Higher Education Reform: Getting the Incentives Right

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Preface

This book is a joint product of the Netherlands Bureau for Economic Policy Analysis (CPB) and the Center for Higher Education Policy Studies (CHEPS). From the CPB, Erik Canton and Richard Venniker (both from the Knowledge Economics Unit) participated, and from CHEPS Ben Jongbloed, Jos Koelman, Peter van der Meer and Hans Vossensteyn joined the team. To acknowledge the individual efforts, the names of the authors are mentioned at the beginning of each chapter.

A number of other people have given constructive input to this project. Representatives of a number of organisations participated in an advisory committee. From the Ministry of Education, Culture and Science Drs. R. Kleingeld, Drs. W. van Niekerk, Drs. R. Ulrich, and Drs. G. van der Vliet joined the committee; from the Ministry of Agriculture, Nature Management and Fisheries Drs. R. Brockhoff; from the Ministry of Economic Affairs Drs. R. Duvekot; from the Ministry of Finance Drs. D. Kabel, Drs. O. Merk, and Drs. P. Reuter; Prof. dr. L. Meijdam from Tilburg University; Dr. G. de Jager from the HBO-raad, Netherlands Association of Universities of Professional Education; and from the VSNU, Association of Universities in the Netherlands Drs. E. de Munck, Dr. C. Otten and Drs. B. Wiersema. Helpful comments from the members of the advisory committee are deeply appreciated.

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F.J.H. Don
Director, CPB

Introduction

The higher education sector is generally considered to be an important contributor to economic prosperity. Higher education brings forth human capital and knowledge, which are indispensable ingredients for the process of economic growth (*cf.* Barro and Sala-i-Martin, 1995; Romer, 2001). Modern societies have an urgent need for highly skilled labour, not only to push ahead the technological frontier by creative researchers but also to adopt and diffuse existing knowledge.

While this crucial role of higher education for economic growth is widely recognised, the way in which countries organise their higher education system differs vastly. Traditionally, the higher education sector is strongly intertwined with the public sector through an extensive system of regulation and financial support (direct and indirect). Apart from this very general common feature, countries differ in policies with respect to student selection, tuition fees, student support programs, public funding of teaching and research, and so forth. This country-specific nature of higher education reflects the fact that the university system is often deeply embedded into a nation's history and culture. Only recently some countries have begun to revisit the role of government. This development was spurred by the tightening of fiscal constraints on public outlays in most OECD countries, which forced governments to rethink their task in (virtually) all sectors they are involved in.

The Netherlands forms no exception. There is an ongoing debate on the function of higher education in the society at large, and the role of the various stakeholders in the higher education sector, including the government, the higher education institutions, students and the private sector. The current debates in the Netherlands concern a wide range of issues.

- First of all, within the perspective of the "knowledge economy" it is claimed that there is a sheer need for highly skilled graduates who are employable in a broad spectrum of jobs. On the other hand, there is an ongoing concern that too few students attend programs in engineering or natural sciences. This calls for a discussion on private and social returns to education, and on the appropriateness and efficiency of government policies to influence the mix of graduates.
- A second category of issues is concerned with access to higher education. In this perspective, we particularly mention the continuous debates on the level of tuition fees, changes in the student support system and the way to assign student slots for programs with restricted capacity;
- A third issue addresses the relation between diversity and transparency in the higher education sector. To improve transparency on the international higher education market, institutions are reforming their study programs towards the Bachelor-Master model. This should also contribute to international labour mobility, as the range of qualifications offered become more transparent to foreign employers. However, in competing for students, higher education institutions are trying to distinguish themselves by means of differentiation – in terms of programs, duration, modes of delivery (applying new technologies), target groups and the academic quality of their

programs. Related to this is the issue of quality assurance, including the accreditation of programs (or higher education institutions);

- Fourth, and finally, there is a growing tendency to include market-type mechanisms as a coordinating device in the higher education system. Providers are supposed to become more competitive and accountable. For instance, the funding of education and research is increasingly becoming performance-based. In addition, in a period when public funds are not keeping up with growing student numbers, the higher education institutions become increasingly inclined to look for additional sources of revenue. This has resulted in more contract activities and increased public-private cooperation.

This book aims to provide a helicopter view on options to organise higher education systems. It is, however, impossible to elaborate on all the above-mentioned issues in this study. Therefore, we have to limit ourselves – both in terms of the perspective we take and the issues we look at – even though we realise that many of the issues are interrelated. To that end, particular attention is paid to the institutional setting in which the higher education sector is operating.[1] Often, this means a close inspection of the incentive structure. It would be too narrow, though, to merely focus on high-powered economic or financial incentives. Financial incentives may have adverse and unintended effects when people are intrinsically motivated in their work, as these incentives could trigger a shift toward activities that generate measurable output while important other activities that generate hard-to-measure output are crowded out.

Since the Dutch experience with alternative arrangements in the higher education system is limited, we shall look across the borders and try to learn from experiences in other countries. Again, the organisation of the higher education system should be seen in the context of the specific institutional setting: systems of higher education successful in one country may fail in another. A critical evaluation thus requires a more profound understanding of the specific institutional structure in those countries.

Organisation of the study

The structure of this study is the following. In **Chapter 1** we describe the most eye-catching characteristics of the Dutch higher education sector. **Chapter 2** is a refresher on the economics of higher education. **Chapter 3** is about private contributions to higher education in conjunction with the issue of accessibility. The Australian Higher Education Contribution Scheme – allowing students to take out loans to pay for tuition while repayment of debt is income-contingent – is

[1] Douglas North, Nobel Laureate in 1993, defines institutions as follows: "Institutions are the humanly devised constraints that structure human interaction. They are made up of formal constraints (*e.g.* rules, laws, constitutions), informal constraints (*e.g.*, norms of behavior, conventions, self-imposed codes of conduct), and their enforcement characteristics. Together they define the incentive structure of societies and specifically economies." (pp. 360, 1994).

examined in greater detail. **Chapter 4** discusses decentralisation in the higher education sector by examining the US system in which most institutes have considerable freedom in deciding on their own tuition fees and admission criteria. In **Chapter 5** we look at funding of education and explore in greater detail the Danish taximeter-model in which the financial flows are directly linked to student performance. **Chapter 6** deals with research funding, and concentrates on the UK system in which research assessments influence the allocation of public funds for academic research. In **Chapter 7** we study the impact of university-industry ties on academic research by examining the US, where some interesting initiatives have been undertaken to promote a fruitful exchange of knowledge between universities and the private sector. Finally, **Chapter 8** presents food for thought for Dutch policymakers: what lessons can be learned from our international comparison?

1 The Dutch higher education system

Erik Canton and Ben Jongbloed

In this chapter we describe the most important features of the Dutch higher education sector. We pay particular attention to those characteristics playing a prominent role in the remaining discussion.

1.1 Binary system

The Dutch higher education sector includes two different levels of education, *viz.* professional training (*HBO, Hoger BeroepsOnderwijs*) and academic training at universities (*WO, Wetenschappelijk Onderwijs*).[1] HBO-institutes offer 4-year programs at the Bachelor-level, and universities offer 4-year (for some disciplines 5-year) Master- and 4-year Ph.D.-programs.[2] Universities prepare students for independent scientific work in an academic or professional setting. HBO-programs prepare students to practise a profession and to enable them "to function self-consciously in the society at large".

In the wake of the Bologna-agreement[3], the Dutch government is preparing a plan to reform the degree structure in the binary system along the lines of the two-cycle Bachelor-Master system used in Anglo-Saxon countries.[4] As it stands, the plan entails the following important changes:

- Introduction of a two-cycle Bachelor-Master structure both at the HBO-institutes and the universities;
- The undergraduate Bachelor-program at universities of professional education takes four years and proposals for the length of the graduate Master-program should come from the universities of professional education themselves. Probably, the vocational Master-program will not be eligible for public financial support;
- A logical choice on the length of the Bachelor- and Master-programs at universities would be a 3+1 or 3+2 year structure. But differentiation in the length of the Master-program should be allowed. It is not yet clear to what extent Master-programs will be financially supported by the government;

[1] HBO-institutes are officially called universities of professional education. We use both names.

[2] More precisely, people who completed an undergraduate WO-program may use the title Drs. (Doctorandus), Ir. (Ingenieur) or Mr. (Meester).

[3] The Bologna-declaration can be downloaded from the web at www.unige.ch/cre.

[4] In 2000, the Education Council (*Onderwijsraad*) advised the Minister of Education on the implementation of a Bachelor-Master system in higher education. The report *Invoering Bachelor-Master Systeem in het Hoger Onderwijs* is available from the Internet at www.onderwijsraad.nl (in Dutch).

- In order to reflect the difference between HBO- and university-degrees, HBO-institutions will confer the Professional Bachelor degree and Professional Master degree, while universities will offer the following degrees: Bachelor of Arts (B.A.), Bachelor of Science (B.Sc.), Master of Arts (M.A.), Master of Science (M.Sc.), Master of Philosophy (M.Phil.) and Philosophical Doctor (Ph.D.).

1.2 Formal tasks

The Dutch Higher Education and Research Act (*Wet op het hoger onderwijs en wetenschappelijk onderzoek*, WHW), which came into force on the 1st of August 1993, regulates the role and activities of universities and HBO institutions.[5] Previous legislation assigned a central role to government, with an emphasis on regulation and planning. The new Act, which has its origins in the 1985 policy document "Autonomy and Quality in Higher Education", propagates the philosophy of steering from a distance and institutional autonomy. Detailed ex ante control by the government has been replaced by ex post control of a more general nature.

According to the WHW, the formal tasks of universities are:

- To provide academic education (both undergraduate and graduate training);
- To carry out scientific research;
- To disseminate knowledge to society.

The tasks of HBO-institutions are:

- To offer professional training;
- To carry out research relating to the education-programs.

The Open University is mentioned separately in the WHW. This institution provides vocational- and university-training in the form of distance learning.

1.3 Types of institutions

The WHW distinguishes between funded institutions (*bekostigde instellingen*) and designated institutions (*aangewezen instellingen*). An important distinction between funded and designated institutions is that funded institutions are eligible for financial support from the government, in contrast to the designated institutions. The funded institutions are listed by name in the WHW. The designated institutions are allowed by the Minister of Education to offer recognised training programs. In principle this designation is of unlimited duration, but the Minister could revoke the designation. Regular full-time students at funded and designated institutions are eligible for

[5] In addition, the WHW also applies to the academic hospitals, the Open University, the Royal Netherlands Academy of Arts and Sciences (KNAW), and the Royal Library.

student support. Finally, there are some privately funded institutions that offer higher vocational training programs but where students are not eligible for public support.

There are 13 funded universities, and one designated university (University of Nijenrode) in the Netherlands. And there are 66 universities of professional education of which four are designated.[6] Most institutions eligible for government support are funded by the Ministry of Education, but some receive their funding from the Ministry of Agriculture.

Funded and designated higher education institutions cannot freely decide on their location. They can only offer education in the city where they are established, unless permission is granted to deviate from this rule. Both the funded and the designated institutions have to fulfil requirements with respect to quality, registration, education, examinations and dissertations, and entry level. In addition, the funded institutions also have to obey rules in connection with planning and funding, personnel, the position and legal status of students and external candidates[7], and management structure. Rules in relation to titles (*e.g.* Drs., Ir. or Mr.) do not differ between both types of institutions. By-and-large, the designated institutions have (slightly) more autonomy.

The Minister of Education decides on recognition of training programs. Recognised programs are listed in the *Centraal Register Opleidingen Hoger Onderwijs* (CROHO). Private schools can only receive the status of designated institution when their programs are recognised.[8]

1.4 Funding structure

The public higher education sector receives financial resources from three pillars:

- The *first flow of funds* contains public core funding and revenues from tuition fees;
- The *second flow of funds* consists of project-based public payments allocated by the Dutch research council (NWO, *Nederlandse Organisatie voor Wetenschappelijk Onderzoek*) and the Royal Netherlands Academy of Arts and Sciences (KNAW);
- The *third flow of funds* comprises income from contract activities.

[6] It should be noted that the market for professional training has become more concentrated through scale increases (in 1985, there were 432 universities of professional education).

[7] External candidates (*extraneï* in Dutch) take examinations without having attended the institution as a regular student.

[8] Recognition is not the same as accreditation. At this moment, there is no accreditation system in use but the Ministry is considering to transform the current system of quality assurance into a system based on accreditation.

With respect to the *core funding flow*, the WHW distinguishes between funding of teaching and funding of research activities at universities. Teaching funds depend on the number of students and study performance. The public contribution to research activity is influenced by social and scientific needs, the profile of the university, and the quality of research. Public contributions are lump-sum amounts, so that institutions have the freedom to relocate their funds between various activities.

Several components of the core funding flows of universities are performance-based: core funding of teaching is partly connected to the number of graduates (50%) and the number of first-year students (13%), and core funding of research is partly connected to the number of Ph.D. dissertations and designer certificates. But the largest part of the core funds for research is predetermined. A more detailed description of the funding models for WO- and HBO-institutions is included in the Annex "Public funding of higher education in the Netherlands, performance-based models".

Table 1.1 shows the relative sizes of these flows in international perspective. From this small sub-set of countries, the picture emerges that core funding is relatively important in the Netherlands, while revenues from tuition fees and the second and third flow are relatively small (at least in the WO-sector).

Note that tuition fee payments refer to gross private contributions to educational costs. As students are often eligible for financial support from the government, net private contributions can be (substantially) lower. More on this in Section 1.7.

Table 1.1 Composition of revenues of the higher education sector, international comparison

	First flow (%)		Second flow (%)	Third flow (%)	Total (%)
	Core	Tuition fees			
Australia ('97)	48.2	14.7	5.6	31.5	100
Denmark ('97)	63.9	-	18.8	17.3	100
the Netherlands ('97)					
WO	72.1	5.5	3.4	19.0	100
HBO	69.1	17.1	-	13.8	100
UK ('97)	38.5	11.5	4.8	45.3	100
US ('95/'96)					
public	35.0	18.3	12.3	34.5	100
private	2.5	41.4	14.2	41.8	100

Note: WO stands for *Wetenschappelijk Onderwijs*, and HBO for *Hoger Beroepsonderwijs*.
Source: Jongbloed and Vossensteyn (1999), and own calculations.

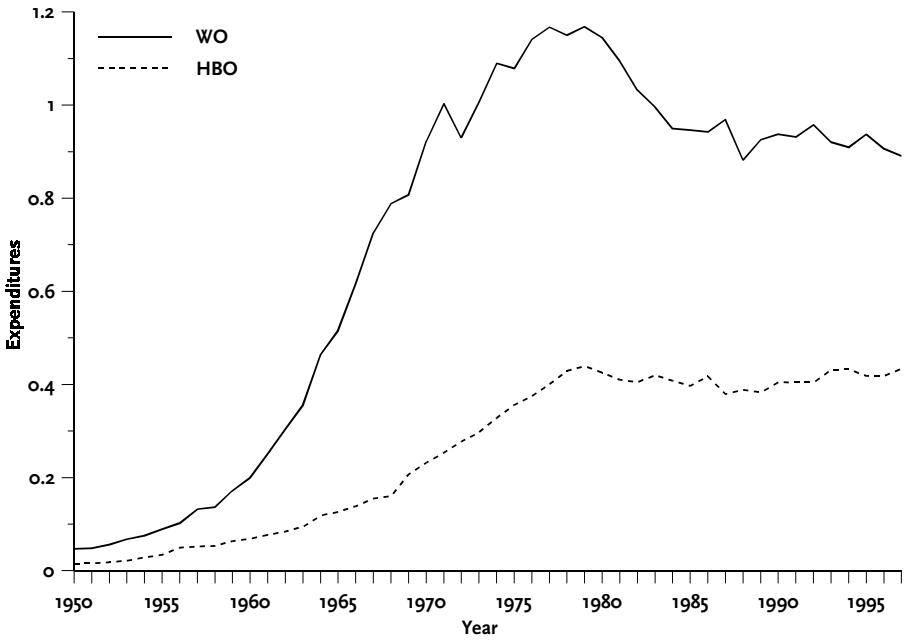
In connection with the *second flow of funds*, NWO acts as an intermediary in granting funds for separate research proposals submitted by individual researchers or research teams. Projects are funded on a competitive basis. Table 1.1 shows that project-based research council funds represent about 3% of university income.

The *third flow of funds* concerns contract research and contract teaching carried out for government, non-profit organisations, private companies, charitable boards, and the European Community. For universities, this supplementary source of income has been growing fast since the early 1980s. It now represents about 19% of university income for teaching and research (excluding income from other services provided by universities). For the HBO-sector it is difficult to obtain figures for income from contract activities. Surveys reveal that it nowadays lies in the neighbourhood of 14% of their income.

1.5 Public expenditures on higher education

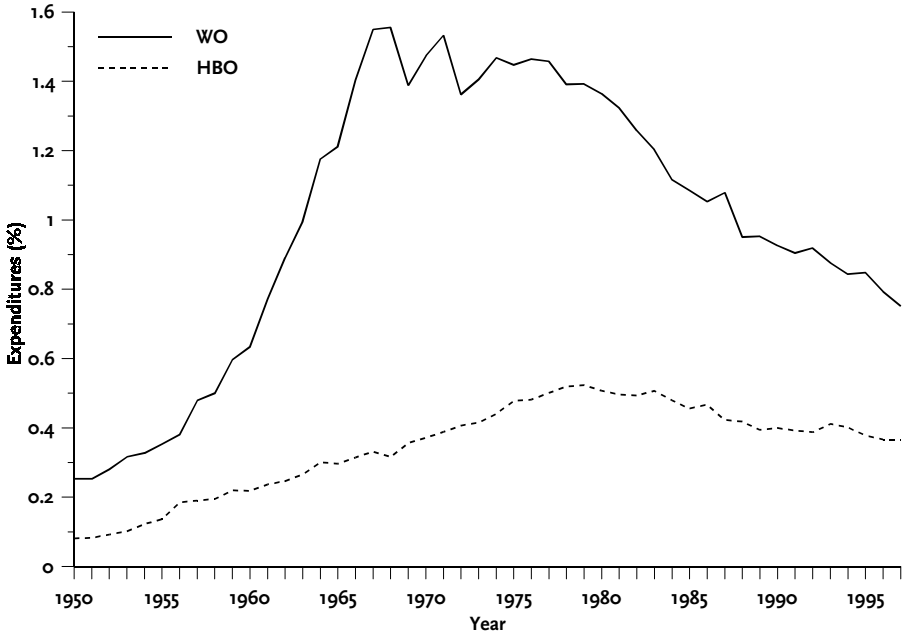
In Figures 1.1-1.3 we plot public outlays on higher education for the post-war period. Figure 1.1 shows real expenditures (in billions Dfl.), distinguished into HBO-level and WO-level. Total public expenditures have risen rapidly, especially during the sixties and seventies. Since the early eighties there is a clear change in this development. Real public expenditures on WO-training declined, and real public outlays on HBO-training were frozen. Figure 1.2 presents public expenses on HBO- and WO-training as a fraction of GDP. Relative outlays on university-training have sharply declined since the mid seventies, while relative public expenditures on HBO-training have slightly decreased since the early eighties. By-and-large, public expenditures on higher education have not kept up with GDP since the late 1970s.

Figure 1.1 Real public expenditures on HBO and WO (billion Dfl., CPI is 1 in 1950)



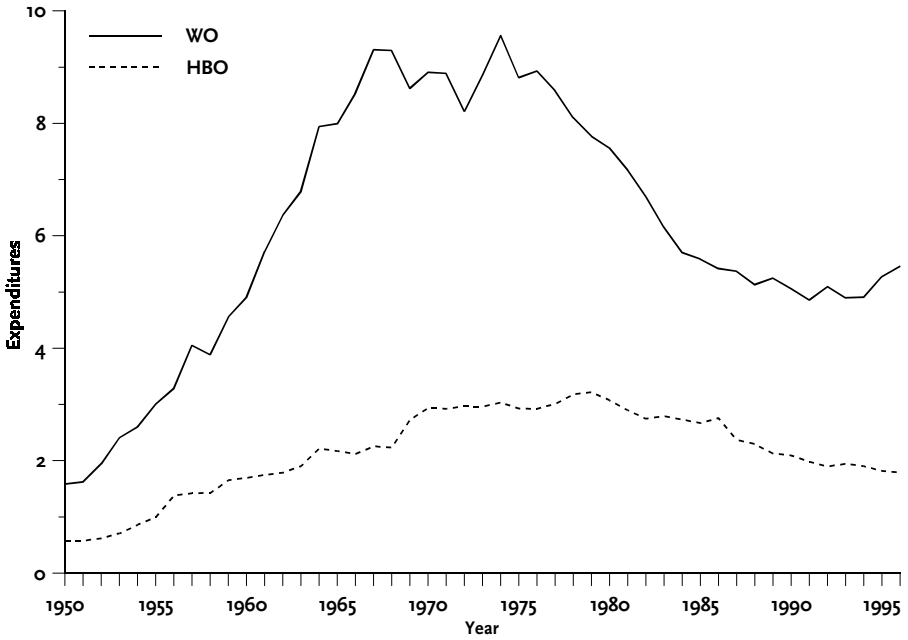
Source: Public expenditures on HBO and WO are obtained from CBS (1992), CBS-Statline, and OCenW (1999); The series for the Consumer Price Index is from CPB (1998) and CPB (2000).

Figure 1.2 Public expenditures on HBO and WO (% of GDP)



Source: Public expenditures on HBO and WO are obtained from CBS (1992), CBS-Statline, and OCenW (1999); Data on GDP are from CBS-Statline.

Figure 1.3 Real public expenditures on HBO and WO per student (thousand Dfl., CPI is 1 in 1950)



Source: Public expenditures on HBO and WO are obtained from CBS (1992), CBS-Statline, and OCenW (1999); Enrollment series are collected from CBS (1992) and CBS-Statline; The series for the Consumer Price Index is from CPB (1998) and CPB (2000).

Figure 1.3 shows the historical development of the average public expenditures per HBO- and WO-student. The inclusion of research expenditures is largely responsible for the substantial cost differences between a HBO- and a WO-student. A trend break occurred around 1975. Public expenditures per WO-student declined thereafter, but slightly recovered in recent years. And public expenditures per HBO-student slightly declined. This consolidation of public spending was supported by efficiency gains from the exploitation of economies of scale in the HBO-sector (see footnote 6).

