education. Excluding non-market activities from these estimates produces a […] substantial downward bias…."* The implication of our view is that the estimates based on the original JF-methodology, are highly upward biased. Table 8.11 in JF (1992b) shows that the estimated investment based on market activities varied around 40 percent of the estimated total educational investment over the period 1952-1986. In Ahlroth *et al*. (1997) the corresponding percentage is even

smaller, 27 percent in 1990[3]. Ahlroth *et al*. present two sets of output measures, one including and the other excluding the value of non-market activities. Despite the large differences between these output figures, the authors provide no guidelines for preferring one for the other. Our calculations confirm the large differences between the two output estimates, showing that our modification of the JF-methodology is empirically important.

Another extension compared to JF and Ahlroth *et al.* is that we make a separation of investment in higher education into subject fields. More precisely, incomes are cross-classified by educational attainment level from 12 to 18 years, by six different subject fields, gender, and age from 19 to 75 years. Deriving the aggregate output measure from disaggregated cross-classified estimates improves the accuracy of the earnings measures. We also account for the fact that individuals may invest in education throughout their lives. In Norway, an increasing number of individuals enrols in full-time higher education at older ages. By contrast, JF (1992b) and Ahlroth *et al.* (1997) assume that no education takes place after the age of 34.

The rest of the paper is organised as follows. Section 2 describes the methodology, including our theoretical justification for choosing a more narrow income concept than JF. Section 3 describes the data, Section 4 reports the results, and Section 5 concludes.

2. Methodology

Measuring productivity effects by wage differentials

We confine this study to the pure "economic", i.e. the productivity, effect of higher education, ignoring externalities, cultural and other "non-economic" effects. Despite this limited ambition, output and important inputs in higher education cannot be observed directly, and quantification must rely on strong assumptions on the relationship between observable earnings and corresponding labour productivity. More specifically, the method presumes that the various categories of labour are employed up to the point where the producer value of the marginal productivity equal the wage rate facing producers.

There are a number of distortions that may cause the wage rate of a type of labour to diverge from the corresponding marginal productivity. These include some wage bargaining systems in which labour is

[3] This percentage is derived from Table 6 in Ahlroth *et al.* (1997).

not employed according the "right-to-manage" principle, monopolistic pricing and unobservable non-pecuniary benefits. In the public sector, which absorbs the majority of employees with higher education in Norway, the absence of markets for the produced services makes it difficult to use the wage structure as a measure of productivity differentials. In addition, wage rates in the public sector are heavily regulated, and the actual possibilities for adjusting the labour input are probably too limited to ensure that the marginal revenues and costs are equalised for different types of labour at all times.

In qualitative terms all these problems reduce the validity of our study as well as all empirical studies based on the assumption that wages reflect marginal productivity. However, no interesting empirical analysis will have access to perfect data. The interesting question is therefore whether wage data are distorted to such an extent that our measure of output in the education sector is inferior to alternative estimates. Our opinion is that there are reasons to believe that the relative wage structure provides a sufficiently good description of the corresponding relative productivity structure. Hægeland and Klette (1999) find that wage and productivity differentials by education are quite similar in the Norwegian manufacturing industries. This conclusion is based on an analysis of a data set with variables for individual workers matched with a comprehensive data set for manufacturing plants for the period 1986 to 1993. In addition, the hypothesis that wage rates (roughly) equal the producer value of marginal labour productivity underlies lots of other empirical work, also on the Norwegian economy, including e.g. growth accounting and cost-benefit analyses.

Our purpose is to quantify the social, rather than individual, value of output in the higher education sector. Whereas the individual will consider the after tax wage income when calculating the individual returns to education, the social evaluation of the output should capture the productivity effect. According to our assumptions, taxes on labour income paid by individuals are irrelevant when measuring productivity gains from education. On the other hand, this line of reasoning also suggests that the payroll tax should be included. Including the payroll tax would imply an inflation of our output measure by the average pay-roll tax, which equals about 12 per cent[4] in Norway. Neither JF nor Ahlroth *et al.* (1997) have included the payroll tax in their calculations. More substantially, we would argue that the pay-roll tax should be excluded because the income corresponding to this tax should be attributed to the sector, which employs the labour and pays this tax. Then changes in the payroll tax rate do not directly affect measure of the productivity effect of education, to the extent that the tax