To put these data in international perspective, we present figures on expenditures per student in a number of OECD economies in Table 1.2. These expenditures amount to an average of $10,893 per student in tertiary education for 29 OECD countries.[9] University-level training is more expensive than non-university forms of tertiary education. Average expenditures per student in the Netherlands is somewhat below the OECD average. This may partly be explained by the relative over-representation of (less expensive) students in humanities and social sciences in the Netherlands.[10] The second part of the table shows expenditures per student relative to GDP per capita. Again, the Netherlands are slightly below the OECD average and the US are on top with 59%.

Table 1.2 Expenditures on tertiary education, international comparison

	Expenditure per student (US $ converted using PPPs), 1997 Tertiary education			Expenditure per student relative to GDP per capita (%), 1997 Tertiary education		
	All	Vocational training	Scientific training	All	Vocational training	Scientific training
Australia	11,240	7,852	12,024	51	36	55
Denmark	7,294	-	-	29	-	-
the Netherlands	9,989	6,862	10,028	45	31	45
UK	8,169	-	-	-	-	-
US	17,466	-	-	59	-	-
OECD	10,893	6,765	8,252	49	34	47

Source: OECD (2000, pp. 94, 95).

1.6 Tuition fee policies

Tuition fees for regular full-time students are centrally determined by the Minister of Education and are uniform for all subjects in HBO and WO (in Dutch: *wettelijk collegegeld*). The tariff for

[9] We consider tertiary education and higher education as identical, see OECD (1998, pp. 425).

[10] About 40% of Dutch students attends a program in social sciences, against 25% in the EU; 11% of Dutch students is enrolled in engineering and architecture, while this is 15% in the EU (data from Eurostat).

regular students amounts to Dfl.2,874 (€1,304) in 2000/01. Table 1.3 shows that tuition fees have increased in recent years. The last two rows in the table show the tuition fee ratio, *i.e.* tuition fees as a percentage of the total direct cost of a higher education program. Relative private contributions have been fairly stable around 19% of average direct costs in the WO-sector, whereas the tuition fee ratio has gradually increased for HBO-programs.

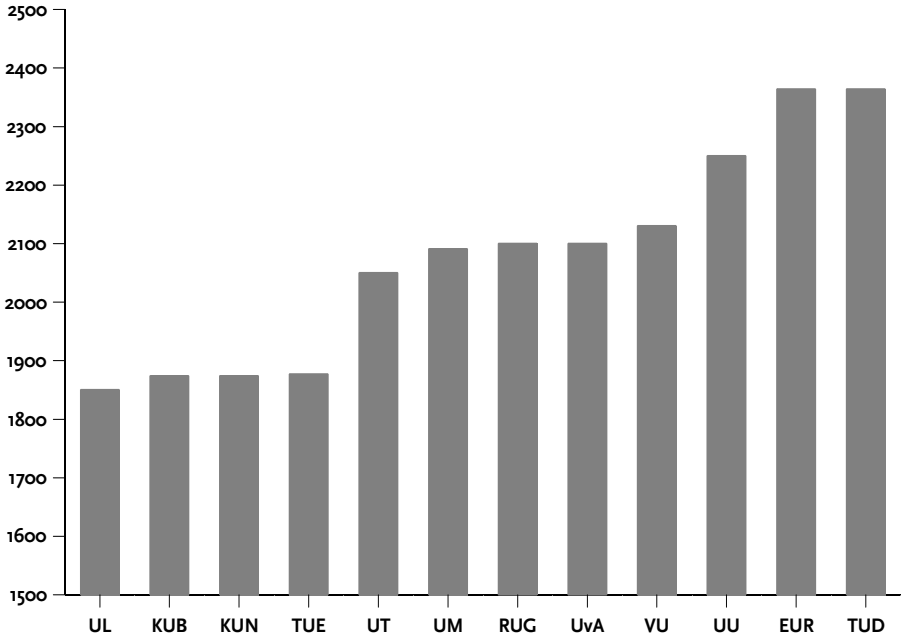
From September 1996 on, tuition fees for part-time students, students who have not completed their studies within the nominal length of study plus 2 years (6 or 7 years), and external candidates can be set by the institutes themselves (in Dutch: *instellingscollegegeld*). To see whether the institutions make use of this possibility for tuition fee differentiation, we plot the prices charged to part-time students at the 13 funded universities in Figure 1.4. Tuition price for part-time students is relatively high at Erasmus University Rotterdam and Delft University of Technology. These observations bring us to the conclusion that most universities make some use of the room for tuition fee differentiation. However, as shown by Jongbloed and Koelman (1999), HBO-institutions hardly use the possibility to set tuition fees beyond the minimum rates set by the government.

Table 1.3 Tuition fees for regular full-time students, 1994-2001

	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Nominal fee (Dfl.)	2,150	2,250	2,400	2,575	2,750	2,816	2,874
Real fee (Dfl.)	2,150	2,217	2,333	2,452	2,567	2,572	2,561
Tuition fee ratio, WO	19%	18%	18%	19%	19%	19%	
HBO	18%	19%	20%	21%	22%	22%	

Note: The final two rows display tuition prices as a percentage of the average direct educational costs of a training program.
Source: The CPI is set at 1 in 1994; inflation data are from CPB (1998, 2000); Tuition fees and average direct educational costs are from OCenW (2000, 2001) and the homepage of OCenW (www.minocw.nl).

Figure 1.4 Tuition fee differentiation for part-time students at Dutch public universities



Note: Tuition fees (in Dfl.) refer to the academic year 1999/2000; Abbreviations have the following meaning: Universiteit Leiden (UL), Katholieke Universiteit Brabant (KUB), Katholieke Universiteit Nijmegen (KUN), Technische Universiteit Eindhoven (TUE), Universiteit Twente (UT), Universiteit Maastricht (UM), Rijksuniversiteit Groningen (RUG), Universiteit van Amsterdam (UvA), Vrije Universiteit (VU), Universiteit Utrecht (UU), Erasmus Universiteit Rotterdam (EUR), Technische Universiteit Delft (TUD). Source: Homepages of the universities.

1.7 Student support system

In 1986, a system of family allowances, tax facilities and means-tested grants was replaced by one system of direct financial student support through the introduction of the Student Finance Act. Although this system has gone through a large number of reforms, it still consists of the following three basic provisions:

- All regular full-time students at funded and designated institutions receive a *basic grant* for the nominal duration of a higher education program (4 or 5 years). As of the academic year 1996/97, the basic grant is called the "performance-related grant" because students receive it initially as a loan. If students show satisfactory academic performance, the loan becomes a grant.[11] The amount of the basic grant depends on the housing conditions of students. As of January 2001, the basic grant amounts to Dfl.147 (€67) per month for students who live with

[11] More specifically, students must meet the following performance requirements. In the first year, students must pass 50% of the exams, that is 21 out of 42 study points. If they meet this requirement, all initial loans become a grant. The initial loans students receive in the second, third, and fourth (and in some cases fifth) years, can be turned into a grant if they complete their study within ten years. Note that voluntary loans (*cf.* third provision) cannot be transferred into a gift.

their parents and Dfl.454 (€206) for students who live on their own. Students are free to take out less than the maximum grant to reduce the debt in case they do not meet the performance requirement;

- Students can apply for a *supplementary grant* when parental income is below some threshold (means-tested). This grant can only be received for the nominal duration of study (4 or 5 years). The supplementary grant is also subject to the performance requirements applying to the basic grant. Depending on parental income, the maximum amount of the supplementary grant is Dfl.431 (€196) per month for students who live with their parents and Dfl.467 (€212) for students who live on their own. Students are eligible for the maximum grant when parental income is below approximately Dfl.52,000 (€23,597);[12]
- Finally, students can voluntarily take up an interest-bearing *student loan* of at most Dfl.504 (€229) per month. The loans are not means-tested.[13]

Apart from the basic provisions, students are allowed to earn an additional annual net income of at most Dfl.19,500 (€8,849). Student support is reduced when they earn more. This arrangement also comprises a subsidy-element, as other groups receiving financial support from the government are not allowed to earn additional income.

Finally, students eligible for student support also receive a public transport pass, entitling students to free public transport either on working days or in the weekends (the days public transport is not for free, the transport pass entitles them to a 40% discount on all fares).

In a worst-case scenario, students could end up with a debt of approximately Dfl.90,000 (€40,840). After a grace period of 2 years, debts must be repaid within a period of 15 years with a minimum monthly installment of Dfl.100. If graduates have difficulties in repaying their monthly installments, they can ask for an annual means test. Based on that, monthly repayments can be reduced (even to zero). Any remaining debt after 15 years is acquitted. Loans are interest-bearing. As of January 2001, the interest rate is 5.18%.

1.8 Admission policies

There are some uniform requirements (set by the government) to enter higher education in the Netherlands. These admission criteria refer to the secondary school diploma: level (*HAVO* for HBO and *VWO* for university-training) and – sometimes – subjects chosen.

For university programs, an exception to this rule holds for medicine, dentistry, and veterinary science, where numbers are capped (a *numerus clausus* applies). For those subjects a lottery is used to ration places upon final exam scores. This lottery system, first adopted in the

[12] Modal income is approximately Dfl.56,000 (€25,412) in 2000.

[13] In case parent are not willing to contribute to the costs of study, students are allowed to take an additional loan.

1970s, has been heavily debated because in some occasions very talented students were not admitted. The ultimate question therefore is: should merit replace luck in gaining entrance to *numerus clausus* programs? As a result, a new selection system was implemented in 1999. The main difference with the old system is that all candidates with high grades in the final secondary education exams gain direct admission to the program of their choice. The other applicants will have to revert to the weighted lottery procedure. More recently, other changes in this weighted lottery procedure have been proposed. In particular, a small number of universities and HBO-institutions have been allowed to experiment with setting their own entrance criteria: they can allocate a small percentage of available places in study programs with a *numerus clausus* to applicants that pass specific entrance tests. In Chapter 4, we will return to this issue by looking at student selection within the US higher education system.

While there is hardly any selection of students at the moment of entrance, institutions have the possibility to give a negative advice on whether or not to continue at the end of the first year of registration. This advice can be binding at the discretion of the institution, implying that a student with a negative advice is no longer allowed to register for the program in question. This selection mechanism is actively used at Leiden University, where first-year students who pass less than 50% of their exams receive a negative advice. It is not known to what extent other Dutch higher education institutions make use of this selection opportunity, but anecdotal evidence suggests that HBO-institutions also make use of the instrument of binding advice.

1.9 Quality control

To assess the quality of teaching and research activities, the universities and HBO-institutions have set up a system of quality control. This quality control is carried out by the institutions themselves, in collaboration with external experts, through their representative bodies (VSNU and HBO-raad).

The quality of teaching in individual subject areas is assessed every six years in the university-sector and every four years in the HBO-sector. The assessments are based upon self-evaluations conducted by the faculties, reviewed by a committee of academic and professional peers that visit all institutions. On behalf of the Ministry of Education, the Inspectorate for Higher Education oversees the quality control system. To follow any actions taken as a result of the quality assurance reports, the inspectorate visits each institution. It has a role in ensuring that institutional quality control mechanisms are in place. If the Ministry feels that unsatisfactory actions have been taken by the institutions, it may withdraw its funding, although this rarely happens. Institutions (so far!) are not ranked, nor does something like an unofficial pecking order exist – at least not to the relatively uninformed outsider like a prospective student. The quality assurance reports of individual faculties are public. The reports are used by the

institutions and individual faculties (*e.g.* for public relations), and by students and parents to obtain information about particular programs or institutions.

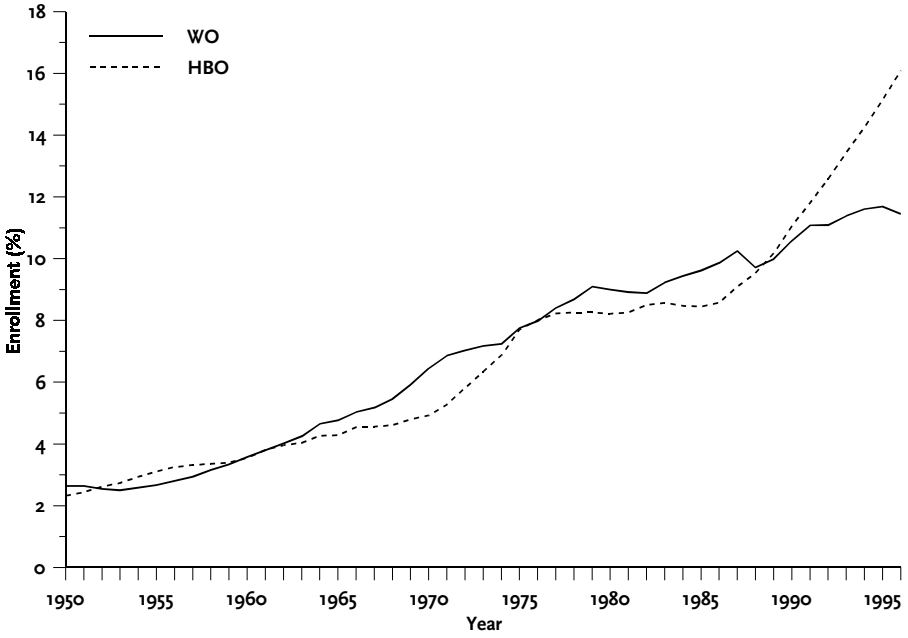
Research at Dutch universities is also subject to quality assessments through peer review. The review considers international benchmarks and the review panel usually has at least one international member (although, as is the case for teaching assessments, in practice this individual may come from across immediate borders). Although there are no direct financial rewards associated with a positive research evaluation, the ratings often do influence the internal budgeting process of universities.

1.10 Enrollment

In Figure 1.5 we plot student enrollment in Dutch higher education. Student participation in HBO-education has shown a gradual increase from about 2% of the age group 18-24 (26,000 students) in 1950 to approximately 16% (233,000 students) in 1996. Participation in university training has risen from 3% (29,000 students) in 1950 to 11% (166,000 students) in 1996. Note that student enrollment in university education was relatively stable since the early nineties, whereas HBO-participation has grown rapidly over the last ten years.

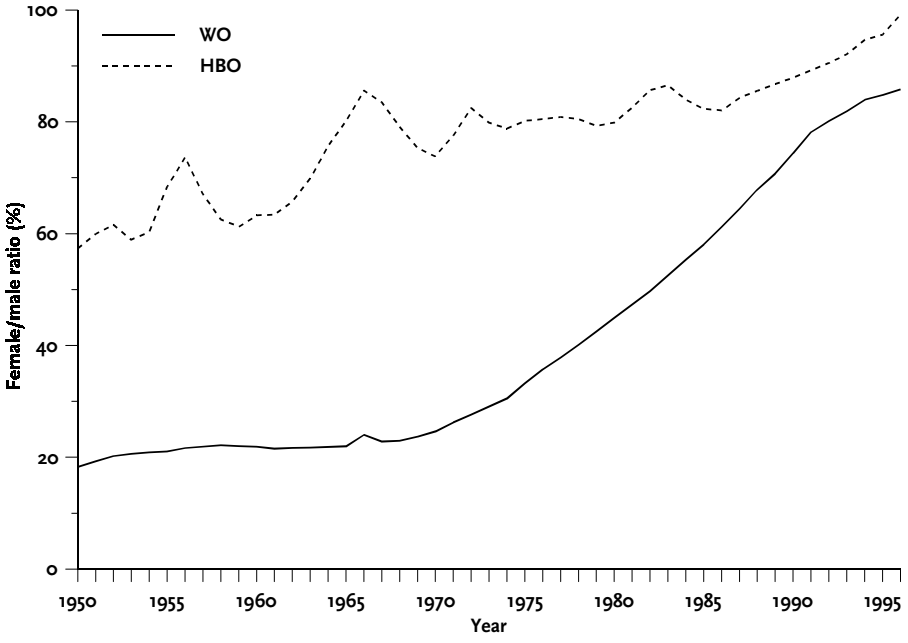
To further investigate the gradual expansion of the higher education sector in terms of student participation, we look at the gender-composition of the student population. Figure 1.6 shows the female/male-ratio for Dutch HBO- and WO-students over the past fifty years. The historical pattern of the participation of women in higher education differs between vocational and university training programs. Female participation in HBO has been larger than in WO. In 1950, the female/male-ratio was about 57% in HBO-education, compared with only 18% in university-training. By 1996, female enrollment was equal to male enrollment in HBO-training, and approximately 86% of male participation in WO. From these observations we conclude that the increase in student enrollment is largely generated by the catch-up of female participation rates to the level of male enrollment rates in higher education.

Figure 1.5 Student enrollment in HBO and WO (% of age group 18-24)



Source: The enrollment series are from CBS (1992) and CBS-Statline; The number of people in the 18-24 age cohort is available from CBS (1998).

Figure 1.6 Female/male-ratio in HBO and WO



Source: CBS (1992) and CBS-Statline.

Participation rates in tertiary education for the countries in this study are listed in Table 1.4 In the Netherlands we observe that 11% of the age group 17-34 participates in higher education, an intermediate position in international perspective. The enrollment rate is highest for the US, but systems of higher education are not perfectly comparable among countries so that we cannot draw any a priori conclusions regarding access to tertiary education. In fact, the level of some of the US colleges is comparable with intermediate vocational education in the Netherlands (*MBO, Middelbaar Beroepsonderwijs*). The 70% completion rate (the fraction of students completing their studies) in the Netherlands is of intermediate size.

Table 1.4 Participation in tertiary education, international comparison

	Net enrollment in tertiary education, age 17-34 (%)			Completion rate (%)
	All	Non-university	University	
Australia	14.9	5.1	9.9	65
Denmark	6.9	1.1	5.8	67
the Netherlands	10.7	-	10.7	70
UK	9.4	2	7.3	81
US	16.2	6	10.2	63

Source: OECD (1998, pp. 185 & 198).

Annex: Public funding of higher education in the Netherlands, performance-based models

Funding of universities

As of the year 2000, the Dutch university sector receives government funding according to the so-called *prestatiebekostigingsmodel* (PBM).

The PBM is a distribution model. The Minister determines the macro-budget for the university sector, and subsequently decides about the distribution of the macro-budget to the individual institutions. The two most important components of the macro-budget are:[14]

- Teaching component
  a. component for basic teaching facility (37%);
  b. component for certificates (50%);
  c. component for first-year students (13%);
  d. component for workplace veterinary medicine and workplace dentistry.
- Research component
  a. component for basic research facility;
  b. component for dissertations and designer certificates (*ontwerperscertificaten*);
  c. component for research centers (*onderzoekscholen*);
  d. component for excellent research centers (*toponderzoekscholen*);
  e. component for strategic considerations.

In 2000 the total budget of the Ministry of Education available for universities is Dfl.4,084.2 million. The Minister decides on the distribution towards teaching and research. The teaching component amounts to Dfl.1,461.6 million, and the research component amounts to Dfl.2,622.6 million.

- Teaching component
  From the total amount available for teaching the component for workplace (Dfl.51.4 million) is subtracted. The remaining budget (Dfl.1,410.2 million) is distributed as follows:
  - 37% for basic teaching facility, *i.e.* Dfl.521.9 million;
  - 50% for certificates, *i.e.* Dfl.705.1 million;
  - 13% for first-year students, *i.e.* Dfl.183.2 million.

  Next we describe how these amounts are distributed to the individual universities. To avoid large fluctuations in financial flows, funding is based on two-year averages of number of certificates

[14] In addition, there is a component for academic teacher-training, for academic hospitals, for allowance after dismissal (in Dutch: *wachtgeld*), and for investments.

and number of first-year students. A weight is applied to account for differences in costs of training programs. There is a low and a high tariff-group. Put loosely, alpha and gamma-studies belong in the low category and bèta, technical and medical studies in the high tariff group. The ratio used in the cost calculation is 1 : 1.5.

The component for basic teaching facility is distributed according to fixed amounts per university. This component is meant to guarantee teaching capacity independent of the number of students. In addition, it serves as an additional stabilising factor in the financial flows. This component has a historical base. Also the component for workplaces (veterinary science and dentistry) is allocated by means of fixed amounts per university.

The next table shows the distribution of teaching funds across Dutch universities according to this *prestatiebekostigingsmodel*.

Table 1.5 Funding of teaching, WO-sector (1999)

TEACHING mlj. Dfl.	Component for basic teaching facility	Component for certificates	Component for first-year students	Component for workplace	**Total**
UL	46.1	58.6	14	0	**118.7**
UU	72.1	100.8	23.6	35.5	**232**
RUG	50.9	84.4	19.2	0	**154.4**
EUR	29.2	51.9	15.3	0	**96.5**
UM	26.3	38.5	15.5	0	**80.4**
UVA	62.4	93.1	22.1	6.6	**184.2**
VU	41.3	59.9	16.8	6.1	**124**
KUN	41.4	65.6	13.7	3.1	**123.8**
KUB	16.4	31.5	8.7	0	**56.6**
TUD	68.3	57	17.7	0	**142.9**
TUE	37.4	32.2	8.9	0	**78.5**
UT	30.2	31.6	7.9	0	**69.7**
Total	**521.9**	**705.1**	**183.2**	**51.4**	**1,461.6**
	37% of 1,461.6-51.4	50% of 1,461.6-51.4	13% of 1,461.6-51.4		

Note: Abbreviations have the following meaning: Universiteit Leiden (UL), Universiteit Utrecht (UU), Rijksuniversiteit Groningen (RUG), Erasmusuniversiteit Rotterdam (EUR), Universiteit Maastricht (UM), Universiteit van Amsterdam (UVA), Vrije Universiteit (VU), Katholieke Universiteit Nijmegen (KUN), Katholieke Universiteit Brabant (KUB), Technische Universiteit Delft (TUD), Technische Universiteit Eindhoven (TUE), Universiteit Twente (UT).
Source: OCenW, www.minocw.nl/begrotin/finschema/hfd2.htm.

- Research component

  The government budget for public research comprises 5 parts. The component for basic research facility is based on a fixed amount per university. The component for Ph.D. and designer certificates is calculated from the number of Ph.D. dissertations and designer certificates per university (based on two-year averages). Two tariff groups are considered for

Ph.D. dissertations, a low tariff group (alpha and gamma) and a high tariff group (bèta, technical, medical). The ratio in the funding of low tariff dissertations, high tariff dissertations, and designers is 3 : 6 : 5. The component for research centers is allocated to the universities proportional to the sum of the component for basic research facility, the component for Ph.D. and designer certificates and the strategic consideration component (SOC, *component strategische overwegingen*) of the previous year. The component for excellent research centers is allocated by the Minister after consultation of NWO. The strategic consideration component is allocated on the basis of fixed amounts per university. This component is adjusted in order to implement PBM not involving additional expenditure for the universities. The next table shows the distribution of research funds across Dutch universities according to the *prestatiebekostigingsmodel*.

Table 1.6 Funding of research, WO-sector (1999)

RESEARCH mlj. Dfl.	Component for basic research facility	Component for Ph.D. and designer certificates	Component for research centers	Component for excellent research centers	SOC	**Total**
UL	34.6	34.9	9.2	8.9	150.8	**238.3**
UU	56	47.2	12.8	14.2	213.2	**343.5**
RUG	43.4	30.9	9.7	12.3	156.7	**253**
EUR	28.5	19.7	5.3	4.8	78.9	**137.2**
UM	20.2	13.6	3.8	3.1	75.3	**116.1**
UVA	52.7	41	11.9	12	186.3	**303.9**
VU	33	21.6	8	7.6	134.9	**205.1**
KUN	32.6	25.3	8.1	6.5	127.7	**200.1**
KUB	18	4	2.3	1.8	29.8	**56**
TUD	37	35.2	14.8	12.8	300.1	**399.9**
TUE	18.6	28	8	11	140	**205.7**
UT	18.7	23.3	6.2	5	110.7	**163.9**
Total	**393.4**	**324.8**	**100**	**100**	**1,704.5**	**2,622.6**

So the most important part of research funding is represented by the strategic research component. The name of this component is derived from the fact that the government seeks to fund "strategic" research, *i.e.* research relevant to society. This is where the quality criterion is coming to the fore. Although the Ministry of Education and the universities agreed that quality and social relevance are to play an important role in allocating this component, the universities took the view that a reshuffling of research funds would be a major intrusion on the university's autonomy. So far, the universities have been successful in avoiding any relocations. Therefore, this part of research funding is still mainly based on historical allocations (though over the years some additional allocations were made to relatively new or expanding universities). Thus, unlike teaching, most of the funds for research are not distributed on the basis of output.

From the 1998 budget on, an additional feature was introduced in the research funding model. A two-part compartment for strengthening the system of so-called research schools in the Netherlands was added to the three already existing research budget compartments. It was called the *breadth and depth* strategy. Through the first part of this compartment (the *breadth* compartment), universities were encouraged to continue on the road towards establishing research schools. So far, more than 100 research schools have been established. The aim of research schools is twofold:

- To have a structure in which researchers from different universities concentrate their research activities on certain (sub-) disciplinary fields;
- To locate the training of new researchers (Ph.D. students) in this structure. This strategy, based on arguments of scale and synergy, seeks to strengthen and improve the quality and profile of university research in general.

The second part in the research school compartment (the *depth* compartment) was targeted at supporting those research schools which are considered to be among – or show potential to become part of – the best research institutes in the world in particular research areas. The underlying strategy for this component is to reward excellence.

The funds in connection with the breadth as well as the depth components were to be transferred from the strategic research component (*i.e.* the historic allocations described earlier). NWO, the Dutch research council, was to decide what research schools qualify for the depth support. Six research schools, all of them in natural sciences, were selected in 1998 as top research schools and qualified for additional support. This selection met with a lot of criticism, especially from the social sciences. The present (liberal) Minister of Education has abolished the depth strategy and decided to take another approach that was not targeted at large-scale research schools, but also to smaller scale groups, predominantly from the social sciences and humanities.

Funding of universities of professional education[15]

The funding model for the HBO-sector is also a distribution model with a fixed macro-budget. The allocation of the available budget to the institutions is based on the number of "education-demanding students" (in Dutch: *onderwijsvragende studenten*). The number of education-demanding students is calculated from:

$$owv = \frac{A \times NBA + U \times NBU}{Ja + Ju}$$

where:

owv	number of education-demanding students;
A	number of students and external candidates who receive a degree;
NBA	normative length of stay for students who complete their study;
U	number of students and external candidates who drop out;
NBU	normative length of stay for students who drop out;
Ja	number of years that students who complete their study have been registered at the institution;
Ju	number of years that students who drop out have been registered at the institution;

The Minister uses *NBA*=4.5 (years) as the normative funding period of people who complete their study, and *NBU*=1.35 as the normative funding period of drop-outs.

The total amount of funding is then calculated from multiplying the number of education-demanding students by a fixed reimbursement per student (for 2001 Dfl.9,850 for "p-programs" (*practicum-georiënteerd, e.g.* technical studies) and Dfl.7,615 for "g-programs" (*gamma-georiënteerd, e.g.* economics)).

[15] A detailed description of the HBO funding model is available from the homepage of the HBO-raad, www.hbo-raad.nl/beleidszaken/handboek/regelgeving/besluit.html.

2 Economics of higher education

Erik Canton and Richard Venniker

This chapter is a short introduction to the economics of higher education. We discuss important economic concepts and mechanisms on the market for higher education services. We do so by looking at a sequence of questions:

- Why do people attend higher education (Section 2.1)?
- Why should government support higher education (Section 2.2)?
- How to organise public funding of higher education – student support versus institutional funding (Section 2.3)?
- Public or private provision of higher education (Section 2.4)?
- Should the higher education market be deregulated (Section 2.5)?
- Why combine education and research in universities (Section 2.6)?
- Why should government support research (Section 2.7)?
- How to organise public funding of research (Section 2.8)?
- Does government failure reduce the desirability of government intervention (Section 2.9)?

2.1 Why do people attend higher education?

Students participate in higher education for two basic reasons: consumption and investment. Under the consumption motive, higher education generates immediate benefits related to students' curiosity and the pleasure to learn. Under the investment motive, students incur the costs of education (both time and money) in order to enlarge their future expected income. The available empirical evidence for the Netherlands suggests that the investment motive is the most important factor behind the decision to attend higher education.[1]

Two mechanisms may account for the positive effect of education on income. The first operates through the effect of education on knowledge and skills, or human capital. The second operates through the informational role of education. These mechanisms are known in the literature as the human capital model and the signalling model.

2.1.1 The human capital approach

The human capital approach (*cf.* Schultz (1961), Becker (1964)) stresses that education enhances the knowledge and skills embodied in people, thus raising their human capital. More human capital, in turn, implies higher salaries and a smaller chance of ending up unemployed. Human

[1] *Cf.* Kodde and Ritzen (1984), Huijsman *et al.* (1986), and Oosterbeek and Webbink (1995).

capital also generates non-monetary benefits related to job satisfaction, personal development, and participation in social life.

2.1.2 The signalling approach

An alternative view holds that education primarily serves to reveal the innate ability of people. Innate ability is considered to be the main determinant of people's productivity. If it cannot be observed directly, people can provide information about their productivity by investing in education. So education helps to alleviate the information problem on the labour market. Consequently, education may be a beneficial investment for individuals, even if it does not increase their productive capacity. This signalling (or screening) effect has been put forward by Arrow (1973) and Spence (1973).[2]

What do the data say about the importance of the human capital versus the screening hypothesis? Hartog (1983) compares earnings of people who attended a higher education program but did not obtain a degree to earnings of people who completed the program. He finds a significant negative effect of the graduation gap, *i.e.* the number of years short of graduation for those who did not complete their studies. Quantitatively, the effect of a year of nongraduation is in the same order of magnitude as the earnings gain of an additional year of tertiary education. This finding gives support to the human capital augmenting view of education, and is in contrast with the prediction of the screening hypothesis. Other evidence supporting the human capital model is presented in Groot and Oosterbeek (1994). However, according to Temple (2000) and Weiss (1995) the overall importance of signalling remains controversial and the results of natural experiments to test the correlation between earnings and schooling are not necessarily inconsistent with the signalling view of education.

2.1.3 How high are the financial and non-financial returns to higher education?

- Private rates of return

In order to estimate the profitability of higher education investments, the benefits should be set against the direct and indirect costs of education. The major direct costs are tuition fees and study materials like books. The indirect costs consist of forgone earnings. If students wouldn't have taken up a college education, they probably would have entered the labour market. The income they would have earned on the labour market should be counted as costs of education. Without further adjustments, this overstates the real costs to students. In many countries students receive education-related subsidies. And most students take up small jobs during their study, although probably at lower wages than they would have earned in full-time jobs. Both

[2] A standard critique to the signalling approach is that higher education is a costly instrument to signal ability. Admission tests may be a much cheaper instrument to solve the information problem.

these incomes should be subtracted from the forgone earnings to arrive at the real costs to students.[3]

Estimates for rates of return to years of education in the Netherlands vary from 3% to 8.6% (Table 2 in Hartog *et al.*, 1999). International estimates of the returns to an extra year of education lie somewhere in between 5% and 15%, depending on the time and country.[4] These findings are mostly based on ordinary least squares (OLS) regressions. Two problems stand out. First, if schooling is measured with error, the regression coefficient is underestimated (see Card (2000) for a formal proof). Second, selection effects give rise to an upward bias in the regression coefficient. When the model does not control for ability, the effect from schooling on income is overestimated. The general view holds that the downward bias due to measurement error is in the same order of magnitude as the upward bias from selection effects, so that the OLS-estimate is a reasonable approximation of the "true" returns to schooling (*cf.* Krueger and Lindahl, 2000). By-and-large, it is warranted to conclude that education yields a substantial private financial return.

Most studies on rates of return to schooling do not explicitly distinguish between primary, secondary and tertiary education. What is known about the private financial returns to higher education? Ashworth (1997) obtains estimates of the average returns to higher education for the UK in the range of 9-21%, depending on assumptions with respect to economic growth, graduate unemployment and the type of student support. More recently, Blundell *et al.* (2000) estimate a rate of return to an undergraduate degree of around 17% for men and 37% for women (also for the UK).[5] For the Netherlands, the private returns to an extra year of higher education are about 5.5% (HBO) and 10% (WO), *cf.* Canton (2001a).

- Non-financial returns

  Non-financial returns to higher education add to the already substantial financial returns. Non-financial returns refer to non-wage labour market remuneration, intra-family productivity, child quality (level of education and cognitive development, health), own and spouse's health, consumer choice efficiency, labour market search efficiency, marital choice efficiency, attainment of desired family size, charitable giving and savings (*cf.* Wolfe and Haveman, 2000). These non-financial returns are far harder to measure. Wolfe and Haveman (2000) survey the literature on this issue, and conclude that non-market returns to schooling are substantial: conservative estimates of the value of non-labour market influences are in the same order of magnitude as estimates of the annual financial rate of return to schooling.

[3] In addition, the consumption value of education should be taken into account.

[4] A meta-analysis of the literature on the returns to schooling is provided in Ashenfelter *et al.* (1999).

[5] These results do not support the claim of declining marginal returns to schooling at the tertiary level.

By-and-large, higher education is a very profitable investment for individuals. And given that education also yields non-financial benefits, the presented rates of return to schooling should be interpreted as conservative estimates.

2.2 Why public support of higher education?

Governments all over the world intervene heavily in the higher education sector. The public sector supports both students and institutions, and regulates the activities of higher education institutions, which are frequently even publicly owned. In the previous section we have seen that higher education is a profitable investment from an individual's viewpoint. Why then should the government intervene in the higher education market? The basic arguments for government intervention in private markets are market failures and income redistribution. The market failures that are relevant for the higher education sector are:

- Human capital spillovers;
- Capital market constraints;
- Risk / insurance market imperfections;
- Imperfect information / transparency problems.

In this section, we will summarise the empirical evidence of these market failures. In addition, two other reasons for government intervention are considered, namely the connection between higher education and income redistribution, and the impact of tax distortions.

2.2.1 Human capital spillovers

People do not reap the full benefits of their educational investment: the benefits partly accrue to others. Higher educated individuals may increase the productivity of co-workers[6], may enhance social cohesion, and are less likely to engage in socially wasteful criminal activities. As a result, the total returns to educational investments for society (*i.e.* the social returns) may exceed the sum of all private returns. Rational self-interested individuals do not take these external benefits into account in their own investment decisions. When social returns exceed private returns, investment in higher education tends to be too low from a social perspective. However, in the current situation the government already provides substantial financial support to the higher education sector. And current subsidies to higher education may in fact be so high that individuals invest beyond the socially optimal level (*i.e.* private returns exceed social returns to schooling).

[6] Such gains could be realised when skilled workers use their education to devise improved production methods for the less skilled workers (*cf.* Gemmell, 1997). Lucas (1988) proposes human capital spillovers as an explanation for people to reside in cities (despite higher costs of living compared to rural areas).

Do the private and social returns to higher education differ, and, if so, by how much?[7] Empirical evidence is scarce. The tentative conclusions for education in general are the following. Blundell *et al.* (1999, pp. 15) write: "The very few available estimates of the rates of return to education at the aggregate level do not, however, suggest that allowing for an externality effect adds very much to private rates of return based on earnings differences". Acemoglu and Angrist (1999) estimate private and social returns to (compulsory) schooling in the US, and conclude that their analysis "offers little evidence for sizeable social returns to education" (pp. 22).

Two studies – background reports to a government-commissioned study on the future of the higher education sector in the UK – have focussed especially on higher education (Gemmell (1997), and Steel and Sausman (1997)). They do not find strong evidence for the existence of externalities related to higher education. In particular, Gemmell (1997, Section 3.51) writes:

"The most likely source of reliable evidence is likely to come from comparing macro and micro estimates of rates of return to higher education. Present evidence is very limited; again it is suggestive of a small externality effect, at best, associated with higher education but a greater weight of evidence is required before firm conclusions can be stated."

Finally, it should be noted that private and social returns to schooling may differ for other reasons than human capital spillovers. For instance, Temple (2000) mentions signalling and rent-seeking activities (think of lawyers) as explanations for why the social return could be lower than the private return, and more efficient matching between workers and jobs as a reason why the social return may exceed the private rate of return.

2.2.2 Capital market constraints

Students may need to borrow money in order to finance their study. But student loans are hardly provided by private banks. Two factors account for this reluctance to offer study loans by commercial banks:

- There is no asset market for human capital, hence human capital cannot serve as collateral;
- Individual characteristics and individual behaviour that influence the return on human capital investments are hard to monitor by banks. Students who are more likely to default (irrespective of their behaviour) are more inclined to apply for student loans, while students with very low default risks are induced to refrain from applying for loans because they do not want to pay the risk premium (the adverse selection problem). This raises the average default risk of the students that still want to apply for loans, which drives up the risk premium on student loans and induces even more relatively low-risk students to refrain from loans, and so forth. It may

[7] Recent overviews of the literature on private and social returns to education are Temple (2000) and Venniker (2000).

even lead to the situation where banks are unwilling to lend against commercial interest rates. In addition to this adverse selection problem, the fact that individual behaviour is difficult to monitor could lead to moral hazard in the sense that students reduce their efforts in order to relieve the debt obligation.

How relevant are capital market imperfections in practice? When liquidity constraints are important, one would expect that parental income has a positive impact on the enrollment decision. However, Oosterbeek and Webbink (1995) conclude from Dutch data that the effect of parental income on enrollment is not significant. Other authors have reached similar conclusions (*cf.* Shea, 2000).

This does not imply that the government has no role in alleviating credit market problems. In fact, the observation that liquidity constraints do not seem to be very important in the current situation could indicate that government intervention is effective. A widely-used government instrument is to lower the price of educational services through subsidies, which weaken the liquidity constraints and the need to borrow. This policy is not very efficient: rich students also benefit from these subsidies, while the poorest students may still not be able to finance their study.

A more efficient type of public action is to provide student loans or to stand surety for student loans at commercial banks. One possible objection is that students with unfavourable social backgrounds are less willing to incur debts. Income-contingent repayments will alleviate this problem (but also introduce other issues like a distortion of the labour supply decision and post-graduate education).

2.2.3 Risk

Investing in higher education involves two types of risk:

- Students may be unsure about the effect of higher education on their human capital (due to uncertainty about their own ability and about the quality of the educational services);
- Students may be unsure about the effects of higher human capital on their prospective income and employment opportunities (due to uncertainty about the future (composition of the) demand for labour).

The first risk is primarily idiosyncratic: pooling of the risk, resulting in a less risky portfolio of educational investments, is possible in principle. The sum of the individual investments is not risky for society as a whole. The second risk is a form of aggregate risk, so that risk-sharing is more difficult; its effect on individual decisions can only be limited by shifting risk from more to less risk-averse individuals (which is also possible for the first type of risk).

Both pooling (reduction of risk) and shifting of risk will induce risk-averse people to increase their investment. But markets fail to provide such insurance, due to the moral hazard and

adverse selection problems mentioned before with regard to the capital market failure. The resulting under-investment in education is generally expected to be particularly severe among poorer families, who have to finance their education through loans and are afraid to be left with large debts they can't repay.

Many governments provide partial insurance by providing income-contingent student loans. As stated above, this distorts future choices that have an impact on earnings, like the labour supply decision, the choice of jobs and choices for further education. The graduate tax, which has been proposed as an alternative to student loans, also provides partial insurance. With graduate taxes, students receive funds and in return the government gets a claim on their future income through a special income tax for graduates. This system introduces solidarity between successful and unsuccessful students. It has some possible drawbacks, however: taxes are based on total income instead of the income that can be attributed to the graduate degree, it distorts future labour supply and education choices, and it is subject to tax evasion (*cf.* Oosterbeek, 1995).

2.2.4 Imperfect information and transparency

The quality of educational programs is difficult to measure. It cannot be observed in advance, but it can be observed (at least partially) by the students during study and afterwards: to put it differently, education is an experience good. In principle, this introduces the possibility that providers of education collect tuition fees and subsequently provide insufficient quality.

The relevance is likely to be limited, since colleges and universities have been and will be in the market for a long period. This provides room for the reputation mechanism to do its work. Higher education institutes will weigh the potential short-term benefits of lowering the quality of their education programs against the negative longer-term effect on their reputation.[8]

The question is how much of the educational quality remains unobserved by the students and their future employers, even during study and after graduation. The reputation mechanism will not work for this part of the quality. Given the importance that governments attach to the quality of education, the slightest doubts about the effectiveness of the reputation mechanism might be enough to warrant a role for the government. Possible instruments are the certification / accreditation of studies and institutions (possibly also entry restrictions), public provision of information, and public provision of higher education.

[8] But if reputation is very important, entry barriers are high.

2.2.5 Income redistribution

Higher education subsidies may be used to bring about a more equal income distribution. Subsidies on higher education raise the supply of highly educated people, which exerts a downward pressure on their wages. Similarly, the wages of lower qualified people are pressed upwards because of a decline in their supply (*cf.* Teulings, 2000; Goldin and Margo, 1992). The strength of this mechanism depends on the price elasticity of student demand for education, the wage elasticity of labour supply (of both highly educated and lower educated labour), the wage elasticity of labour demand, and the substitution elasticity between higher and lower educated workers.

Even when a flatter income distribution results, the overall redistribution through higher education subsidies need not be from high incomes to low incomes. This is due to the fact that the subsidies are financed by general taxes, while the beneficiaries (the individuals entering higher education (even the marginal ones)) have better income prospects than the ones that do not enter higher education. So a reduction in gross wages of educated workers relative to employees with less education not necessarily implies a reduction in the private return to schooling (private returns are based on net wages). Targeting subsidies to the marginal students who would not have taken a higher education program without the subsidies enhances efficiency: subsidising students who would have entered higher education anyway is wasteful. Targeting seems hardly possible, however, as it is difficult to identify the marginal student.

2.2.6 Tax distortions

A final argument for public contributions to higher education has to do with correction for income tax distortions. In most countries, government expenditures are financed partly by the revenues from (progressive) income taxes. These income taxes distort a number of private decisions. A familiar one is the distortionary effect on the labour supply decision. But income taxes are also likely to affect the education decision, *e.g.* when income taxes are progressive, or when income taxes are proportional but education expenditures are not tax-deductible. In these cases, public subsidies to higher education may correct for distortions induced by the income tax (*cf.* Van Ewijk and Tang, 2000).

2.3 How to fund higher education?

After having dealt with the question why the government should support higher education, we now take up the issue how to arrange this public funding. Governments finance higher education through two channels: student support and funding of the higher education institutions. This section discusses both funding channels in more detail.

2.3.1 Student support

Student support decreases the cost of education to students, and may thereby increase the demand for education. The effectiveness of student grants depends on the elasticity of the demand for higher education: how much does the demand for education increase in response to a decline in the private cost of education? The available empirical evidence suggests that students' price responsiveness is low. For instance, Oosterbeek and Webbink (1995) write: "from the insignificance of the effects of forgone earnings and parental income we must conclude that the demand for higher education is completely inelastic" (pp. 377). However, the demand elasticity may differ between students and there is some evidence for the US that students from poor families are more responsive to price changes (*cf.* Dynarski, 1999). When the elasticity of demand differs between students depending on observable characteristics, student support may be targeted to specific student groups (*e.g.* need-based grants).

Increased demand for higher education is not necessarily translated one-for-one into more accumulation of human capital. Students may use the grants simply to finance a few years of leisure, without actively participating in higher education. This moral hazard would prevail especially in the presence of large information asymmetries about student effort. Fortunately, student effort can be measured to a fair degree. To improve the efficiency of student support in enhancing the human capital of students, grants may be made contingent on such measures (*e.g.* minimum number of study points per year). The maximum number of years for which students are in principle entitled to public support may also be limited.[9]

Student support may also be in kind, like cheaper public transport for students. This is warranted when the government likes to influence the expenditure pattern of students (possibly because of paternalistic motives).

2.3.2 Funding of higher education institutions

Part of the subsidies to higher education are channelled directly to colleges and universities.[10] Institute funding is often not (only) linked to student enrollment, but also to (a proxy for) educational production. So two issues stand out:

- Funding channel: customer or producer subsidisation?
- Funding conditions.

[9] *Cf.* the discussion of the Dutch student support system in Chapter 1.

[10] In some cases, funding through student support and direct funding should generate equivalent effects, at least when students behave in a similar fashion (which may not be the case, *cf.* Cohn, 1997). Perhaps the clearest example of a system where the funding channel does not matter for the incentive structure is a voucher-scheme where students hand-in their drawing rights at the institution from which they buy higher education services or a "voucher-like" scheme where institute funding is directly linked to the number of enrolled students (a "funds-follow-the-child" voucher-model). In this example, the institutions would be indifferent between both funding-principles (when funding conditions and administration costs are identical).