[4] The pay-roll tax rate differs across regions. For the majority of workers the rate equals 14,1 percent. In rural regions the rate is lower. In the most northern region (including the county Finmark and the northern part of Troms) firms do not pay pay-roll tax.

change is not shifted over to wages. Neither will variations in the *average* payroll tax between sectors, which is due to regional differentiation combined with differences in the localisation of industries, directly affect the output measure. We find it unreasonable that two persons, who are identical with respect to education and wages, should yield different contributions to the measure of aggregate output from higher education because they work in firms subject to different payroll tax rates. By excluding the pay-roll tax from the wage rate, our measure of output from the education sector also becomes analogous to the producer value concept used in the national accounts when calculating output by sector. For example, the tax levied on electricity is not included in the producer value of the sector producing electricity.

Choice of income concept

As pointed out in the introduction, the output measure in the present study deviates conceptually from the one chosen by JF as we exclude changes in the value of non-market labour activities. The argument for our choice of output measure becomes most transparent by considering the simplest possible model of individual labour supply:

(1) $\text{Max}_{C,F}\, U(C,F)$

subject to

(2) $PC + WF = WT$,

where C is consumption, F is the number of hours allocated to leisure and other non-market income activities, T is the total number of hours that the individual can allocate during the period, $L = T - F$ is the number of hours allocated to labour, $U(.)$ is the standard utility function, P is the price of consumption, W is the wage rate corresponding to the given educational attainment. In the following we choose the normalisation $P = 1$. We will refer to WT as full income.

Provided that additional education raises productivity and the relative wage rate, nominal full income increases proportionally to T. JF insist that growth in full income is the relevant output measure. In our opinion, the output measure should capture the increase in utility of the increase in the value of the time endowment caused by education. Such a definition of real income makes it equal to the nominal full income deflated by the cost of living index. When the utility function is homothetic, the cost of living index is a function of W and P, independent of U. In this case, this measure of real income is

proportional to the utility level. Considering marginal changes in the non-homothetic case, we define the *change* in the utility level as the change in the real income index. When the individual chooses to increase his productivity and wage (in terms of consumption) through more education, he recognizes two effects on his/her real income: First, full income increases proportionally to *T*. Second, there is a negative effect since a higher wage rate implies an increase in the price of leisure. The effect on utility, measured in money terms, of a marginal increase in *W* caused by education, equals the increase in labour income. This is easily seen from differentiating the utility function and utilising the first order conditions:

$$dU = u_C dC + u_F dF = \left(LdW + WdL\right) - WdL = LdW \,, \tag{3}$$

where the marginal utility of money has been normalised to unity. Our choice of wage income, rather than full income, as the basis for measurement of output, is an extended real income concept, since it corrects the increase in nominal full income for both inflation, and the increase in the price of leisure attributable to growth in the wage rate due to more education. Note that the utility gain in Eq. (3) is not the return to a marginal investment in education, since the costs of additional education are not subtracted.[5]

Formal definition of output

We measure lifetime market labour income for students enrolled in higher education in 1995. These students have completed at least 12 years of primary and secondary education. Except from our choice of market income rather than full income as the relevant annual income concept, the mapping between the sequence of annual income and the output of the education sector is the same as the one proposed by JF. For the sake of comparison we follow Ahlroth *et al.* by using the same notation as in JF (1992b). We cross classify students by gender (*s*), age (*a*), educational attainment in years (*e*), and field of study (*T*). Let *ymi(e,T,s,a)* denote the individual annual *pre-tax* labour income[6]. Discounted per capita lifetime labour income is the sum of expected earnings, discounted back to 1995. This income is calculated by a backward recursion. A person in his eighteenth year of education has reached the highest possible educational attainment level and will receive the income contingent on eighteen years of educational attainment, age, gender, and field of study, in each remaining year of his lifetime. The individual expected discounted lifetime labour income *mi* is given by

[5] Of course, these costs include the opportunity cost of time.

[6] In JF (1992b) *ymi* denotes the *net of tax* annual market income.

(4) $$mi(e=18,T,s,a)=\sum_{b=a}^{D}(\frac{1+g}{1+r})^{b-a}\,ymi(18,T,s,b)\prod_{c=a+1}^{b}sr(e=18,s,c),$$

where D is the age in the last year with market income, g is the annual average growth rate of wage income, r is the discount rate, b and c period indexes, and *sr(e,s,c)* is the survival rate.

A person having completed his seventeenth year of education will continue into the eighteenth year of education with probability *senr(e=17,T,s,a)* and receive discounted lifetime labour income *mi(e+1=18,T,s,a+1)* computed in Eq. (4). Alternatively, he may leave the education sector with probability 1- *senr(e=17,T,s,a)*, start working and receive the lifetime labour income *mi(e=17,T,s,a+1)*. The possibility that the individual may undertake an additional year of higher education later is taken into account in this measure. A person in his sixteenth, fifteenth, fourteenth, or thirteenth year of education, have similar options to that of the person in his seventeenth year. In general, the expected discounted lifetime labour income for a person with e years of educational attainment, field of study T, gender s, and age a can be computed by the backward recursion:

(5) $$\begin{aligned}mi(e,T,s,a)&=ymi(e,T,s,a)+\frac{1+g}{1+r}[senr(e,T,s,a)sr(e,s,a+1)mi(e+1,T,s,a+1)\\&+(1-senr(e,T,s,a))sr(e,s,a+1)mi(e,T,s,a+1)].\end{aligned}$$

Let *nu(e*+1*,T,s,a)* be he number of individuals who enrolled in higher education at level e+1, with field of study T, gender *s,* and age a. We find the projected value of the total investments made by all of these individuals in 1995, under the assumption that they actually complete that education level[7]:

(6) $$gsi(e,T,s,a)=nu(e+1,T,s,a)\left[mi(e+1,T,s,a)-mi(e,T,s,a)\right].$$

Eq. (6) reflects that an individual who enrols in higher education level e+1 will receive lifetime income corresponding to educational attainment level e+1, rather than the lifetime income corresponding to attainment e. In particular, he forsakes market income in the additional year of education. The gross production in the higher education sector in a year, is defined as the sum of total investments *gsi(e,T,s,a)* for each group of individuals with the same characteristics *e, T, s,* and *a*:

[7] The assumption that students in higher education complete the education level *e+1* that they are in enrolled in, within the regulated time, is controversial. We have partly adjusted for the fact that students may use more than the regulated time in the measures of lifetime income.

(7) $$TSI = \sum_{e,T,s,a} gsi(e,T,s,a)$$

The value of inputs in the higher education sector includes the sum of foregone earnings of students in that year, outlays on teaching and administration staff, maintenance and depreciation of buildings and other types of capital, electricity and other material inputs. The opportunity cost of the students' time is by far the largest cost, but is not included in the national accounts. Note that Eq. (6) implies that the production measure, *TSI*, is net of the value of the time used by students on education.[8] *Value added*, *VA*, for the higher education sector in a given year is therefore defined as

(8) $$VA = TSI - Intermediate\ Consumption,$$

where *Intermediate Consumption* includes neither the value of time spent by students, wage costs of teacher and other types of staff nor capital costs.

3. Quantification of concepts

Age-earnings profiles

Relying on the correspondence between wages and productivity, the returns to higher education can be estimated via age-earnings profiles. The present study relies on age-earnings profiles estimated on annual earnings data taken from the Norwegian system of register data, organised by Statistics Norway. In addition to basic demographic information, this system contains information about education, income and employment relations. The income measure is total annual earnings. The estimating sample is restricted to individuals aged 20-64 years. In order to improve the correspondence between measured earnings and the wage at the individual's main employer, individuals with multiple jobs within a single year have been excluded from the sample. The same holds for self-employed, participants in active labour market programs, wage earners with extremely low or high wage rates and part-time workers. The data contain information on the highest completed

[8] In this respect, the output concept *TSI* is measured in the same way as gross production is measured in the sector *Wholesale and Retail Trade* in the National Accounts. The output concept in this sector seeks to capture the value of the distributing commodities to customers, not the value of the commodities that are sold. For example: When an apple is sold in a grocery shop, the intention of the gross production concept in the National Accounts is to measure the value of *making the apple purchasable* for the consumer. The grocery shop, and any other firms in the *Wholesale and Retail Trade* sector, does not produce the value of the apple, only the transaction of it. The price paid by the shop for the apple is therefore deducted from the consumer price of the apple when calculating the contribution from this transaction to the National Accounts measure of gross production. Similarly in the education sector: Students use their time and human capital, as well as teachers, localities, materials etc. to increase their human capital. Our measure of gross production is the increase in the human capital over one year, not the accumulated human capital at the end of the year.