First we look at the funding channel. Often, both the students and the institutions receive government funding. A reason for governments to subsidise institutions may be that they regard themselves as better informed about the performance of universities and colleges than the students. But this presumption has always been questionable, and is likely to become less valid due to the increasing diversity in consumer tastes. Another possible reason is that governments regard themselves as better informed about what are good choices for society. When governments like to stimulate demand for certain studies, this might be done most efficiently by directly subsidising the institutes delivering these studies, so it is argued. But this argument is not convincing, as student support systems can be adapted to take account of different degrees of subsidisation across disciplines. So the economic rationale behind the distinction between student and institute support is not clear.

Second, funding conditions impact on the efficiency of institutional funding. In practice, "hybrid" funding systems are often used. In the Netherlands, for instance, direct funds for universities consist of a fixed component, and a variable component depending partly on the number of completed degrees and partly on the number of first-year students (see Chapter 1 for more information). The fixed component serves to guarantee capacity independent of student enrollment. The performance-based component should promote efficiency in educational production. A more elaborate discussion on the pros and cons of output-based funding will follow in Chapter 5.

2.4 Public versus private provision of higher education

In many countries, especially in Europe, colleges and universities are predominantly public institutes. The major explanations are that public institutes do not have a profit motive, and that (part of the) decision authority rests with the central government instead of the individual agencies (think of general remuneration rules for civil servants, tuition fee regulation). What economic arguments can justify the choice for public provision, instead of merely public funding?

Public provision replaces the profit motive of private providers. When educational production is imperfectly observable (and hence non-contractible), profit maximisation may bear a cost in terms of reduced quantity and / or quality of the delivered services. Several factors may reduce the strength of this argument, however. Profit maximisation generally also implies strong incentives to innovate. Only when innovation is relatively unimportant in higher education, this would support public provision. Furthermore, when quality can be assessed by students, and hence consumer choice is effective, competition between suppliers and reputation mechanisms mitigate the problem of quality or quantity reduction. Many private providers,

moreover, have a non-profit status as well (in the US, but also in the Netherlands[11]). Public provision should then only be introduced when it is believed that too few non-profit institutes are operating in the market for higher education (and subsidies do not help to increase this number). An additional argument for public provision is that it enhances government control over the production process (*cf.* Poterba, 1995). The question, however, is whether public provision is more efficient in doing so than regulation of private providers of higher education.

Counterarguments to public provision exist as well. Prominent ones are that government production is cost-inefficient (although empirical evidence is not very strong), objectives of public institutions are not clear and may also result in over-provision of services or provision of the wrong services. These government failures will be discussed more extensively in Section 2.9.

2.5 Should the higher education sector be deregulated?

The market for higher education will become more and more international due to globalization and the ongoing European integration process. Students and staff become more mobile, and educated people will more often spend some time working abroad. Implementation of the Bologna Declaration (see Chapter 1) is an important step towards the creation of a European market for higher education programs. Moreover, ICT-developments, the advent of distance learning, and the advance towards the "virtual university" might have a major impact on the higher education system.

These trends and developments strengthen the necessity for the higher education sector to focus on market conditions, and to compete for students, teachers, researchers and research funds. So it can be expected that competition between higher education institutions will intensify. This encourages institutions to improve their quality (or reduce their price). To do so, and to compete successfully on the international higher education market, institutions need to have the instruments to improve on their performance. As government regulation limits the room for manoeuvre of the institutions, this brings us to the question whether the higher education sector should be deregulated.

Government intervention in the form of regulation can refer to conditions of employment, curriculum requirements, restrictions on commercial activities, tuition fee policies and admission criteria. For example, in some countries tuition prices and admission criteria to enter higher education are regulated by the public sector. What would happen when tuition price and student selection policies were deregulated? To answer this question, we should look at the

[11] In the Netherlands a distinction is made between public schools (*openbare scholen*) and (almost completely) publicly funded non-profit private schools (*bijzondere scholen*) which often have a religious character. This distinction stems from the school struggle between Roman Catholics and Protestants in the 19th century. The outcome was that every (religious) group became eligible for the same public support as the public schools (*cf.* Hartog *et al.*, 1999).

production technology of education. The educational process is frequently described as a *customer-input technology*: students are both consumers and producers of education.[12] Interactions among students (the peer effect) and between students and staff are important ingredients to the educational process, and determine a large part of the quality of the training program (*cf.* Rothschild and White, 1995, Lazear, 1999). This notion of a customer-input technology has two major implications:

- It provides a theoretical justification for selection of students. Universities can reach a higher quality-level by selecting the best students (or the best mix of students);
- It gives a rationale for price discrimination among students, *e.g.* by selectively providing grants. Students who generate positive spillovers should pay lower net tuition fees than students who generate no (or even negative) spillovers. In this way, universities and colleges internalise these "classroom-externalities".[13]

It should be noted that student selection and tuition fee differentiation not necessarily call for deregulation, but the general view holds that the information advantage of higher education institutions warrants the delegation of decision authority to these institutions.

In the current Dutch practice, the set of instruments available to the higher education sector to improve its performance is limited: there are few possibilities for student selection or price discrimination among students. In Chapter 4 we will discuss the issue of deregulation in more detail, and we shall look at the US experience with respect to student selection and tuition fee differentiation.

2.6 Why combine education and research in universities?

Education and research are often combined within single higher education institutes. This suggests the presence of efficiency gains from joint production: fewer resources are needed to produce a given amount of the two services if they are produced together rather than separately.[14] In economic terms: there are economies of scope. These complementarities between education and research may depend on the program level. Nerlove (1972) considers

[12] For another example of a customer-input technology one might think of a trendy bar. Most people do not go to such a bar because they are thirsty, but because they want to meet with and talk to others. This social interaction is probably the main product of the bar. The number and type of customers therefore determine the production technology of this bar. In the case of queueing, the porters often give priority to those customers whose presence will be appreciated by the other guests. By doing so, the porters correct for the external effects associated with the appearance of these popular visitors.

[13] According to the model of Rothschild and White (1995), the price of education to a student actually consists of two components: a price for the product education, and a price for each student's input. The first price may vary between institutes of higher education, the latter price may vary between individual students.

[14] The same holds for combining different fields and disciplines within institutions (*cf.* Nerlove, 1972).

graduate training and research to be inextricably intertwined, whereas benefits from joint production of undergraduate training and research are less obvious.

Empirical evidence about the importance of complementarities is scarce.[15] A recent example is Koshal and Koshal (1999), studying whether there are economies of scale and economies of scope in higher education.[16] For a sample of 158 private and 171 public universities in the US, they find that institutions can reap benefits from joint production: their estimation results suggest economies of scope for research activities in the range of 5-26% for public institutions and in the range of 23-117% for private universities (unfortunately, the authors do not provide an explanation for this large difference between public and private institutions). This joint production of education and research activity has a number of consequences:

- The incentives on both activities should be balanced. Rearranging the incentive structure could change the allocation of time and money between the activities. When one of the activities is harder to measure than the other, combining the tasks may divert efforts toward the better observable activity;
- Subsidies on one activity probably affect the price of the other activity. For example: it is possible that subsidies to university research will raise the price of undergraduate education. But it might also lower this price. The direction of the effect depends on two factors: the elasticity of substitution between research and education, and the supply elasticity of the resources used in higher education (most importantly researchers);
- When there are good reasons for public production of (academic) research, it may be more efficient – in light of the gains from joint production – also to provide higher education in the public domain.

2.7 Why and when should research be publicly funded?

Governments spend large amounts of money on academic research. They do so for two basic reasons:

- To support the formulation and implementation of government policy;
- To correct an insufficient level of private investments in research.

[15] One difficulty is to separate true jointness in production from scale effects (resulting from more efficient use of common facilities).

[16] Economies of scale are measured by the ratio of average to marginal costs. Economies (diseconomies) of scale are said to exist if this ratio is larger (smaller) than 1. Economies of scope are measured by the cost difference between separate and joint production divided by the cost of joint production. Economies (diseconomies) of scope are said to exist if this ratio is larger (smaller) than 0.

First, government policy makes intensive use of the insights of research, with a special focus on the social sciences and the humanities, although the natural sciences are relevant as well.

Second, private firms invest in research in search for innovations. Frequently, however, others than the investor benefit from the research findings without paying for it.[17] Investors will not take account of these benefits to others, and may consequently give up investment opportunities that are beneficial to society. Even stronger, when the others are competitors in the same market, the spillovers lower the private returns.

Two characteristics of knowledge account for the presence of spillovers: use by one individual does not reduce the availability to others (knowledge is non-rival), and access to knowledge is frequently hard to prevent (knowledge is imperfectly excludable). Excludability of knowledge is partly influenced by the possibilities of and efforts by inventors to protect the use of knowledge. Well-known possibilities are secrecy, patents and licensing agreements, and exploitation of first mover advantages. When governments consider private research efforts to be too low, they can strengthen private incentives to invest in research by extending the possibilities to protect the results from research efforts, *e.g.* by extending the scope or length of patents.

These possibilities are most relevant for applied research and development, which are relatively close to the process of commercialisation. Private appropriation of the benefits of basic research results – which require subsequent research before commercial applications are possible – is much harder to achieve. On top of that, the outcomes of basic research are highly uncertain. Strengthening intellectual property rights, or subsidies for private research endeavours, are therefore not likely to be efficient stimulators of basic research. Moreover, the wide potential applicability of basic research findings makes excludability less desirable, and wide dissemination more attractive. This may even apply for basic research that is currently carried out by private firms. Actual examples concern the investments in basic research by large pharmaceutical companies, as well as by the more recent and much smaller biotechnology firms. In these cases, monopoly pricing of the products that follow from the research efforts (prescription drugs for wide-spread diseases like cancer and aids, or materials and techniques that are crucial for further academic research, like Polymerase Chain Reaction) may be very undesirable.

When wide and open dissemination is deemed to be very important, a possible way out is to publicly finance the production of knowledge and freely disseminate the results.[18] In principle, optimal dissemination of *existing* knowledge (no matter how basic) occurs when it is priced at the cost of transmitting it (*e.g.* the labour costs of the researcher explaining the research findings, or the costs of publication, *cf.* Cornet and Vollaard, 2000). This is basically what

[17] Other, but less important, justifications mentioned in the literature are uninsurable risks of research, large fixed costs (entry barriers) and the short time horizon of firm-owners (shareholders).

[18] An alternative, making use of auctions, has been proposed in Kremer (1998).

happens in academic research. Academic researchers are driven by priority of discovery: the first to openly reveal some findings receives the credit for these findings (think of the Nobel prize or attaching researchers' names to findings), and the financial benefits attached to it through the academic reward system (tenure, promotion). This induces academic researchers to be productive and disclose their research findings quickly. The latter feature stands in sharp contrast with researchers in commercial firms, who are urged to keep their findings secret (*cf.* Dasgupta and David, 1994).

The difficult question remains how large the subsidies to academic research, and to the various scientific disciplines, should be. Obviously, this depends on the returns to society and the risk characteristics of the research. Theory is ahead of measurement here. One of the most influential attempts is Mansfield (1991). Based on appraisals of R&D-managers in large firms he arrives at a social rate of return of academic research of 28%. The fact that a study with so many reservations made by the author himself has been so influential is illustrative for the poor state of knowledge about the returns to academic research. The importance of academic research for innovation differs between industries, and consequently between academic disciplines (see SPRU (2000), Figure 2). Moreover, the way in which academic research contributes to innovation differs between industries as well: through codified knowledge, through students, and through a number of other channels.

2.8 How to organise public funding of research?

As mentioned above, basic research with a strong public good character should be financed by the government. The question how to design such a finance system then becomes urgent. In practice, two funding methods are often used, namely input-based and output-based funding.[19]

While performance-based funding may help to stimulate research output, some potential drawbacks have to be kept in mind. Most importantly, output-based funding requires that research production can be measured. This is a rather controversial issue, as opinions differ on the question what should be measured. Any proposed indicator of research output will have its drawbacks. When high-powered incentives are applied to imperfectly measurable research production, problems could arise with the unmeasured part of research production. For instance, output-funding could induce researchers to substitute creative, innovative but hard-to-publish research for more conventional types of research which may be easier to publish. Therefore, a hybrid funding structure combining low- and high-powered incentives may be the optimal choice. Another risk of output-based funding is that underperforming institutions may

[19] For instance, in the Netherlands a distinction is made between core funding (*eerste geldstroom*) and project-based funding (*tweede geldstroom*). Put loosely, core funding is an example of input-based funding (though a small component depends on performance), while project-based funding is an example of output-based funding (see Chapter 1 for more details).

get worse, as the better students and staff members will be the first to move to another university. Such a downward trend could reinforce itself, ultimately leading to the closing down of the institution. Finally, higher education institutions also serve a regional function, and could be an important vehicle for knowledge spillovers to the local economy. So even when research does not meet national or international standards, it may serve an important regional function.

Output- or performance-based funding aims to improve research productivity. An interesting example in the literature on the design of output-based research funding systems is Lazear (1997). At the heart of the analysis is the idea that the rules concerning the allocation of research grants determine the implicit incentives for researchers. Lazear studies the incentives present in the current US system and evaluates their economic efficiency. A number of interesting conclusions emerge from his analysis:

- A limited number of large grants is better than a larger number of small grants, as in the former case talented researchers are motivated to submit ambitious research proposals;
- When past performance plays a role in the assessment of research proposals, young researchers have an incentive to bring their projects to a successful end but more experienced researchers may reduce their efforts. An efficiency-gain can be reached by making research grants age-contingent. By assigning larger grants to senior researchers, their tendency to reduce efforts is combatted;
- Assigning grants ex post has the advantage that researchers have a direct interest to finish the project, but could lead to avoidance of more risky research projects. It might be better to assign grants ex ante, and to encourage the completion of projects by making the assignment of future grants contingent on past performance.

2.9 Incentives and inefficiencies in the public sector

In the previous sections we have discussed possible rationales for government intervention in the higher education market. However, while government policies improve matters in some cases, in other cases the outcome may not be better or even be worse than under a free market regime. Government policies may not be effective in achieving their goals, or they may create offsetting problems in other directions. The major reasons for these government failures are limited information, bureaucracy (X-inefficiency, limited incentives for innovation) and the limitations imposed by the political process (*cf.* Stiglitz, 1988).

First, limited information influences the potential to target subsidies, impedes accreditation and information provision by the government, impedes efficient delivery of student loans and insurance, and impedes efficient choice of research areas and projects. This could lead to wasteful government spending.

Second, bureaucracy involves the absence of the disciplining threat of bankruptcy and (to some extent) competition, and typically provides low-powered individual incentives (restrictions

on salary structure, tenure). Note, however, that there may be good reasons for these low-powered incentives related to the nature of public services (*cf.* Dixit, 1999). An example is the tenure system. The system of tenure – a strong guarantee of permanent employment after a demanding probationary period – has been hotly debated (*cf.* McPherson and Schapiro, 1999). It has been attacked for lowering incentives to provide effort after tenure has been achieved, or – as McPherson and Schapiro (pp. 85, 1999) put it – "entrenching a lazy professoriate, more interested in attending faraway conferences and producing unreadable research than in teaching or developing practical insights…". On the other hand, proponents point at the following positive effects of tenure: academic freedom, honest evaluation of the work of students and peers, honest evaluation by current faculty of new tenure candidates, and good mentorship of new faculty by experienced researchers. Furthermore, although there seems to be a general consensus about the relative inefficiency of public producers and some empirical studies do indeed confirm this consensus view, the issue is far from settled.[20]

Finally, in democratic nations governments are elected. Assuming that governments like to be re-elected, the supposed effects of government policies on different groups in society – and particularly the powerful groups – influences the policy agenda (see Poterba, 1996). This power of vested interests could erect substantial barriers to change (*cf.* Nahuis *et al.*, 2000).

The quick review of the economics of education provided in this chapter should help to gain insight into the various mechanisms at work in the higher education sector. In the next chapters we will elaborately discuss some interesting higher education systems and how they work in practice.

[20] See, for instance, Hoxby (1999).

3 Tuition fees and accessibility: the Australian HECS

Hans Vossensteyn and Erik Canton

3.1 Background

To what extent do higher tuition fees have an effect on the accessibility of higher education? In answering this question, the Australian experience with the reintroduction of tuition fees through the Higher Education Contribution Scheme (HECS) in 1989 is of particular interest. Under this HECS-system, students have to contribute approximately a quarter of the average costs of the training program, either by paying up-front or by taking out a loan and defer repayment through the tax mechanism until after graduation. The most important motivation for the introduction of the HECS was the sheer need to attract additional resources to enable further expansion of the higher education system, as the government encountered budgetary problems. But an important condition was that such private contributions should not hamper access to higher education for people from disadvantaged backgrounds.

Also in other countries the costs of higher education have gradually shifted from governments, or taxpayers, to the students and their parents (Johnstone, 1999). This gradual shift towards private contributions is heavily debated. Both in policy circles and in the academic debate the question "how much students should contribute to their own education" has received ample attention. This question may have become even more urgent in recent years, with OECD countries witnessing an increased fiscal pressure in combination with often sharply rising participation rates in higher education (Barr, 1998a).

From the Dutch perspective, the debate on tuition fees is of particular interest, because tuition fees form an increasing source of revenues for higher education institutions. Moreover, the differentiation of the higher education system in terms of students, programs, duration of courses and life-long learning opportunities will put more emphasis on pricing strategies, their aims and effects.

In the public debate, it is often argued that higher tuition fees translate into lower enrollment rates in higher education. In principle, this need not be a problem. Tuition fees could promote self-selection among students so that only people with sufficient academic competences go to higher education. Talent or innate ability is unevenly distributed among society. People invest in higher education up to the point where the marginal cost of their investment is equal to the marginal private benefit in terms of higher lifetime income. The effect of public subsidisation is that less talented individuals would calculate a positive net present value of participating in higher education. So when there is no student selection, public support to higher education could lead to a reduction of the average quality of the student population.

Also, in the real world there is imperfect insurance against future income uncertainty, and people tend to be risk-averse. A rise in tuition fees could then go along with a reduction in human capital investment by risk-averse individuals (private returns to schooling are reduced). And to the extent that talented people decide not to go to college or university because of the risky investment, tuition fee increases could be harmful. The central issue in this chapter is whether tuition fees endanger access to higher education and, if they do, how governments can prevent that potential students (from particular groups) might get excluded from participation.

In Section 3.2 we first discuss the relevant economic theory and recapitulate the arguments that have been put forward in debates on tuition fees as well as some results on the relationship between tuition fees and accessibility that have been found in the literature. The Australian HECS is described in more detail in Section 3.3, and an evaluation of the HECS is presented in Section 3.4.

3.2 Private contributions and economic theory

3.2.1 Why private contributions?

Private contributions to higher education can be made in several ways, such as through forgone earnings, expenditures on books and payments of tuition fees which cover (part of) the direct costs of education. In this chapter we concentrate on tuition fees. Three basic reasons have been put forward in the literature to legitimate tuition fees:

- Small difference between private and social returns to schooling;
- Equity considerations;
- Reduction of moral hazard / adverse selection.

First of all, no clear evidence for the presence of human capital spillovers is found in the data. Estimates on the private and social returns to higher education are typically in the same order of magnitude (see Chapter 2 for a more elaborate discussion). And when the difference between private and social rates of return to schooling is small, there is no strong case for government intervention to change the current level of participation in higher education.

The second argument that justifies tuition fees has to do with equity. Public subsidies to higher education have a regressive income effect. The average taxpayer funds a service from which only a fraction of the population directly benefits. As students have a higher expected lifetime income than the average taxpayer, government support to students imply an income transfer to tomorrow's well-off. To mitigate such regressive income effects, it is equitable to ask for a private contribution to the costs of higher education (see, for instance, Oosterbeek, 1998). We should add that this is a rather controversial issue, and some people claim the opposite: education helps to reduce income disparities in the economy, and to that end government should support education (*cf.* Teulings, 2000).

Third, tuition fees can help to ensure that the decision to enter higher education is taken seriously. The individual investment encourages and motivates students to work hard (moral hazard is reduced). In addition, if students have to pay a price themselves, they probably will demand value-for-money. On top of that, higher education institutions will compete by offering an attractive price-quality package (Eurydice, 1999). And tuition fees could help to filter out the people who do not belong in a higher education program, so it helps to reduce the adverse selection problem. This effect operates on the borderline between economics and psychology (therefore, being economists, we shall refrain from a detailed treatment of this issue).

All in all, sharing the costs between society and the individual participants in higher education is both efficient and equitable. However, to prevent potential students from under-investment in higher education, governments should safeguard accessibility (we shall come back to the question how to protect access to higher education in greater detail below).

3.2.2 The impact of tuition fees

Tuition fees are expected to have a negative influence on the decision to attend higher education, as they lower the net present value from the educational investment. But measuring the effects of tuition fees is difficult. It is hard to single out the pure effects of tuition fees from all other variables influencing the enrollment decision. In addition, it is almost impossible to identify potential students who did not attend college for the sake of tuition fees. Finally, cases of introducing tuition fees at institutions or in particular countries do not happen so frequently.

The major results of the rich literature on this issue will be discussed here. Leslie and Brinkman (1987) and Heller (1997) review a number of American studies of the 1970s to the 1990s. Their major conclusion is that students are responsive to prices and that – ceteris paribus – for every $100 increase in tuition price one would expect the participation rate to drop by about 0.7%-point. For an average weighted tuition fee of $3,420 and a national higher education participation rate of 0.33 in 1982/83 (*cf.* Leslie and Brinkman, 1987), this corresponds to a price elasticity of -0.73. Others (Manski and Wise, 1983; Moore *et al.*, 1991; Gladieux and Hauptman, 1995) add that particularly low-income students are more sensitive to tuition price levels than higher income students. McPherson and Schapiro (1997, 1998) stress that, though enrollment rates for all racial groups have risen, the gap between the enrollment rates of Whites and other racial groups has widened. This variation in price sensitivity among different racial groups is also shown by Heller (1997).

In addition, Kane (1995) shows that increases in net costs over time are related to decreases in enrollment rates for lower-income students in the US. Next to that, evidence shows that increases in net cost did not inhibit enrollment for more affluent students. However, middle-income students also seem to have reached a price threshold, particularly in the private sector institutions (Breneman, 1994; Campaigne and Hossler, 1998). Based on these findings,

McPherson and Schapiro (1997) conclude that policies that call for cross-subsidisation among students, such as the high tuition – high aid strategies, make sense from the viewpoint of economic efficiency (although targeted student support by the government would be a better policy instrument).[1]

Leslie and Brinkman (1987) address the quandary that participation rates have not gone down in the US while tuition fees increased. They explain this phenomenon by noting that tuition prices did not increase so much in real terms, and that financial support ameliorated access. In addition they note that demand is known to be affected not only by price but by the money income of the buyer, by tastes and preferences, and by the value of the good from a consumption or an investment perspective.[2]

In the Dutch situation Sterken (1995) finds a long-term enrollment elasticity of -0.5, so a permanent increase of the tuition price by 1% would correspond to a reduction in student enrollment of 0.5%, which is a rather strong effect.[3] In contrast, Huijsman *et al.* (1986) find students' higher education demand fairly insensitive to the tuition fee level: they obtain an elasticity of -0.003. Oosterbeek and Webbink (1995) also find a very low elasticity (close to zero). In addition, a recent study by SEO (2000) shows that students hardly seem to respond to financial incentives. Changes in tuition fees or grants have a very small impact on participation.

All in all, in the literature it is found that the price elasticity of higher education is not large, especially not for students from more affluent backgrounds. However, students from socio-economic disadvantaged backgrounds seem to be negatively affected by price increases, even when they are compensated through student support.

After this quick scan of the literature on the impact of tuition fees on student enrollment, we now turn to the Australian experiences with tuition fees in their Higher Education Contribution Scheme.

[1] The high tuition – high aid strategy comes down to a situation in which richer students pay a substantial part of the costs of education which is partly used for providing discounts to poorer students (pooling of risk among students). However, in practice there have been considerable increases in net tuition for low-income students, leading to a growing gap between enrollment rates for high-income and low-income students and to an increased concentration of low-income students at the least costly institutions and programs.

[2] An additional explanation could be expected skill-biased technical change, increasing the future returns to schooling. Also, Bils and Klenow (2000) show that the expected rate of economic growth has a strong impact on the expected returns to schooling.

[3] It should be noted that the econometric specification in Sterken (1995) is disputable.

3.3 The Higher Education Contribution Scheme in Australia

The Australian Higher Education Contribution Scheme (HECS) provides an outstanding experience for analysing the effects of introducing or raising tuition fees. First of all, the introduction of the HECS meant a sudden demand for private contributions in a situation where the individual participants in higher education did not pay any contributions at all. Second, the level of tuition fees to be paid was substantial, around 23% of the average costs of higher education programs in 1989 (when the HECS was introduced). A third argument for choosing the Australian case is that the government tried to limit the negative influences of charging tuition fees on participation in higher education. In particular, they offered a deferred repayment scheme through the tax system for those who could not or did not want to pay the tuition fees up-front. This is a rather novel system, and it has received ample international attention. When studying the impact of tuition price on accessibility, the choice for Australia is therefore a natural one. In the following sub-section we discuss the history and rationale of the HECS. Next we address the features of the tuition fee system and how tuition fees can be paid. In addition, we elaborate on the developments in tuition fee policies since 1989. Finally we evaluate the HECS.

3.3.1 History and rationale

Table 3.1 summarises the most important historical developments in Australia with respect to tuition fees in higher education.

Table 3.1 Some important historical developments in Australian higher education, tuition fee policies

1854	Inception of Australian higher education sector, foundation of University of Sydney.
1854-1974	Tuition prices are charged to students.
1974-1985	Abolishment of tuition fees, Australian higher education is funded virtually exclusively from federal government sources.
1985	Higher education fees appear again, initially in the form of a "Higher Education Administration Charge" ($A250 per student).
1986	Introduction of fees for certain Australian postgraduate students.
1989	Introduction of Higher Education Contribution Scheme.
1997	Differentiation of tuition fees into three tariff bands.
1998	Institutions are allowed to admit (a limited number of) students on a cost-covering basis.

As can be seen from Table 3.1, tuition fees were not new in Australia when HECS was introduced in 1989. The major arguments put forward in the discussion about whether or not to reintroduce tuition fees can be summarised as follows:

- Particularly during the late 1960s, the 1970s and the late 1980s there has been a rapid growth in the demand for higher education (Karmel, 1999). This development indicated the transition from an elite system to a mass and eventually a universal tertiary education system. Though the

increase in student numbers can partially be explained by demographics, the most important contributing factor is an increase in access;

- This growth was expected to continue because, as with other industrialised countries, traditional manufacturing industries were being replaced by the so-called "knowledge processing sector". As such, it was and still is expected that society would need more higher education graduates (*cf.* West, 1998);
- Public funds were regarded too limited to enable the desired expansion of the higher education sector (Meek and Wood, 1997). Until the mid 1970s, public funding for higher education grew rapidly. But since the oil shocks of the 1970s, the social service and health burden on the national treasury was rising dramatically (Karmel, 1999). In addition, a general change toward a smaller government and restrained levels of taxation has led to an end of the expansion in the public support for higher education (Harman, 1989);
- There has been a longstanding debate on the appropriate balance between public and private financing of higher education in Australia. In this debate, more and more stakeholders got convinced that on the one hand the clear private benefits from obtaining a degree justify some private contributions to the costs of education. On the other hand, the private contributions should not impede access to higher education, particularly not for students from disadvantaged backgrounds (Chapman, 1997);
- Finally, it was expected that reintroduction of tuition price would not have an important effect on the demand for higher education. This view was supported by the observation that the abolishment of tuition fees in 1974 has had little impact on improving access of lower socio-economic status (SES) students.

Regardless of the strong arguments in favour of tuition fees, the introduction of the HECS fees was heavily criticised, both by student unions and political interest groups. However, next to the arguments used to defend the HECS, Minister Dawkins offered the HECS-proposal as part of a larger package of reforms for the funding of higher education. The Minister's statement that public funding of universities was only going to be increased if HECS was put into effect, was the final trigger to have parliament accepting the HECS-proposal. If HECS was not accepted, higher education funding would have been frozen. Most members in parliament did not want to refrain universities from increased funding, which was perceived to be absolutely necessary.

3.3.2 The Higher Education Contribution Scheme

When tuition fees were reintroduced in 1989, the Australian government established a system aimed at raising the revenues of higher education institutions, without erecting financial barriers to participation in higher education. Since then, students in Australia generally have been required to contribute to the cost of higher education. In the following, we describe the HECS-system in more detail.

HECS applies to Australian or New Zealand students in Commonwealth funded higher education award courses which lead to degrees, diplomas, associate diplomas, graduate diplomas, graduate certificates, Master's qualifying courses, Master's courses or Ph.D.s. HECS applies to around 80% of all students enrolled in universities. Some categories of students are exempted from the HECS payments, such as TAFE-students (Technical and Further Education), students charged tuition fees by the institution, students in non-award courses, students with an Australian Postgraduate Award (scholarship), participants in enabling courses for disadvantaged students, and students with a merit-based equity scholarship. In addition, all foreign (overseas) students have to pay a cost-covering tuition rate up to $A26,000 (Dfl.36,400) in 1996.

The level of HECS-tuition fees is determined by the Minister of Education. The HECS rate was originally set to recover 20% of the costs of an average university program, which was $A1,800 (Dfl.2,500) in 1989. The level of HECS has been indexed to the cost of living and has risen to $A2,450 (Dfl.3,400) in 1996. These rates relate to full-time students. Part-time students pay proportionately less. Table 3.2 illustrates the development of tuition fees under the HECS-system.

Table 3.2 Tuition price levels under the HECS

1989	1996	1997	1999
Uniform: $A1,800	Uniform: $A2,450	Low: $A3,300	Low: $A3,409
		Middle: $A4,700	Middle: $A4,855
		High: $A5,500	High: $A5,682

Note: $A1≈Dfl.1.31≈€0.60 (January 2001).
Source: DEETYA (1999a) and Dawkins (1999).

Until 1997 tuition fees were equal for all fields of study. However, because HECS is fundamentally a cost recovery system, charging fees that reflect the differential costs of the various training programs have been strongly advocated from the beginning. As of January 1997, tuition fees were differentiated into three tariff bands: low, middle, and high (*cf.* Table 3.2).

This new differentiated tariff structure is not consistent with a pure cost recovery model. The new pricing structure is a hybrid model, in which both costs and expected future benefits from obtaining a particular degree have been given a weight (Chapman, 1997). As such, the most expensive tier not only includes expensive courses like medicine, dentistry, veterinary science and engineering, but also law, which is one of the cheapest courses. Other inexpensive programs, such as economics and business, are charged at the medium level. In addition, compared to the uniform tuition level of 1996 ($A2,450), the weighted average private contribution has increased by about 70%.

HECS payments are made on a semester basis. Normally, students have two choices in how to pay their HECS contribution:

- Pay up-front with a 25%-discount;
- Defer or partially defer their payments until after graduation.

The first alternative allows students to make their HECS contribution directly to the institution at the beginning of each semester. Because students do not use any government facilities to defer their payments, they get a 25%-discount on their payments. In the 1999/2000 situation this implies that a student enrolled in a "band 1" subject will be charged an up-front rate of $A2,557 instead of $A3,409. Over the years, the number of students choosing the up-front payment option has increased, up to 29% in 1997.

The second alternative, chosen by the majority of students (71% of HECS-liable students in 1997), enables students to defer payment of HECS until after graduation. In this method of deferred payments, the Commonwealth government pays the tuition price to the institutions and provides the students with a loan. An important characteristic of the HECS-loan is that no interest is charged on the outstanding debt. The total debt is only indexed annually by adjusting it in line with the cost of living on the basis of the Consumer Price Index. A combination of both payment options is also possible. Since 1998, students may choose to pay part of the fees up-front (at least $A500) with a 25%-discount, and defer the remainder.

When students opt to defer their payment they have to give their Tax File Number to the institution. This identification number is used by the institution to report details of the debt every semester to the Australian Taxation Office (ATO), which further administrates the loans and their refunding. Repayments of the HECS-loan are collected through the tax system and are income-contingent. This implies that people repay at different rates, depending on annual income after graduation. Graduates with high earnings repay more rapidly through higher (monthly) installments than graduates with lower earnings.[4]

The repayments only start when annual earnings exceed a certain threshold. Until 1996, this threshold was equal to the average taxable income of Australians working for pay ($A27,675 per annum in 1996). Since 1997, the income threshold at which repayments start has been lowered (for instance, in 2000/01 it was $A22,346). The annual repayment rate increases with the level of income. If income exceeds the minimum threshold, ATO will withdraw automatically 3% of the total taxable income as HECS-repayment. A growth in income leads to a successive gradual increase in the repayment rate up to a maximum of 6% of total taxable income. The HECS

[4] Recall from Chapter 1 that the Dutch repayment system also includes some income-contingent characteristics by the opportunities offered through the means test for those who expect to have difficulties with their repayments.

repayment thresholds are adjusted each year to reflect any change in average weekly earnings. Table 3.3 presents the repayment rates and income thresholds for 2000/01.[5]

Table 3.3 Tariffs for income-contingent repayment of study debt in Australia, academic year 2000/01

Income ($A)	Tariff (%)
below 22,346	0
22,346-23,565	3
23,566-25,393	3.5
25,394-29,456	4
29,457-35,551	4.5
35,552-37,420	5
37,421-40,223	5.5
40,224 and above	6

Note: 1 $A≈Dfl.1.31≈€0.60 (January 2001).
Source: Australian Taxation Office, www.ato.gov.au.

3.4 Evaluation of the HECS

The primary objective of HECS was to allow the higher education sector to expand without a substantial growth in government funding. In particular, HECS aimed to reintroduce private contributions without jeopardising accessibility to higher education. In this section we will evaluate the HECS-system.

The introduction of tuition fees in Australia in 1989 does not seem to have had any major negative effects on student enrollment. In exploring the effects of the HECS on accessibility, several types of studies have been employed. First, some studies address the issue whether HECS affected the private rate of return to higher education. Chapman and Chia (1989) conclude that the effect of HECS would be so small that demand for higher education (even by students from disadvantaged backgrounds) would not be hampered. Also the 1997-changes to the HECS (lowering of income threshold and differentiated tuition fee rates) would hardly change the high rates of return and, as such, were unlikely to reduce the attractiveness of higher education (Chapman and Salvage, 1997).

Some other studies evaluate the effects on students from different socio-economic backgrounds. The major conclusion is that the proportions of students from different socio-economic backgrounds have hardly changed since the introduction of HECS (Chapman, 1997;

[5] Apart from these automatic repayments through taxes, graduates are allowed to make voluntary repayments of any amount at any time. If the voluntary repayments amount to $A500 or more, the HECS-debt will be reduced by the amount of that payment plus an additional 15%.

Andrews, 1999). People from lower SES groups benefited as much as other groups from the increase in student numbers (though they are still under-represented in the student population).

The effects of HECS on individual decision making have also been measured through attitudinal surveys. On the basis of a survey immediately after the introduction of HECS in 1989, Robertson *et al.* (1990) conclude that HECS had little effect on the composition of the pool of applicants and no effect on the composition of those accepting an offer to enroll. On the request of parliament, the Higher Education Council imposed a system of monitoring the effects of the HECS, particularly for the socio-economically disadvantaged. In their first survey in 1991, executed by the consulting firm Ernst and Young, it was found that school leavers gave a low ranking to HECS for deciding not to go to higher education. School leavers who intended to go to university and adults indicated HECS as a middle-ranking factor for deciding not to enroll, after academic factors and more pressing economic factors. The Council concluded that "most qualified applicants from across groups in the study would not be significantly deterred by HECS" (Higher Education Council, 1992, p.21).

Using data from the Australian Council of Educational Research (ACER), Chapman and Chia (1993) compare the composition of 18-year-old students in higher education in 1988 and 1993. Students were distributed among three family wealth categories and then compared on the basis of their participation rates. For all three categories, participation rates had gone up by around a third between 1988 and 1993. Though the participation rate of those from wealthy backgrounds is larger, the introduction of HECS did not exert any discernible effects on the socio-economic composition of the student body.

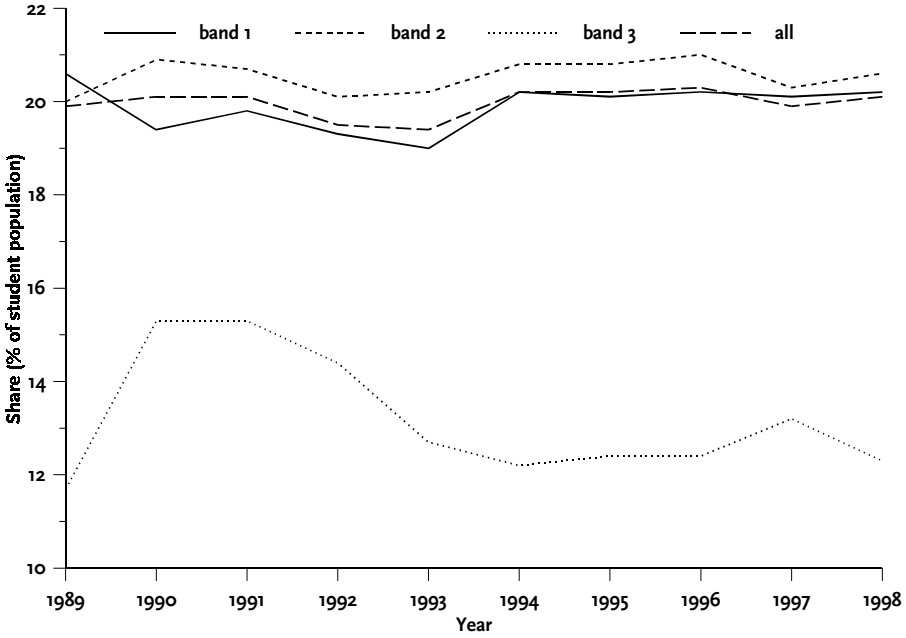
More recently, Ramsay *et al.* (1998) survey students eligible to enter the University of South Australia and compare the views of students from low socio-economic status entering the institution through the university's special access scheme (USANET) with the views of a control group. An interesting finding is that HECS appeared to have a more positive impact on the decision to enroll for the USANET-students than for the control group. All in all, the surveys on the attitudes of students do not support the idea that HECS erects a barrier to higher education. At the national level, Encel (2000) studies the effectiveness of a number of government programs targeted at indigenous Australians. He finds that their participation has shown a fairly steady increasing trend since 1987, though participation rates are still lower than for the non-indigenous population.

Students choosing the deferred payment option have to accept a debt. Opponents have indicated that some groups of (potential) students might be unwilling to incur a HECS-debt because they dislike debt (Andrews, 1999). This debt-aversion stems from either the aversion to the risk of being unable to repay the debt, or because it shifts expenditures from the future to the present. In an unpublished report by Sharp & Anderson Marketing Consultants, it is concluded that SES-background of people had no strong or consistent effect on debt-aversion as measured by the willingness to apply for new mortgages or personal loans and the amounts

involved. All in all, there seems to be no support that HECS deters people from low SES-backgrounds because of debt-aversion (Andrews, 1999).

A next step in the HECS arrangements was taken in 1997 when the income thresholds at which repayment through the tax system starts was lowered and when tuition prices increased substantially and fees were differentiated into three tariff bands. The question thus emerges whether low SES-students are under-represented in the three HECS-bands. Figure 3.1 shows the share of commencing students from low SES-backgrounds.

Figure 3.1 Share of commencing students from low SES backgrounds (17-24 year)



Source: Andrews (1999).

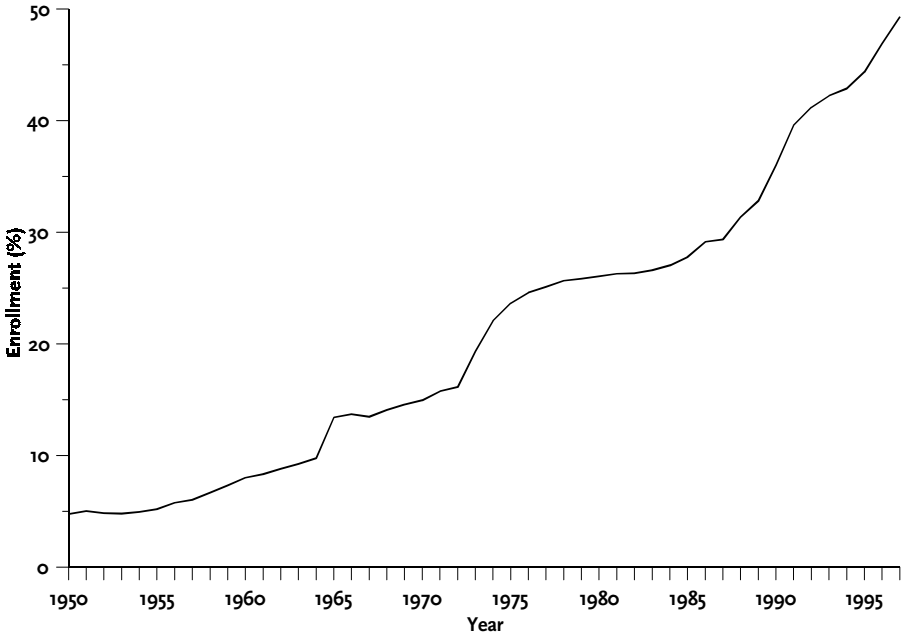
First of all, this figure shows that the proportion of commencing students from low SES-background has been stable around 20%. From the figure it also appears that low SES-students are particularly under-represented in band 3 fields (law, medicine, etc.). This situation, however, has been a long-term feature which certainly prevailed before the introduction of HECS in 1989. Such inequalities have been recognised as long as universities exist in Australia. A Commonwealth Education Survey in 1984 already indicated a domination of students from high socio-economic backgrounds in veterinary science and law. However, the choice of courses does not seem to be determined by financial motives. Recent work of Harvey-Beavis and Elsworth (1998) and James *et al.* (1999) found that subject choice is primarily influenced by the intrinsic interest in the field. Also, under-representation of low SES-students in band 3 fields can probably be explained by the very high entrance scores required in conjunction with the relatively low performances of low SES-students at secondary school.

A second interesting conclusion from this figure is that the recent changes in the HECS-system (increasing and differentiating fees, lowering the income threshold) do not appear to have any effect on the proportion of students from low SES-groups. However, because students can attend courses from differently priced programs, the price borders between the various disciplines are not fully clear. This has made the original simple HECS structure a bit less transparent.

Between 1989 and 1997 total enrollment in universities increased from 441,076 to 658,827 students. This reflects a rate of growth that never could have been funded by public means. In addition, the number of rejected applicants for higher education places has fallen substantially. Together with a stable distribution of students and new entrants over different socio-economic groups, this brings us to the conclusion that more people from all social classes attend higher education (Andrews, 1999). However, though the participation of low SES-groups remains stable, these groups are still seriously under-represented in higher education (DEETYA, 1999b).

The higher education sector also witnessed a rapid expansion in terms of the percentage of people in the 20-24 age cohort enrolled in a higher education program. Figure 3.2 shows the historical development over the 1950-1997 period. In 1950, about 5% of the 20-24 year-old people participated in some form of higher education; by 1997 this percentage has risen to 50%. The average annual growth rate in student enrollment over the 1950-1988 period was 5.3%, and over the 1989-1997 period it was 5.2% (recall that HECS was introduced in 1989). This is a negligible difference.

Figure 3.2 Enrollment in higher education (percent of age cohort 20-24)



Source: Enrollment data are taken from DEETYA (1998), and population data on the 20-24 cohort are taken from UN (1999).

Opponents of HECS complained that the new and untried arrangement would cause an enormous administrative burden. It is true that university administrators need to collect all up-front HECS payments and have to forward data about the individual debt of all persons who choose to defer their payments. The government compensates the institutions for these administrative costs, which were estimated at about $A12 million (in 1995). This is approximately 2% of total HECS-revenues.

The administrative burden as a result of the deferred payment option mainly stems from the additional tasks for the Australian Taxation Office (ATO), which administers the loans and collects the repayments. In addition, once the individual's income exceeds the income threshold an automatic trigger imposes the appropriate charge. It has been estimated that the administrative burden of this arrangement is about $A5,5 million per year. This is about 1% of total HECS revenues in 1995 (Chapman, 1997).

The actual experience with HECS shows that repayment rates of the debt are high. Recent statistics on repayments through the tax system show that after its initial years of operation the total amount repaid has increased very strongly. So it can be concluded that most graduates are able to repay their HECS-debt. In fact, most of the graduates repay their debt even within ten years, as can be seen from Table 3.4.

Table 3.4 Outstanding debt in HECS-system

Age of outstanding debt	% of total
Studied before 90/91	1%
Last studied 90/91	2%
Last studied 91/92	4%
Last studied 92/93	7%
Last studied 93/94	10%
Last studied 94/95	13%
Last studied 95/96	17%
Last studied 96/97	46%
Total	100%

Source: Dawkins (1999).