level of education for each individual (5-digit code). Our measure of years of schooling is the standard number of years necessary to complete this level, which does not necessarily reflect the actual number of years spent in school. Moreover, if an individual with e.g. a master's degree later takes a master's degree in another field, it does not show up in our measure of years of schooling. Returns to education for the different educational attainment levels were allowed to vary between six fields of education: i) General fields of study, ii) Humanities, aesthetics and teaching, iii) Administration, economics, social science and law, iv) Industry, craft, natural science and technology, v) Health service, and vi) Other fields.

Our measure of experience is potential labour market experience, defined as age minus years of schooling minus seven, which was the standard school-starting age in 1995. In the estimated age-earnings profiles, experience is included as a quartic. Returns to experience are allowed to differ between four education levels: Primary (up to nine years of schooling), secondary (10-12 years), lower tertiary (13-14 years) and upper tertiary education (15 years or more). In addition, dummies for gender and regional (county) dummies were included.

Full-time students' earnings are set to zero. The reason is that the quality of the information available on time allocation of students is rather poor, and we do not have reliable information about income of students.[9] It is possible to extract information on student market labour income from the Income Register available from Statistics Norway. Such an effort would improve our estimates, but has so far been beyond the scope of this project.

Student numbers and educational progress

Statistics Norway produces and maintains data on higher education enrolment and attainment for different fields of education. Foreign-born individuals and part-time students have been excluded from the data set due to low quality of data on enrolment and attainment.[10] The projections of educational attainment levels and choice of subject fields of study for cohorts from year 2000 to 2099, are estimated by using the dynamic microsimulation model MOSART, developed in Statistics Norway, see Fredriksen (1998). MOSART is used to simulate the life courses of Norwegian individuals. The model's probabilities of transitions in the education system are estimated from a database in which

[9] Lyngstad (1999) finds that market labour income constituted as much as 71 percent of the annual disposable income, excluding student loans, of the average Norwegian male student in 1997. However, these figures are not broken down on students differing with respect to educational attainment level, subject field and age.

[10] Also for full-time students, we do not know whether they have been registered with an educational attainment level of *e+1* by October 1, 1996, if they were registered as enrolled in year *e+1* on October 1, 1995. As the observed time needed to complete a study year often does not correspond to the regulated progression time, this may be a controversial assumption.

combinations of educational attainment and subject fields for the study years 1992/1993 and 1993/1994 of each individual are matched. Furthermore, the transition rates are calibrated to the actual educational attainment levels in 1997. The estimated transition rates may be biased downwards, because we have not been able to control appropriately for mortality.

Growth, discounting, and mortality

In our baseline projection, we have assumed that real wages will grow by 2.5 percent per year, which is in line with long-run historical trends, see Statistics Norway (2003, pg. 44-47). The real risk adjusted discount rate has been set to 3.5 percent in accordance to the recommendations for public cost-benefit analyses given in Ministry of Finance (1997). Mortality rates have been taken from the database of the MOSART-model mentioned above.

4. Results

Baseline estimates

From our baseline assumptions, we estimate the social gross production in the higher education sector to NOK 77.4 billions, or NOK 17 800 per capita, see Table 1. This estimate should be interpreted as the total *increase* in the present value of pre-tax real wage income - reflecting labour productivity - over the lifespan due to one more year of educational attainment, for all students enrolled in full-time higher education. The corresponding cost-based estimate in the NA equals NOK 13.9 billions[11], less than 18 percent of our baseline estimate.