Winding up, the general conclusion to be drawn from all studies with a direct or indirect focus on the effects of HECS is that ever since its introduction higher education has expanded considerably without lowering the proportion of students from low SES-groups. The under-representation of low SES-individuals is mainly the result of non-financial (barely manipulable) factors such as values and attitudes. HECS is only of minor importance, if there is any influence at all. By-and-large, there is no evidence that HECS reduced accessibility of higher education (Chapman, 1997). Even the recent increase and differentiation in fee levels does not seem to have influenced applications and student enrollment. In addition, the rate of repayment by

graduates who deferred their tuition payments until after graduation through the tax system appears to be considerably higher than expected. Most graduates repay their HECS-debt in full within a period of 10 years after graduation. Finally, the administrative system collecting tuition fees up-front or after graduation through the tax system operates effectively and efficiently.

Altogether, the introduction of private contributions through HECS and its subsequent changes do not seem to have had a negative influence on the accessibility for students from lower SES groups. The socio-economic composition of the student population did not change, implying that participation in higher education also increased for low-SES students. This suggests that applicants are relatively unresponsive to changes in tuition fees. However, we do not know what the developments would have been without the introduction of HECS and its successive changes. So while the conclusion that HECS did not deter accessibility seems warranted, a skeptic may argue that higher education enrollment could have increased even more rapidly without private contributions (the counterfactual).[6] Though we cannot refute this argument, we are inclined to conclude from the Australian case that private contributions to higher education can be introduced or increased without hampering access to higher education, as long as payment is contingent on the individual (future) income situation.

[6] A possible way to try and take account of the counterfactual would be to run a regression for student enrollment on tuition fees, per capita income and perhaps some other control variables. The obtained regression coefficient for per capita income captures the consumption motive for education and the role of capital market constraints (in both cases the predicted sign is positive). So when credit market problems are solved through provision of loans – as in the HECS system – the obtained income effect would mainly reflect the consumption value of higher education.

4 Deregulation of higher education: tuition fee differentiation and selectivity in the US

Erik Canton and Hans Vossensteyn

4.1 Background

This chapter deals with the issue of deregulation in the higher education sector. To what extent should higher education institutions be free to determine their own policies? Or should the government decide on important issues?[1] We study this question in detail by focussing on two major and interrelated issues (giving an indication of the extent of deregulation), namely the determination of tuition fees and selection of students. Our research questions are:

- What are the main effects of deregulating tuition fee policies?
- What are the main effects of deregulating admission policies?
- How do these policies interact?

Discussions on deregulation often meet with resistance. Opponents argue that deregulation promotes inequality and endangers access. And differentiation in the higher education sector could come at the cost of transparency, so it is argued. On the other hand, there is an increased need for diversity to improve the match between demand and supply. And deregulation will foster competition between suppliers, leading to a better price-quality ratio.

In the US the higher education sector is strongly diversified with completely regulated public schools on one end of the spectrum and fully free private universities on the other end. These differences within the American higher education sector provide an excellent case-study for evaluating the effects of deregulation.

We start in Section 4.2 with a brief discussion of relevant theory on deregulation in general, and on student selection and tuition fee differentiation in particular. Section 4.3 provides some insight into the present situation with respect to admission and tuition fee policies in Australia, Denmark, the Netherlands, the UK, and the US. In Section 4.4 we study tuition fee and admission policies in the US, and present some empirical findings on the connection between tuition fees and academic quality, and between quality and student selection. In Section 4.5 we evaluate the pros and cons of a deregulated higher education system in the US in terms of the effects on educational quality and accessibility.

[1] By deregulation we have in mind the relaxation of existing regulations in the public sector, permitting higher education institutions to determine their own tuition price, to adopt their own admission policy, to design their own curriculum, to develop their own human resource management, and so forth. To put it differently, this form of deregulation devolves control over decisions to the individual institutions. It should be noted that the terminology is also used to refer to privatisation, *e.g.* de-monopolisation, de-nationalisation, and "contracting out" (*cf.* Dill, 1997). But these other forms of deregulation will not be discussed here.

4.2 Deregulation and economic theory

4.2.1 Tuition fee deregulation

In many countries tuition fees, *i.e.* the prices of higher education charged to students, are controlled by the government.[2] By keeping tuition fees low, the government tries to promote access to higher education. This is the basic argument behind regulated tuition fees. However, the available empirical evidence suggests that the price elasticity of the demand for higher education is low (see Chapter 3). When students' responsiveness to price reductions is weak, the expansion in demand due to regulated tuition fees is limited. In that case, a price cap is a costly instrument to promote accessibility as it merely implies a shift in educational spending from price-insensitive students to the average taxpayer.[3]

In addition, in light of recent trends and developments it seems inevitable to move towards a more differentiated higher education system when there is consensus that a country needs to have some excellent universities "in-house".[4] For instance, globalization will extend the higher education market beyond national borders. Students and staff become more and more mobile internationally, and educated people will more often work abroad. Also new technological opportunities such as the advent of the Internet and ICT-developments will have their impact on the higher education market, for instance by facilitating distance learning and the "virtual university". So to prevent the best students and staff from switching to a foreign university, the higher education sector has to offer an attractive alternative. To facilitate quality-differentiation, it could be helpful to allow the higher education institutions to set their own tuition prices.

What will happen when institutions are permitted to set tuition fees themselves? Tuition fees would then more closely reflect actual costs and market conditions. This will promote competition in the higher education sector. Schools try to differentiate themselves by looking for niches in the market, *i.e.* particular price-quality combinations (*cf.* Hoxby, 1997). The match between demand and supply will improve, as institutions become more responsive to students' need and social demand. Competition for students will be fostered (through tuition discounting, for instance), and institutions try to recruit students who fit best with the study program.[5]

Two remarks are in order. First, one may argue that the objective function of higher education institutions is different from those of firms operating in other markets. Whereas

[2] In most countries tuition fees only cover a fraction of the average direct cost of a higher education program (in the Netherlands about 20%, see Chapter 1).

[3] It should be noted that estimated price elasticities may become unreliable for large price changes so that enrollment changes could be larger than predicted from the estimates when cost-covering tuition fees are charged.

[4] Also the Minister of Education, Mr. Hermans, recognises the importance to provide "Harvard-, Yale- and Princeton-like" training programs (*cf. de Volkskrant*, 14 November 2000).

[5] There is a growing literature on the effects of competition on (higher) education. An interesting example is Epple and Romano (1998), who demonstrate that competition promotes quality-differentiation. A recent empirical investigation of these effects is available in Epple, Figlio, and Romano (2000).

commercial firms mostly pursue maximisation of profit or shareholders' value, higher education institutions may strive for excellence, or academic reputation. It is therefore unlikely that the pricing policy of the higher education institutions is based on pure profit-maximisation. In addition, because of the customer-input technology in educational production, an institution must take account of the effects of its pricing policy on the student population. Second, the asserted consequences of tuition fee deregulation will only materialise when competition in the higher education market is not hindered. This is our next topic.

4.2.2 Impediments to competition

An opponent could argue that the alleged competition between schools when fee differentiation is permitted will fail to occur. Indeed, a number of factors could impede the competitive process, namely:

- Limited student mobility;
- Information problems;
- Indivisibilities;
- Economies of scale.

First, students often choose to go to a higher education institute in their neighbourhood. Especially the vocational colleges often mainly serve a regional market. And even in a small country like the Netherlands students often choose a university in their region. It remains the question whether this is so because students are home-loving or because they think that higher education institutions do not differ so much. However, travelling costs are limited, and the observation that Dutch students are prepared to move when institutions differentiate themselves[6] supports the claim that student mobility is low because differentiation is limited. This low mobility could be problematic, as it turns the higher education institutions into local monopolies. In a fix-price system, this could lead to a reduction in educational quality – for instance when the academic staff wants to have an easy life. In a flex-price model it could lead to lower quality and / or higher tuition fees. So in both systems student immobility could worsen the price-quality ratio. And since quality decreases are more difficult to observe than tuition fee increases, there is a real danger of falling educational standards in an environment with limited student mobility.[7] Hoxby (1997) studies the historical development of competition in the US higher education market in light of this problem of limited student mobility. The large distances

[6] Two examples show that a substantial fraction of students comes from all over the country if institutions differentiate themselves. University Maastricht attracts lots of students from other regions because of its specific didactic system, and Wageningen University provides unique programs in the field of agriculture.

[7] A related interesting issue is whether ICT developments and distance-learning are going to reduce the importance of location. In the limit, spatial factors turn irrelevant ("the death of distance") so that the market for higher education becomes a global one. As a consequence, price-quality ratios will improve because competition for students becomes more intense.

and limited transport facilities severely hampered students' freedom of movement for a long time. Technological developments in the transport- and telecommunication-sector (resulting in a reduction of travelling-expenses and telephone-tariffs) helped to foster student mobility, and thereby competition in the higher education sector. In our reading, the analysis in Hoxby predicts that competition in the higher education system is going to intensify in the near future, in light of the above-mentioned trends of globalization and the advent of the Internet.

Second, information problems hamper the competition process in a free market. For instance, students and prospective students often have limited information on the quality of the various education programs. When educational quality is difficult to observe, higher education institutes could exploit their information advantage at their own benefit. This will result in similar problems as mentioned above: lower quality in a fix-price setting; lower quality and / or higher price in a flex-price setting. Leslie and Johnson (1974) stress the importance of these information problems in their sceptical review on competition in the higher education industry. Another information problem is that one cannot completely know the value of an education program in advance. Education is to some extent an experience good. This implies that established incumbent schools have an advantage in the market. As a consequence, reputation effects could erect entry barriers for (potential) newcomers and thereby frustrate the competitive process.[8] Again, the incumbent institutions might be tempted to raise the price-quality ratio.

Third, higher education programs are to a large extent indivisible. A college entry decision is in fact a yes or no decision. It is not a serious option to attend two years of a three year program and then go to the labour market. And it is often difficult to attend part of a program at one college and the remainder at another. This implies that students are "locked-in" at their higher education institution. So once enrolled, student mobility is sharply reduced. To put it differently, competition for more advanced students in the higher education market is almost entirely ruled out. This could lead to a deterioration of the price-quality ratio, and a mismatch between student demand and the institution's specialisation pattern.[9]

Finally, educational production is sometimes characterised by economies of scale. Natural sciences, engineering and medical studies require expensive equipment and laboratories. Such investments can only be made when the institute is large enough. This implies that large schools have a cost advantage over small ones, and that there are substantial entry barriers for newcomers in the market for such costly study programs. In case of such a "natural" monopoly,

[8] An interesting observation in markets with experience goods is that entry of new firms in the market may actually induce incumbents to *increase* their price. The intuition is that the new firms attract the price sensitive customers while the incumbents keep the price insensitive ones. This segmentation of the market enables the established firms to raise their price as they keep the loyal customers. An example of this effect can be found in the market for pharmaceuticals (*cf.* Frank and Salkever, 1991).

[9] The intended introduction of a two-cycle Bachelor-Master system in the higher education sector in the wake of the Bologna-declaration will help to intensify competition for more advanced students in the Netherlands.

the government could impose price regulations to prevent the abuse of market power. To put it differently, differences in the cost structure across subject areas could give rise to differences in the extent of price regulation.

4.2.3 Student selection

For some commodities, customers may have a double role in that they are involved in both the production and the consumption process (*cf.* Chapter 2). Think of a trendy bar. Most people do not go to such a bar because they are thirsty, but because they want to meet and talk to others. In fact, social interaction is probably the bar's main product. And value-added is determined by the number and type of visitors. In case of queueing, the porters often give priority to those customers whose presence will be appreciated by the other guests (beautiful girls do not have to wait in the cold and do not have to pay an entrance fee). By doing so, the porters correct for the external effects associated with the appearance of these popular visitors.

This may seem a peculiar example, but comparable principles are at work in the higher education sector. We can characterise the educational process by a *customer-input technology* in the sense that students are both consumers and producers of education. Social contacts among students and communication between students and staff are important ingredients of the educational process. This implies that the quality of a training program partly depends on the quality of the students (*cf.* Rothschild and White, 1995).

The notion of a customer-input technology has one major implication: it provides a justification for selection of students. Universities can reach a higher quality-level by selecting the best mix of students. It thereby also gives a rationale for price discrimination among students, such as merit-based student aid. According to this principle, the best students should pay lower net tuition fees in order to correct for the positive spillovers they generate. These customer-input arguments are not purely academic: both selection of students and merit-based aid are actually used in the US as well as in some other countries, and the notion of customer-input technology is often mentioned in this context.

4.2.4 Problems with student selection

Two problems may arise with selection of students:

- Errors in the selection process;
- Matching versus mixing of students.

First, selecting students inevitably involves making mistakes. Sorting out good students is difficult, and there is always the possibility that suitable students fail the admission test and unsuitable students pass the test. (By "suitable" we mean students who would have completed their studies if they were enrolled and by "unsuitable" students we mean students who do not

complete and drop-out.) We refer to these errors as type I and type II errors.[10] While these errors in the selection procedure are problematic, it should be realised that open admission also leads to mistakes as some fraction of the student body will drop out. So open admission involves type II errors. An ultimate assessment of the problems with student selection should therefore be based on a comparison with the mistakes connected with open admission. We are not aware of examples of such type of cost-benefit analysis (CBA) in the literature; a first attempt of a CBA to explore the desirability of student selection in the Dutch context is presented in Canton (2001b). Though student selection can also be organised in a centralised system, the higher education institutions probably have more information on observed student characteristics than the government, so that delegation of the selection process to the individual institutions would result in a better allocation of talent.

Second, there is a debate on matching versus mixing of students. Briefly put, student selection is aimed at matching students while open admission leads to mixed classes. Whereas the notion of customer-input technology argues for matching, other stories would favour a mixing-strategy. For example, mixed classes could be the optimal strategy (from a social point of view at least) when personal talent is not some fixed exogenous endowment but something that could develop in an appropriate environment through social interaction with good students. In that case, matching students according to entrance criteria could imply some loss in human potential. On the other hand, effective education time in the classroom is reduced when bad students ask more of a teacher's time. As a consequence, some mixture of "good" and "bad" students would be the optimal strategy. This is the point made in Lazear (1999).

A final comment is in order. While higher education institutions take account of the consequences of errors in the selection process and internalise spillovers connected with the process of educational production, the benefits from human capital spillovers to society at large might be undervalued. This could imply that the institutions calculate a positive net gain from selective admission, whereas a social CBA would turn out to be negative.

4.2.5 Relationship between tuition fee and admission policies

Decisions about the extent of government influence on the determination of tuition fees impact on optimal admission strategies and vice versa. When tuition fees are centrally determined and uniform across subject areas, student selection may only be partially successful as a vehicle for differentiation. Schools with international ambitions are limited in their freedom to attract additional financial resources as they are unable to charge higher tuition fees, so that they may experience difficulties in recruiting superstars. And by superstars we not only refer to academic

[10] We define a type I error as the rejection of a student who should have been admitted, and a type II error as the admittance of a student who should have been rejected.

staff, but also to students. We have seen that the observation of a customer-input technology in educational production calls for a policy of price discrimination between students. In particular, universities may want to give discounts to students who raise the quality-level of an education program. And when universities are limited in their possibilities to do so, they may be unable to attract the best students. Likewise, higher education institutes who basically serve a local market and who probably have a less expensive production process cannot attract additional students by lowering tuition fees in a regulated environment. So also for this type of school the fixed price policy may have adverse effects on the institution's admission strategy.

4.3 Deregulation in international perspective

In order to illustrate the substantial international differences, let us briefly sketch the actual situation with respect to tuition fee policies and selection procedures in Australia, Denmark, the Netherlands, the UK and the US.

Table 4.1 Tuition fee policies and selection procedures: international comparison

	Tuition fees	Selection of students
Australia	differentiated, centralised	yes
Denmark	zero	yes
the Netherlands	uniform tariff	limited
United Kingdom	uniform tariff	yes
United States	differentiated, decentralised*	yes*

* Some public schools (community colleges) do not charge tuition fees and have an open admission policy.

Table 4.1 presents a summary. In *Australia*, tuition fees are centrally determined but vary across subject areas since 1997 (see Chapter 3). In deciding about the tariff group in which a discipline is classified, the government both looks at the costs of the training program and at the (expected) future earnings for the students in that program. The total number of publicly funded study places is centrally determined by the government. As there are more applications than study places, students are selected on the basis of their results at secondary school. About 5% of the applicants was rejected in 1998. As of 1998, rejected students can buy a study place at a cost-covering tuition price. Universities are permitted to levy cost-covering fees for up to 25% of the Australian students they admit, under the condition that their quota of HECS-supported students are filled. In addition, universities are statutorily required to charge cost-covering fees to international students. So in the Australian system there is differentiation by subject area, between home and foreign students and between home students who are eligible for HECS-funded places and home students who are admitted on a cost-covering basis (*cf.* Greenaway and Haynes, 2000).

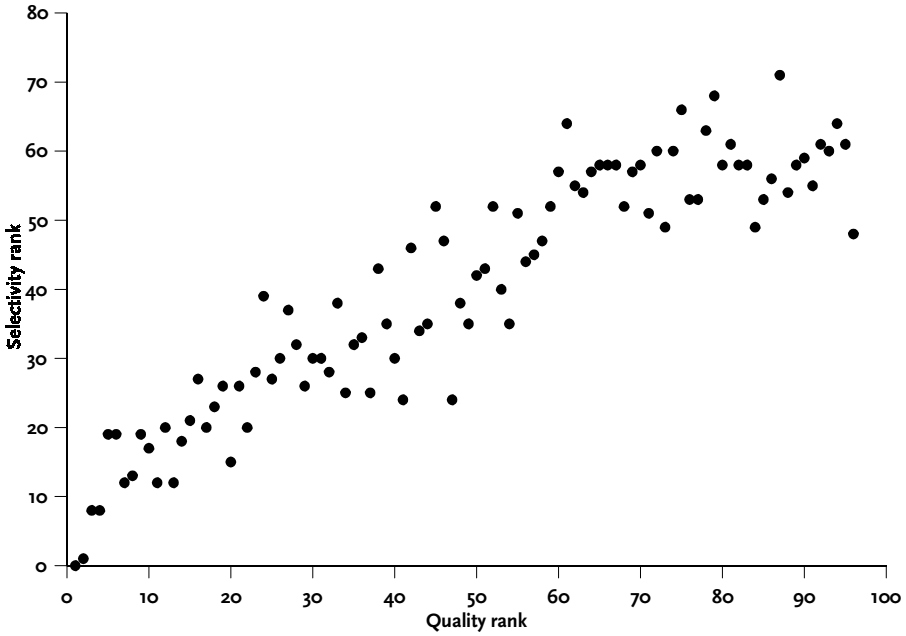
In *Denmark*, no tuition fees are charged. Danish higher education institutions are, however, permitted to select their students. So admission policies are deregulated. As we will see in Chapter 5, some institutions adopt a rather selective admission regime while others accept all applicants. Information on quality-differences across universities is not readily available to students and their parents. This reduces transparency on the higher education market. In addition, student mobility is limited (students do not have obvious reasons to prefer one university over another so that they just might go to the nearest university), and competition for students is hampered.

In *the Netherlands*, tuition fees for regular full-time students are centrally determined by the government. But universities can freely determine tuition fees for full-time students not eligible for student support, part-time students, and external candidates. The institutions do make use of this discretionary freedom (see Chapter 1). Also admission criteria are centrally determined for most subject areas in the Netherlands. Only students applying for a slot at an art academy or Ph.D.-program have to go through a selection procedure. In addition, some studies like medicine or dentistry have restricted admission, based on a weighted lottery where the chance depends on average grade points at secondary school.

In the *United Kingdom* tuition fees are uniform, and centrally determined by the government for regular full-time EU undergraduate students. However, universities are free to set their own prices for part-time students and for non-EU overseas students. Universities have the freedom to set their own selection criteria. These criteria can even differ across various disciplines within the same university, and selection is in general rather rigorous. It is interesting to look at the relationship between student selectivity and quality of the university. *The Times* presents a ranking of 96 universities. Data are collected on teaching assessments, research, entry standards, staff-student ratios, and library and computer spending. This data-set can be used to study the relationship between selectivity and ranking. The top-5 of the UK is (1) Cambridge, (2) Oxford, (3) Imperial College of Science, Technology and Medicine, (4) London School of Economics and Political Science, and (5) University College London. Figure 4.1 shows the relationship between selectivity and rank. The figure clearly shows that the best universities adopt the most restrictive admission policies.

The *United States* have the most liberal higher education system in terms of tuition fee deregulation and admission policies. The next section describes the US-system in more detail.

Figure 4.1 Relationship between selectivity and quality for some British universities



Source: *The Good University Guide*, www.the-times.co.uk/news/pages/tim/98/05/15/timguggug01001.html?999.

4.4 Tuition fee and admission policies in the US

4.4.1 Tuition fee policies

In the US, not only private schools can set their own tuition fees, but also public schools often have some freedom in their pricing policies (except the two-year community colleges who are not allowed to charge any fees). This decentralised character of tuition price policies is rather exceptional. We will explore levels and variety of prices charged to students, and we shall try to detect determinants of tuition fees. In particular, we look at educational quality as a potential explanation for tuition fee differentiation between higher education institutions. To that end, we collected data on research universities[11] available from the National Science Foundation.[12] Because of missing data, two universities are left out (Rutgers the State University of NJ New Brunswick and University of California-Irvine). We thus have data on 102 universities, from which 62 are public and 40 private. We selected a number of variables to get a global picture on the differences between public and private institutes.

[11] Notice that by focussing on research universities, other parts of the US higher education system (like colleges and non-research universities) are not included in the analysis.

[12] On the Internet at caspar.nsf.gov/webcaspar.www.

Table 4.2 Some facts of public and private universities in the US

		Public universities	Private universities	Total
Revenues from tuition fees (% of total revenues)		18	29	22
		(8)	(16)	(13)
Endowment income (% of total revenues)		1	7	3
		(1)	(8)	(6)
Tenured staff (%)		69	63	67
		(7)	(13)	(10)
Salaries ($)		58,629	68,856	62,639
		(6,257)	(11,247)	(9,916)
Quality academic personnel (1.24-4.70)		2.88	3.36	3.07
		(0.67)	(0.77)	(0.75)
Tuition fees ($)	undergraduate / in-state	3,359	18,082	9,133
		(1,085)	(5,645)	(8,055)
	undergraduate / out-of-state	9,510	18,114	12,884
		(2,521)	(5,561)	(5,800)
	graduate / in-state	3,896	16,914	9,001
		(1,491)	(5,724)	(7,389)
	graduate / out-of-state	9,587	16,951	12,475
		(2,665)	(5,637)	(5,450)

Note: Revenues from tuition fees are listed as a fraction of total revenues (adjusted total current funds revenues, excluding Pell grants (Pell grants are grants for students provided by the government)). Endowment income is expressed as a fraction of total revenues. Average numbers are reported above standard deviations. The sample includes 62 public and 40 private universities. Data on quality academic personnel apply to 1993, the other data to 1996.
Source: NSF, data available from Webcaspar (caspar.nsf.gov/webcaspar).

Table 4.2 summarises the data (mean values are above standard deviations). The table shows that:

- Public universities receive 18% of their income from tuition fees, while this is 29% for private institutes. With 74% of its revenues from tuition fees, Northeastern University is on top;
- Endowment income is negligible for the group of public universities, but amounts to 7% for private universities. The "wealthiest" institute is Rice University, with 40% of its revenues coming from endowments;
- The fraction of tenured academic staff is 63% for private and 69% for public universities;
- Annual salaries for academic personnel are on average about $10,000 higher at private universities, but also vary stronger in the private sector (the standard deviation of salary payments is almost twice as high for private universities compared to public universities). The real money-makers are to be found at California Institute of Technology, earning an annual salary of $112,000 (on average);

- With an average score of 3.36, private universities employ slightly better personnel than public universities (the quality-indicator ranges from 1.24 to 4.70). Only one public university is listed in the top-10, namely University of California-Berkeley.[13]

With regard to tuition fees, four categories of students are distinguished: undergraduate versus graduate students and in-state versus out-of-state students. The table shows that:

- On average, tuition fees are substantially higher at private universities;
- The program level (undergraduate versus graduate) is not an important determinant of tuition fees;
- Public universities strongly differentiate between in-state and out-of-state students (since a substantial part of the university budget is paid out of state tax money).

With regard to measurement of quality, two additional comments are in order. First, quality not only refers to academic quality, but may also relate to "fit for purpose". While this dimension is ignored in the U.S. News quality-indicator, some schools publish job market prospects of their graduates (*e.g.* starting salaries). Good job market prospects are an indication that the training program fits market demand. Second, some competition between institutions who measure quality or a system of multiple accreditation could improve the quality-ranking methodology.

[13] The top-10 in terms of quality of academic staff is: (1) Massachusetts Institute of Technology, (2) University of California-Berkeley, (3) Harvard University, (4) California Institute of Technology, (5) Stanford University, (6) University of Chicago, (7) Princeton University, (8) Yale University, (9) Cornell University and (10) Columbia University in the City of New York.

How to measure quality?

In this Box we describe how the U.S. News quality-indicator is calculated (following Graham and Morse, 1999). The quality-indicator is a weighted sum of the following seven categories (a recent discussion of these weights is presented in Webster (2001)):

- Academic reputation. To quantify a school's reputation, the presidents, provosts, and deans of admission are asked to rate peer schools' academic programs on a scale from 1 (marginal) to 5 (distinguished).
- Retention of students. 80 percent of the retention score is determined by the six-year graduation rate and 20 percent is determined by its freshman retention rate.
- Faculty resources. Five factors are used to assess a school's commitment to superb instruction:
  - class size, the proportion of classes with fewer than 20 students and of classes with more than 50 students (40%);
  - faculty salary (35%);
  - the proportion of professors with the highest degree in their field (15%);
  - the student-faculty ratio (5%);
  - the proportion of full-time faculty (5%).
- Student selectivity. Four factors are used to quantify student selectivity:
  - test scores of enrollees on the SAT- or ACT-test* (40%);
  - the proportion of enrolled freshmen who graduated in the top 10 percent of their high school classes for the national institutions and the top 25 percent for the regional schools (35%);
  - the ratio of students admitted to applicants (15%);
  - the ratio of students who enroll to those admitted (10%).
- Financial resources. This is measured by average spending per student on instruction, research, and education-related services.
- Alumni giving. The percentage of alumni who gave to their school is taken as an indicator of alumni satisfaction.
- Graduation rate performance. For year x, this is the difference between a school's six-year graduation rate for the class that entered in year x-6 and the predicted rate for the class (after controlling for spending and student aptitude). The idea here is that the college is enhancing achievement if the actual graduation rate is higher than the predicted rate.

* For more information on these admission tests, visit www.sat.org and www.act.org.

To determine the relationship between quality (see the Box for an explanation of the ranking methodology) and tuition fees, we carry out some regressions. Table 4.3 reports on regression analysis on undergraduate tuition fees. In model (1) and (2) the dependent variable is tuition fees for in-state students, while in (3) and (4) we look at tuition fees for out-of-state students. Comparison of model (1) and (2) shows that tuition fees charged to in-state students are higher and increase faster with quality at private institutions. But also the better public universities charge higher tuition fees to their students. From (3) and (4) it can be seen that public universities still charge lower fees to out-of-state students compared with the private institutions, but the coefficient on quality is now in the same order of magnitude for both types of

institutions: an increase of one standard deviation of educational quality is associated with a $1,685 tuition fee increase (0.68 · 2.478 · 1000) at public universities and $1,949 at private universities (0.78 · 2.499 · 1000).

Table 4.4 presents results from an analysis along the same lines for graduate students. A similar picture emerges here, though private institutions seem to react to quality-increases even stronger than in case of undergraduate training.

Table 4.3 Determinants of undergraduate tuition fees in the US

	(1)	(2)	(3)	(4)
	In-state / Public	In-state / Private	Out-of-state / Public	Out-of-state / Private
Constant	1.377	9.479	2.384	9.716
	[0.556]	[3.868]	[1.074]	[3.815]
Quality	0.689	2.560	2.478	2.499
	[0.188]	[1.122]	[0.364]	[1.107]
R^2	0.18	0.12	0.44	0.12

Note: Standard-errors are between brackets.
Source: See Table 4.2.

Table 4.4 Determinants of graduate tuition fees in the US

	(5)	(6)	(7)	(8)
	In-state / Public	In-state / Private	Out-of-state / Public	Out-of-state / Private
Constant	1.339	5.500	2.267	5.779
	[0.775]	[3.726]	[1.159]	[3.675]
Quality	0.889	3.396	2.546	3.324
	[0.262]	[1.081]	[0.393]	[1.066]
R^2	0.16	0.21	0.41	0.20

Note: Standard-errors are between brackets.
Source: See Table 4.2.

It is important to note that net tuition prices could be substantially lower than gross tuition fees due to "tuition discounting": colleges and universities have embraced the strategic use of aid to students, and aid is shifting from need-based to merit-based. More and more institutions pursue aggressive admission strategies to recruit the students they want to have. Many institutions have paid a steep price in terms of sharply reduced net tuition revenues, leaving them with less money for instruction. Such cut-throat competition could adversely affect the higher education system.

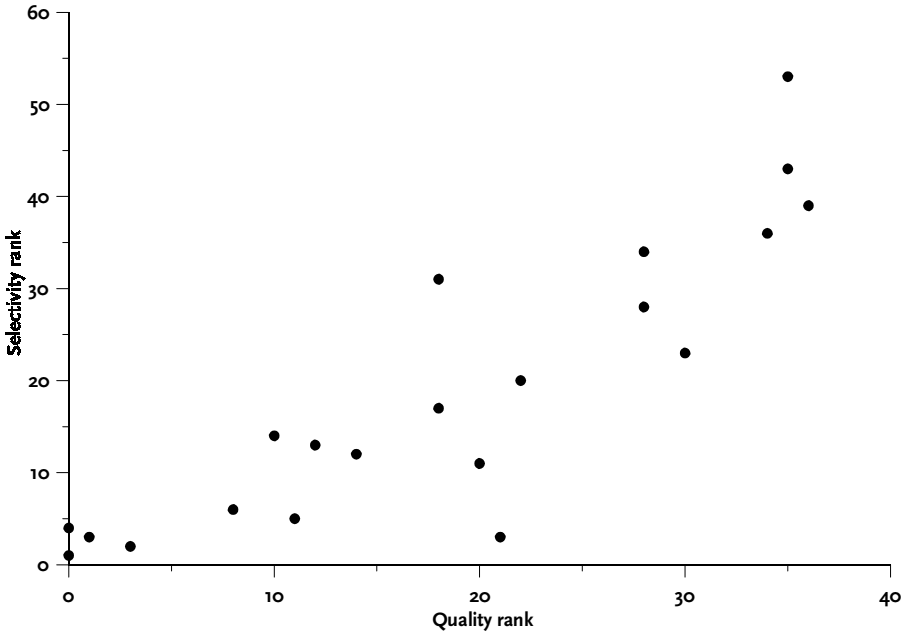
Two final comments about quality-stratification are in order. First, a disadvantage of the ordinal quality-ranking methodology is that it provides no insight into absolute quality-levels and absolute quality-differences between institutions. And some people claim that quality-stratification has led to polarisation in the US higher education system. While we recognise the possibility that good universities get better at the cost of the medium- and lower-ranked institutions, this view is not supported by the facts (*cf.* Duffy and Goldberg, 1998). Second, and finally, it is sometimes claimed that quality-differentiation in education could sustain income differentials across communities. In several states of the US, primary and secondary public schools are largely paid from local property taxes. As a result, there is a large disparity of educational spending per student across districts. Inequity in educational opportunities at primary and secondary public schools could be an important factor behind social polarisation. The interested reader is referred to Bénabou (1996), Fernandez and Rogerson (1996), and Durlauf (1996). However, it is far less likely that quality-differentiation within higher education helps to sustain socioeconomic segregation: students can freely choose across schools, institutions often have need-based student aid programs, and there are substantial returns to higher education (probably also for graduates from lower-ranked institutions).

4.4.2 Admission policies

Let us now turn to the question of student selectivity. Again, a distinction should be made between public and private universities. Private universities can always adopt their own admission criteria, but in case of public institutions the responsible government (state or local government) may control the school's admission strategy (at least to some extent). This role of government differs widely across states: from hardly any to fairly detailed regulation. For the admission to a Bachelor's program universities mostly look at high school scores. In about 20 out of the 50 states a compulsory high school exam guarantees a certain standardisation to make high school scores comparable. In some cases the university takes an additional admission test, *e.g.* the Scholastic Aptitude Test (SAT). Selectivity is very strong at the top: prestigious institutions select the best students from a large pool of applicants (from all over the world). At the bottom end there is no selection at all: community colleges accept all applicants.

This widely diversified character of the American higher education system provides a good example to study the relationship between university ranking and selectivity. In Figure 4.2 we plot selectivity against quality-ranking (*cf.* the Box) for 21 higher education institutes. The figure clearly shows a relationship between selectivity and ranking. Down-left are the best and most selective schools (among them California Institute of Technology and Stanford University). We hasten to add that the relationship in this figure does not reveal any direction of causality: we cannot claim that a better ranking enables universities to be more selective or that more selective universities climb up in rank. Probably both effects play a role.

Figure 4.2 Relationship between selectivity and quality for some American universities



Source: Webcaspar (caspar.nsf.gov/webcaspar) and U.S. News (www.usnews.com/usnews/edu/college/corank.htm).

So the above "eyeball econometrics" approach points at a relationship between educational quality and admission policy. A recent – and more elaborate – study on this connection is provided in Monks and Ehrenberg (1999). They investigate how college rankings influence selection-policy for a number of private universities in the US, finding that a lower ranking:

- Induces universities to accept a larger proportion of the applicants (a one unit drop in ranking leads to a 0.4%-point increase of the acceptance-rate);
- Leads to a reduction in the fraction of accepted students that register for the program (a one unit drop in ranking leads to a 0.17%-point decrease of the fraction of accepted students that registers);
- Decreases the average scholastic aptitude of student inflow (a one unit drop in ranking reduces the average SAT-score by 2.8 points – with an average SAT-score of college students of 1001 in 1991 (*cf.* Hoxby, 1997)).

Another important issue is whether selection helps to improve completion rates. An interesting study dealing with this issue is Light and Strayer (2000). They investigate whether the match between student ability and college quality affects college graduation rates in the US. A number of interesting findings emerge from their analysis. First, students at the bottom end of the observed ability distribution hurt their graduation chances by attending high-quality schools.

Second, the chance of completion first rises with college quality and then falls. So low-quality colleges provide the best chance of graduation for low-ability students, but this is not the case for students with measured ability in the top three quartiles. By-and-large, Light and Strayer conclude that the match between student ability and college quality has a significant effect on college completion.

4.5 Evaluation

In this chapter we looked at the issue of deregulation in higher education by discussing tuition fee and admission policies in a number of countries. By-and-large, government regulation in the higher education sector is still rather strong. In many countries tuition price is centrally determined (like in Australia, the Netherlands and the UK) or zero (Denmark and the other Scandinavian countries). Also admission policies vary substantially. Some countries employ national admission criteria (the Netherlands), others permit the institutions a large autonomy (UK).

The US higher education sector is a good example of a flexible system with regard to tuition price and admission policies. This has led to substantial price- and quality-differentials across higher education institutions. Universities focus on a particular segment of the market, and compete for students within this segment. Economic theory predicts that this would lead to improvements in the average quality and in price-quality ratios, and this claim seems to be supported by the data (*cf.* the empirical analysis in Hoxby, 1997).

We also saw that flexibility may come at a price. Evidence from the US showed that the better universities charge higher tuition fees. This may hamper accessibility for economically disadvantaged students. On the other hand, to maintain or improve their academic reputation, high-quality universities are forced to attract good students (independent of their socio-economic background). For that reason, US universities sometimes employ a high tuition – high aid strategy. Students pay a high price, but poorer students receive financial support that (at least) partly compensates for these higher costs. Put differently, rich students cross-subsidise poor students. If universities do not adopt such a high tuition – high aid policy, they may not be able to maintain their academic quality.

In addition, deregulation will only deliver the desired effects on price-quality ratios when the higher education market is competitive and transparent. Students and their parents must have access to reliable information on study programs, quality, tuition fees and future income prospects to make the correct choices. Such information systems are available in the US and the UK, but may need some further development in the Netherlands and Denmark.

As we have seen, tuition policies and admission policies are interrelated. These issues cannot be studied independently. From the international comparison provided in this chapter, we consider three possible combinations:[14]

- Regulated tuition fees and admission policies
  This system has a tendency to focus on the common denominator. The use of average admission criteria implies that the average quality of the student population will be comparable across higher education institutions. Since tuition fees are centrally determined, also the price mechanism cannot help to serve as an allocation device. Proponents of this system argue that it is equitable, since the regulated system would secure broad accessibility to higher education. Also, in combination with peer review of educational quality the system may provide a high average quality of higher education. Opponents criticise such a system for its homogenising character. The system frustrates the competition process, as universities cannot compete on price and can only partly compete on quality. The latter outcome is due to the fact that admission criteria are uniform, so that students are mixed rather than matched according to ability. This policy of uniform entry criteria could imply a waste in human potential, as the variety in student ability within the classroom is too large.
- Regulated tuition fees, deregulated admission policies
  This system acknowledges heterogeneity in the population with respect to ability as it allows universities to differentiate on enrollment criteria. This will induce quality-differentiation across universities. However, since tuition price cannot be set by the higher education institute, universities are limited in the amount of money they can collect from tuition payments. This financial constraint could limit the scope for further quality improvements.
- Deregulated tuition fees and admission policies
  This system is the most flexible as it allows schools to set their own tuition fees and to follow their own admission strategy. Each university will look for a niche in the market with a particular quality-price combination. The resulting differentiation leads to a better match of students. So while cross-university differences in quality will increase, each classroom will be populated by a more homogeneous group of students. Two problems may arise. First, price will tend to increase in quality. There is thus a potential danger that good but economically disadvantaged students cannot afford to study at the best schools. On the other hand, universities could offer need-based student support for instance through a high tuition – high aid strategy with cross-subsidisation of poor students. Such within-university differentiation in net tuition price is necessary to preserve academic quality. And in combination with the provision of a loan-scheme with income-contingent repayment (*cf.* Chapter 3), higher private contributions to the cost of higher education do not have to affect accessibility. Second, the

[14] We are not aware of an example of the fourth possibility, *i.e.* where tuition policy is decentralised but admission criteria are uniform.

question whether mixing or matching students increases educational production is unsettled yet. Economists should talk to education experts and teachers, and learn from their experience.

To conclude, the US system is rather different from the system in the Netherlands. The US experience seems to show that tuition price differentiation and student selection – as the natural outcomes of increased competition between higher education institutions – promote both average quality and price-quality ratios. However, lack of internationally comparable data hampers a direct translation of the US evidence to other countries. In Chapter 8 we will discuss the issue of deregulation in the context of the Dutch higher education sector.

5 Public funding of higher education: the Danish taximeter-model

Erik Canton and Peter van der Meer

5.1 Background

In Chapter 3 we looked at arguments *why* higher education should be subsidised. In this chapter we look at *how* to organise this public funding. There is an increasing interest to link funding of higher education to educational production. Such a system in which funding is (at least to some extent) conditional on performance is typically referred to as output-based funding. In this chapter we focus on the pros and cons of this funding principle.

The link between funding and performance may promote efficiency because higher education institutes get an incentive to deliver output (as specified by the funding agency), since they lose income when they fail to do so. But an output-based funding system could also have disadvantages. High-powered incentives to produce graduates could lead to narrowly focussed training programs. Non-measurable skills may be undervalued in such a system. In addition, when educational quality is difficult to observe and the reputation mechanism works insufficiently, output-based funding entails the danger of falling standards. In particular, schools have an incentive to let pass students just below the critical border. The average quality of graduates is reduced when more of these so-called infra-marginal students receive their certificates.

An interesting example of an output-based funding system is the Danish taximeter-model. Funding in the taximeter-system is directly linked to student performance: higher education institutes receive funding per passed examination, the so-called taximeter-tariff. The incentives to promote efficiency are thus evenly distributed over the study program, and the system is flexible in the sense that funding is closely connected to educational production.

As we have seen in Chapter 1, the Dutch funding system is a kind of "all-or-nothing" model where the price is paid at the end of the ride (*i.e.* at the moment of graduation). The Dutch funding model is currently debated for its lacks of financial flexibility. And the government is considering the implementation of a new funding model in the HBO-sector, closely resembling the Danish taximeter-model. This new funding model is seen as a first step towards a voucher-system. Therefore, we also pay some attention to vouchers.

The set-up of this chapter is the following. In Section 5.2 we briefly discuss the economic theory on output-based funding systems and vouchers. The important features of the Danish taximeter-model are explained in Section 5.3. In addition to desk-research, we also interviewed a number of Danish experts of the taximeter-model. In Section 5.4 we look at the intended and unintended effects of this taximeter-system, and present some conclusions.

5.2 Funding models and economic theory

Various funding mechanisms have been developed and applied in practice. Each funding system has its own incentive structure and its own advantages and disadvantages. This section discusses two important funding models: output-based funding (often used in practice) and vouchers (often referred to in public debates).

5.2.1 Output-based funding

Output- or performance-based budgeting can be defined as the allocation of resources contingent on an output-indicator.[1] Output-based funding systems are thought to be more efficient than input-based systems.[2] In input-based systems, higher education institutions do not have an incentive to supply education at the lowest possible costs. Output-based systems, in contrast, provide high-powered incentives to deliver the output at the lowest cost. The important pros of output-based budgeting are:

- Promotion of efficiency;
- Transparent allocation of public funding;
- No requirements on production technology are imposed (*e.g.* staff-student ratios).

However, performance-based budgeting may sometimes be problematic. In particular, output-measurement difficulties could lead to:

- Misalignment of incentives, *i.e.* a wrong balance of tasks ("you only get what you pay for");
- "Cream skimming", *i.e.* the output-target is met but other aspects of output are ignored (think of a reduction in quality when institutions are paid for the number of graduates they deliver).

Also, output-funding may not work well when:

- The individuals do not have (enough) control over the performance measures when the relation between effort and performance measures is noisy.

And finally:

- Performance-based budgeting is only effective when efficiency-gains do not flow back to the government, but can be used by the institutions on their own discretion (Hendrikse, 1998);
- Output-based budgeting typically works poorly in cultures dominated by professional norms that denigrate speed and quantity of output relative to the quality, challenge, elegance, thoroughness, creativity or subtlety of the work done (*cf.* Baron and Kreps, 1999).

[1] The indicator could measure more than one dimension of output.

[2] An input-based funding system reimburses the costs of the inputs. So a decision needs to be made on input-requirements. For instance, an input-based funding system could set norms for the staff-student ratio. This implies that an input-based funding system pre-specifies the production technique. To that end it is necessary that the government has detailed knowledge about best practices. Such detailed information is often not available to the government.

The crucial question is how output should be measured. A specific definition of output is necessary to implement output-based funding. Measures used in practice are the number of degrees or the number of passed exams. When output-measurement is difficult, high-powered incentives could be problematic. In particular, high-powered incentives could shift away effort from hard-to-measure activities (development of creativity, problem-solving attitude and general academic competences) towards measurable activities. This could not only lead to undesirable changes in the educational process, but may also affect the quantity or quality of the other main product of a university, namely scientific research.

How should output-based funding be applied when one study program is more difficult than the other? Difficult study programs could have lower completion rates, and a performance-based funding system should take account of these differences, otherwise it is tempting for higher education institutions to offer only "easy" programs. Alternatively, this problem can be mitigated when institutions can select their own students. As a result, institutions will try to select those students with the highest probability to complete their studies. In the remainder of the discussion we shall come back to these problems with output-based funding, and their practical consequences.

5.2.2 Vouchers

In the public debate, vouchers are often mentioned as an alternative funding system to increase efficiency in the higher education sector. The Box summarises the important characteristics of a voucher-system. Proponents argue that a voucher-system increases consumer sovereignty since students can vote-by-the-feet, forcing institutions to supply high-quality education. However, skeptics of voucher-systems stress that parents or students may not be sufficiently informed to make wise choices (Cohn, 1997).[3] Therefore, information on quality of programs and courses, quality of personnel and labour market perspectives must be readily available to students.

It is often argued that vouchers could improve access to higher education because the investment in higher education made by the student is less dependent on initial (including parents') wealth (*cf.* Barr, 1998b). However, it is possible to safeguard access to higher education by other means, *e.g.* student loans with an income-contingent repayment schedule (see Chapter 3), and perhaps at lower costs.