We estimate the opportunity cost associated with spending time in investment in education to NOK 25.1 billions in 1995. This estimate measures foregone market labour income in 1995 and does not depend on future conditions. Recall that this opportunity cost has been deducted from our measure of gross production. However, other kinds of intermediate consumption must be deducted to obtain an estimate of the value added of the higher education sector. According to NA, intermediate consumption (administration, electricity, materials) was NOK 5.0 billions in 1995. The resulting value added figure, NOK 72.4 billions, is more than 8 times higher than the corresponding NA figure. It may also be compared to the NA figure of the total Norwegian GDP, which was NOK 928.8 billions in

[11] In the NA the higher education sector is split into a private and a public sector, see Fløttum (1996) for details. In 1995 the costs included in the gross production measure were, respectively, NOK 12.9 and 1.0 billions in the public and the private sector. Costs in the private sector include item grants to private colleges and universities from central government accounts, plus fees paid by students.

1995. If the NA figure of value added in the higher education sector were replaced by our estimate, the value added share of higher education in total GDP would increase from 1.0 percent to 7.3 percent.

Table 1: Output and Input in the Norwegian Higher Education Sector. Benchmark Estimates and National Accounts. Billions NOK 1995

	Baseline Estimates	**NA**
1. Gross Production	77.4	13.9
2. Intermediate Consumption	5.0	5.0
3. Value Added (= 1 - 2)	72.4	8.9
4. Compensation of Employees + Consumption of Fixed Capital	8.9	8.9
Memo: Value of time spent by students	25.1	-

Projected annual growth in wages rates = 2.5 percent. Real interest rate = 3.5 percent.

If we had followed the JF-procedure by including the projected increase in lifetime value of time spent on non-market activities, the baseline estimate of gross production would increase by 46 percent, from NOK 77.4 to 113.1 billions. But, as pointed out in Section 2, the latter figure overestimates real output, because it neglects that leisure also becomes more expensive when more education raises the wage rate.

Sensitivity analysis

Output estimates based on the JF-approach are particularly uncertain because they depend on discounted future earnings. Subsequently, we quantify how sensitive our output measure is with respect to alternative assumptions of the discount rate and the productivity growth of all types of labour. The latter variable is by our assumptions perfectly reflected by the growth rate of the general real wage level. Gross production is the only variable in Table 1, which depends on the assumptions on the discount rate and the growth in general productivity/market income.

Since higher education is a long-term investment, it is hardly surprising that our estimates also turn out to very sensitive to choice of discount rate. Table 2 shows that the partial elasticity of the output estimate with respect to a one percent increase in the discount rate is about -25. This relative sensitivity is approximately independent of the growth rate of wages within the interval (1.5, 3,5) and initial real interest rates within the interval (2.5, 4.5).

The construction of the output measure implies that it is the net discount rate, defined as the difference between the discount rate and the growth rate of market labour income that matters for the output estimate, cf. equation (5). This is also seen from the figures in table 2, where the impact on output of increasing the growth rate of the general real wage level by 1 percent is about the same as the impact of reducing the discount rate by 1 percent. When the general real wage level grows by 3.5 percent and the discount rate is 1.5 percent, the net interest rate equals -1 and output equals 139.4 billions. This estimate is 3.2 times higher than the one resulting from a net interest rate equal to 3.0 percent (lower left cell).

Table 2: Sensitivity of estimated gross production in the Norwegian Higher Education sector to projected growth in wages rates. Billions NOK 1995

Interest rate\Wage growth	**1.5**	**2.5**	**3.5**
2.5	77.2	103.5	139.4
3.5	58.0	77.4	103.5
4.5	44.0	58.4	77.6

6. Concluding remarks

We have applied a modified version of the methodology introduced by Jorgenson and Fraumeni to obtain a more relevant measure of the output of the higher education sector in Norway than what is provided by the NA. Our baseline estimate of value added based on 1995-data, is more than 8 times higher than the corresponding NA figure. Using our estimate, the share of higher education in (corrected) GDP rises substantially, from 1.0 to 7.3 percent.

We have also provided a theoretical rationale for revising the JF-methodology by excluding the value of non-market activities from the calculations of output in the education sector. This has important empirical implications. In JF (1992b) the estimated investment based on market activities varied around 40 percent of the estimated total educational investment over the period 1952-1986. In Ahlroth *et al*. (1997) the corresponding percentage is even smaller, 27 percent in 1990. If we had followed the JF-procedure by including the projected increase in lifetime value of time spent on non-market activities, the baseline estimate of gross production would increase by 46 percent.

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