Finally, an often-mentioned advantage of a voucher-system is that the money follows the student. But this financial flexibility is already present in a pure input-based system where funding is directly linked to the number of enrolled students, and could also be introduced in output-based funding models, as the taximeter-system demonstrates.

[3] It is also sometimes mentioned that vouchers limit the students' "purchasing power" in terms of number of courses. But this depends on the specific organisation of the voucher-system. For instance, when vouchers are valued in years of registration we are back in the situation where students can take additional courses. And when vouchers are expressed in credits, an option would be to give more vouchers than minimally required.

Pros and cons of vouchers

Rosen defines vouchers as "grants earmarked for particular commodities, such as medical care or education, given to individuals" (1995, pp. 584). Therefore, vouchers form a system of demand-side funding. In case of education, students or their parents receive vouchers from the government which they can use to "buy" education. Schools hand in these vouchers to the government to receive funding (Cohn, 1997). For a good introduction on the economics of vouchers, the interested reader is referred to Bradford and Shaviro (1999) and Johnes (1993). Advantages of a voucher-system are the promotion of consumer sovereignty (voting-by-the-feet), and the promotion of competition among suppliers. To be effective, however, market imperfections (*e.g.* information problems, switching costs and indivisibilities in educational production) should not restrict freedom of choice.

The design of a voucher

In designing a voucher-system, three important choices need to be made:

- The criteria to be eligible for a voucher, such as personal or household characteristics (*e.g.* income or age);
- The freedom of choice on what to spend the voucher, for instance between schools;
- The voucher's reimbursement structure (a typical voucher has a declining marginal rate of reimbursement – at the limit 100% reimbursement up to some ceiling, followed by zero reimbursement).

An additional comment on the reimbursement structure is in order. As mentioned above, vouchers often have a 100% reimbursement rate up to a certain cap and 0% reimbursement thereafter. Some people claim that this aspect makes a voucher system equitable, *i.e.* purchasing power for those who want to enroll in a higher education program is equally distributed. On the other hand it implies that students who follow an expensive program would face higher private contributions. From economic theory we know that the mix between public and private contributions should be calculated on the basis of the difference between private and social returns to education (among other things, see also Chapter 3). So the idea of a fixed government contribution per student may not yield an efficient outcome as total costs and benefits vary substantially across study programs. An optimal voucher-system in the higher education sector may have a different reimbursement structure, for instance a proportional contribution. Vouchers could also be used in the higher education system to provide targeted support for certain disciplines which are perceived to generate important benefits to society (*e.g.* medicine, technical studies, natural sciences). These issues need further attention, as they could complicate the implementation of vouchers in the higher education sector.

5.3 The taximeter-model of Denmark

5.3.1 The reforms of 1992

Prior to the introduction of the taximeter-principle, the Danish financing system did not leave much room for institutional autonomy. Since 1981 (until the reform), education activities at universities were funded on basis of a forecast of passed exams – but there was no adjustment when forecasts turned out to be untrue. Such type of funding system could easily be manipulated. Vocational colleges were micro-managed before 1991. The complete production structure was predetermined by the Ministry. Budgets were calculated from staff-student ratios.

Possibilities to internally relocate the public funds across different fields of study were limited. So funding received for students in economics had to be spent within this department, and could not be relocated to the physics department. Such a system is sometimes called "budgets itemised by program area" (*cf.* Skjødt, 1996).

The Danish higher education sector has been reformed drastically in 1992. In the government report from 1998 on the taximeter-model the following key-arguments for the reform are given:

- To promote efficiency, and to induce higher education institutions to become more results-oriented and customer-focussed;
- To link the allocation of grants to educational production so that institutions with more students and better results are rewarded accordingly;
- To avoid erosion of standards;
- To implement a system that is simple, fair, transparent and automatic;
- To promote quality-competition among higher education institutes.

The 1992-reform consists of a new funding system combined with a decentralisation of the government structure. The main changes are:

- A change of the funding mechanism. As of 1994, the institutions have received their funds in the form of a block grant. The amount of government funding is set by the taximeter-principle, the topic of our next sub-section;
- The introduction of four-year agreements on the total number of study places per institute (before the reform agreements on total study places were made on a yearly basis), and a considerable increase in the number of study places. Universities and vocational colleges have the freedom to reallocate the study places over the different fields of study. This increases their flexibility and makes them better able to adapt to changes in demand, which should lead to a better match between supply and demand. Each institution decides how many students will be admitted to each program and selects the students in case demand outnumbers its capacity. Only a few expensive programs, *i.e.* medicine and dentistry, have a nationally restricted admission.

5.3.2 The taximeter-principle

In the taximeter-model funding is directly linked to the number of students who pass their exams. This funding-principle is therefore a good example of an output-based funding system. The Danish higher education sector receives funds from the Ministry of Education to provide education (research-funding is under the auspices of the Ministry of Research and Information

Technology[4]). The teaching component, which on average makes up one third of the revenues of Danish universities, is based on a unit-cost principle. For each student who passes an exam an amount of money is paid to the university. The total of these so-called active students determines the available budget in a particular year. In this system each exam is weighted. The weights of all exams of a 5-year program add up to 5. Universities do not receive compensation for students who fail their exams or do not take exams. The tariff paid per passed exam, the "taximeter", varies according to the field of study, and has three components:

- A tariff for the costs of education and equipment;
- A tariff for joint costs (*e.g.* administration, buildings);
- A tariff for practical training (for a few subjects).

For the year 2000, the Minister uses taximeters for 20 fields of study.[5] These tariffs are displayed in Table 5.1.

When the taximeter-model was implemented in 1994, tariffs were calculated under two important restrictions:

- The switch to the new funding system should not have budgetary consequences for the individual institutions in the first year;
- The taximeter-model should not lead to a relocation of funds between institutions in the first year.

These tariffs are therefore predominantly historically determined. The tariffs are not derived from cost-calculation of the most efficient supplier (*i.e.* benchmarking), so historically created inefficiencies will not be eliminated. Taximeter-tariffs are adjusted annually to balance the budget of the Ministry of Education. As of the introduction of the taximeter-model, there has been a lot of discussion about the level and differences between the taximeter-tariffs. For instance, at University of Copenhagen the faculty of science is actively lobbying for higher tariffs. This has also led to tension with other departments. Similar problems arise in the health faculty but here problems are less urgent as the health faculty receives more external funding.

Also the Ministry of Education is dissatisfied with the current tariff structure, and is considering to reduce the number of tariff groups. In addition, it has been suggested that there should be a premium for completion, as students often do not finish their thesis on time. In computer science, for instance, many students leave before graduating. Recall that this would

[4] The basic research grant has a historical base. Foremost the largest part of the grant is allocated according to last year's distribution. Changes are incremental. Only a small part of the grant is related to the university's income from teaching activities, that is "number of active students". Public funding also depends on the institution's income from external funds, *i.e.* grants from the Danish Research Council, the Danish National Research Foundation, the European Union and so forth. Besides these quantitative measures, other more qualitative measures will be used in allocating the basic research budget over the institutions. This new system is not yet completely implemented and is still heavily debated (*cf.* Jakobsen, 1997).

[5] But because of overlap, there are only 13 different tariffs, *cf.* Table 5.1.

imply a move towards the current Dutch system, where funding is largely linked to the moment of graduation (*cf.* Chapter 1).

Table 5.1 Tariff per full-time equivalent student for higher education in 2000 (DKK, excluding VAT)

Subject	Rate for direct teaching related expenditure	Rate for joint costs	Rate for practical training
Law, Economics, Danish, History etc.	24,700	5,800	
Psychology, Languages, Theology etc.	27,600	6,400	
Teacher Training (domestic science)*	27,600	7,900	
Mathematical Economics	32,800	6,400	
Educational Theory	32,800	7,900	
Physiotherapy	32,800	9,700	14,200
Marketing	34,200	6,400	
Teacher Training (old program)	38,100	7,900	33,200
Teacher Training (new program)	40,400	7,900	
Mathematics, Statistics	42,400	7,900	
Music, Communication, Journalism	42,400	9,700	
Athletics	47,800	7,900	
Geography, Dentistry	54,500	7,900	
Medicine	54,400	7,900	83,300
Computer Science, Physics, Chemistry, Biology	54,400	9,700	
Pharmacy	62,800	9,700	
Engineering, Agricultural Science	62,800	11,100	
Veterinary Science	83,700	11,100	
Ph.D.-program, non-laboratory subjects	87,900	21,100	
Ph.D.-program, laboratory subjects	132,000	21,100	

Note: 100 DKK is about Dfl.30,- or €13.64. Reported tariffs refer to annual public funding of a student who passed all exams in that year.
* Self-governing colleges of education have an additional rate for capital expenditure (6,800 DKK in 2000).
Source: Personal communication with Jesper Wittrup, Danish Ministry of Education.

5.3.3 Safeguarding the quality of higher education

As mentioned before, an output-based funding system could give rise to quality problems. In such a system, it is tempting to let (infra-marginal) students pass their exams to increase revenues. What measures have been taken in Denmark to safeguard educational quality?

The Danish Ministry of Education acknowledged this danger and therefore established (already in 1992) an evaluation center: the *Evalueringsinstitut* (EVA). By performing regular evaluations of the educational programs this center should improve and maintain the quality of higher education.

EVA is funded by the Ministry of Education, but acts as an independent body with the task to evaluate the quality of study programs and to publish these evaluations. A negative evaluation does not have direct financial consequences for the institution, but the Minister could intervene when performance is not improved. Although EVA's reports are publicly available, the

presentation is rather technical and it is written for the institutions and generally not read by the students. According to EVA, no overall change in quality has been observed since the introduction of the taximeter-model.

Another counterforce to the erosion of academic standards is the long-standing system of external examination.[6] The external examiners should:

- Ensure a fair and equal treatment of all students;
- Monitor nation-wide quality standards;
- Advise the institutions on the quality of the programs, and annually submit a report of their impressions or critique to the institution (*cf.* Thune *et al.*, 1996).

The three universities we visited make use of external examiners ("censorship") more frequently than the required minimum. Aarhus uses more and more exams with censorship, and at Copenhagen Business School about 60% of the examinations are censored. The institutions reported a number of additional benefits of the system of external examiners, such as the informal exchange of information on quality of particular courses and the opportunity to meet and talk to colleagues (though it could be questioned whether this cannot be arranged outside the system of external examination).

Both the EVA and the Ministry of Education consider the system of external examiners as too costly. They believe that efficiency in educational production can be improved by having less exams censored by an external examiner. However, imposing a maximum use of external examiners seems to be at odds with one of the aims of the reform, namely to increase institutional autonomy. With an output-based funding system institutions have an incentive to produce efficiently, so apparently the intensive use of external examiners yields enough benefits to the institutions. By pointing at the expensive character of the system of external examiners, it seems as if the government tries to impose input-requirements or methods of production (as in a line-item budgeting system). Our interviews revealed that it seems to be a matter of money: the government may point at the inefficient use of external examiners as an excuse to reduce the taximeter-tariffs.

Our impression from the expert interviews is that universities question the functioning of the EVA while they attach heavy weight on the system of external examiners. Aarhus is not too happy with the EVA: evaluations are not always objective and too much dependent on the evaluation board. And University of Copenhagen criticises the "ivory tower character" of the

[6] The composition of the corps of external examiners must reflect a substantial (at least one third) number of employers of the graduates from the program in question. External examiners are either colleagues from other universities or people from business companies or the public sector. There is a national pool of these external examiners, but there are some complaints that the pool is too small. Professors can propose the name of an external examiner (this aspect makes it less objective). The Minister of Education imposes the rule that at least one fourth of the examinations should be taken in the presence of an external examiner.

EVA. But the three universities we visited were (very) happy with the system of external examiners, although they all acknowledge that it is a costly instrument to guard academic quality.

5.4 Evaluation of the taximeter-model

5.4.1 Danish evaluation studies

A first evaluation of the taximeter-system has been performed by the Danish Evaluation Institute (EVA) in 1995. The Ministry asked the EVA to evaluate whether the taximeter-model has had any negative effects on educational quality. In the response the EVA concluded that:

- No negative trends could be found in the most recent evaluations of the study programs. On the contrary, EVA actually found that the reform had resulted in increased awareness of student needs, and a more open attitude towards students' suggestions, for instance by taking student evaluations more seriously;
- The teachers' "professional ethic" in general prevents them from letting more students pass as a response to output-based funding;
- The intensive use of external examiners prevents the local examiner to let more students pass.

A second and much broader evaluation of the taximeter-model, not only in higher education but also in other parts of the educational system and other government sectors where the taximeter-principle is applied, took place in 1998 (Undervisningsministeriet, 1998). The overall conclusions of this evaluation were positive, not only for higher education but also for the other systems investigated. In particular, it was concluded that as a result of the reform the management of the education sector has improved considerably. There is an increased focus on "value for money". For instance, managers are now more eager to find the best offer when buying new equipment or choosing a bank. Unprofitable activities are more rapidly discontinued, and the institutions have improved their ability to adjust and take up new initiatives, where before the reform they would often wait and do nothing until a real crisis occurred.

Also, educational institutions now seem to be more inclined to provide a good service to their students. Typically, additional effort is made to reduce the number of drop-outs. Furthermore, most institutions consider the quality of their teaching programs to be the decisive factor in the competition process.

The above mentioned effects are more pronounced at the vocational colleges than at the universities. One of the reasons could be that university funding is less affected by fluctuations in the number of active students, since taximeter-grants cover only about a third of their total revenues (the remainder include grants for research, capital expenses and so forth).

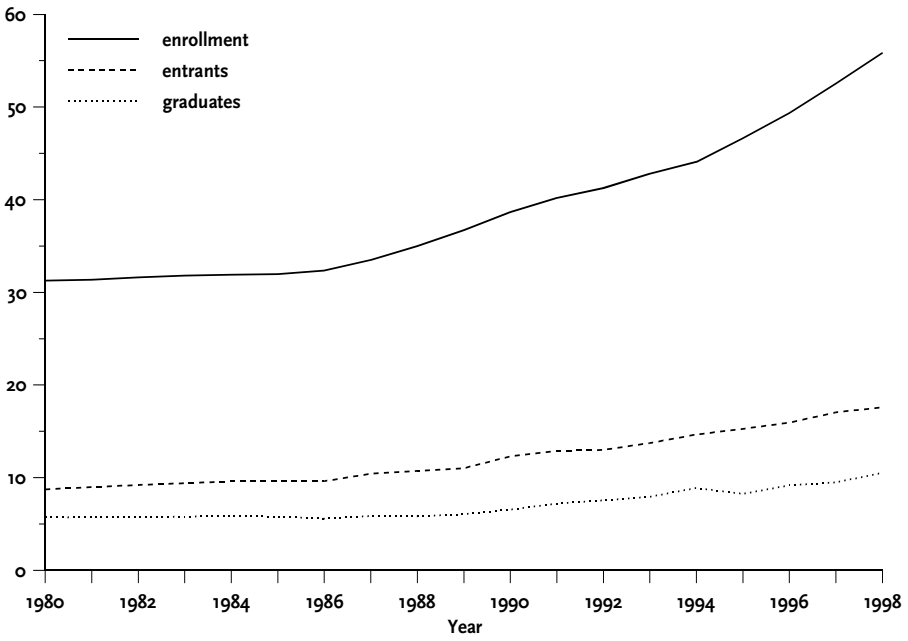
Furthermore, the governance structure at the universities is rather complicated, which could lead to agency-problems and hamper efficient management.

5.4.2 Student performance

One objective of the introduction of an output-based funding system was to improve student performance, *i.e.* to lower drop-out rates, to increase completion rates and to lower the length of study. Was the reform successful in this respect?

In Figure 5.1 we plot data on enrollment in Danish higher education (number of enrolled students as a percentage of the age cohort 20-24), entrants and graduates in higher education (also as a percentage of the age cohort 20-24) over the past twenty years. The figure clearly shows that enrollment started to increase around 1985, and in 1998 about 56% of the Danes within the 20-24 age group participated in some form of higher education. Also the fraction of people within this cohort entering and graduating from higher education increased. Between 1980 and 1998, the fraction of entrants as a percentage of the relevant age cohort doubled, while the fraction of graduates as a percentage of the relevant age cohort increased by approximately 85%. This suggests that completion rates have fallen and / or the average length of study has increased. So despite the introduction of the taximeter-model in 1994, we do not observe a clear improvement in student performance in the data.

Figure 5.1 Participation, inflow and outflow in Danish higher education, 1980-1998 (percent of age cohort 20-24)



Source: Data on enrollment, number of entrants and number of graduates are from the Danish Ministry of Education. Population data are from the UN (1999).

Figure 5.2 shows the number of graduates as a percentage of the number of enrolled students. A peak occurred in 1994, the year when the taximeter-model was actually implemented. About 20% of the enrolled students graduated in that year. For the years 1995-98 there is no clear evidence for a trend break in completion rates, though the period is too short to draw firm conclusions.

Figure 5.2 Completion rate in Danish higher education, 1980-1998 (number of graduates as percentage of total enrollment)

Source: Danish Ministry of Education.

According to University of Aarhus, educational production (number of students times study performance) has risen during the first years of the taximeter-model. However, this upswing is due to a volume-effect in the sense that more students applied for a study place at Aarhus. The volume-effect is triggered by a temporary demographic wave. The intended positive effects from the taximeter-principle on completion rates did not appear. And there is no evidence that the drop-out rate has lowered or the length of study has shortened. Despite a more pro-active attitude of the university to prevent students from dropping-out through study boards and counselling, this has not yielded any positive effects. In other words, attempts by the university to prevent students from dropping-out turned out to be ineffective in Aarhus.[7]

University of Copenhagen is more positive about the taximeter-model. At the end of the demographic wave, the number of applications for study places at University of Copenhagen

[7] To improve upon this situation, University of Aarhus started to monitor the cohorts entering in 1996 and 1999. Unfortunately, research results are not yet available.

dropped. A first reaction by the university was to lower entrance standards (mean grade points at secondary school), so that more students were admitted. But this did not turn out to be a sensible strategy. In fact, lowering entry standards led to an increase in the dropout-rate, and this strategy did not yield a positive effect on their revenue stream. Therefore, entry standards were increased again. This caused a reduction in the intake of new students, but completion rates (and thus taximeter-funding per student) increased.

Also according to the Copenhagen Business School (CBS), the taximeter-model has led to a more active attitude to improve study performance. A common problem in the Danish higher education program is the preparation of a thesis. About 40% of the students do not succeed to submit their thesis in time and students receive too little guidance. To improve on this situation, CBS developed a more active and student-friendly attitude with the result that more and more students are able to finish their thesis on time.

5.4.3 Budgetary effects

An often-mentioned drawback of the taximeter-system is its open-ended character (at least in the short-run). If more students pass exams, more resources are made available to the institutions. It is not possible to calculate in advance exactly how many active students there are, and therefore it is not possible to predict the exact funding to be paid by the government. This has already resulted in "unpleasant surprises": in some years actual expenses exceeded the budget of the Ministry of Education by almost a billion Danish crowns. Not surprisingly, the Ministry of Finance is especially concerned about this problem. The Ministry of Education now has an agreement with the Ministry of Finance with regard to overspending. The Minister of Education may overspend 200 million DKK (approximately 70 million Dfl.) before intervention is needed. Some measures have been taken to decrease the likelihood of such negative surprises in the future. One of these measures is to set a fixed maximum grant for certain types of open education, for which it is particularly difficult to predict the number of active students. However, to the extent that the upswing in expenses reflects a general improvement in study performance it is only an inter-temporal reallocation of funds (future outlays are moved forward). So in our view overrunning the budget could actually be a sign that the taximeter-model is effective in improving study performance.

5.4.4 Quality once again

An often-heard argument against output-based funding systems is that educational quality may be lowered. Is this fear justified? Perhaps the most powerful mechanism to maintain academic standards is reputation. In an open sector where information about a school's quality is readily available to (potential) students, the number of applications will be affected by the school's reputation (*cf.* Chapter 4 on the US). A reduction in educational quality in response to the taximeter-model is considered to be "self-defeating" (University of Copenhagen). Neither the

universities nor the Ministry of Education and EVA reported a structural drop in academic standards, although some mentioned that students and academic staff occasionally express their concern about educational quality.

Institutions can select their own students. Entry standards vary across universities. Some universities receive ample applications, and they can select the best students. But especially the far-away colleges have to accept everybody. This will lead to quality differences. While this differentiation between universities is accepted, the Ministry of Education recognises that transparency is at stake.

People at Copenhagen Business School talked about a hump-shaped relationship between the average quality and number of intakes. When too few students are admitted, educational quality is too low because there is not enough student interaction and the scale is too small too generate enough financial means. And when too many students are accepted, the average quality of the student population is lowered.

In our interpretation, the expert interviews revealed that quality-differentiation has been promoted (though perhaps unintentionally) within the taximeter-system. Some universities strive for excellence and adopt a rigorous student selection policy. For instance, at University of Copenhagen we were told that their tough program in economics is used as a marketing instrument to attract good students – for instance by presenting examples of former students who were admitted to a Ph.D.-program at American top-universities. Other universities admit all applicants, which may come at the cost of educational quality. For a more elaborate discussion on the pros and cons of quality-differentiation, we refer to Chapter 4.

5.4.5 Competition

The taximeter-model should facilitate competition between schools. When the money follows the student, there should be no financial impediments to student relocations (apart from switching costs). However, Danish students are discouraged from switching between universities. Students have to add at least half a year to their study time when they switch to another university. This is because universities normally require students to take additional courses, as courses taken at another university may not be recognised, or considered to be "too light". Students perceive these barriers to switch as a problem. Moreover, by erecting these barriers universities can reduce competition. Indeed, the intended effect of voting-by-the-feet has not appeared. As a consequence, the market for higher education is still to a large extent a regional one. Students want to live close to their relatives and are only prepared to move to another part of the country when programs are very different.

International mobility of students is also limited (apart from international student exchange programs) as degrees obtained in other countries are often not recognised. For instance, a Bachelor-degree from the UK is not accepted in Denmark.

There is some evidence that the taximeter-model induced universities to search for new markets. For instance, the University of Copenhagen has been more creative to attract students and money (also from firms) by offering new courses and programs. Or – as one expert put it – the taximeter-model "has triggered an incentive to build up new business". It is admitted that some moral hazard is present in the sense that there is an incentive to supply soft courses, but this effect is counterbalanced through the danger of loss of reputation and students.

5.4.6 Other issues

Most Danish universities also apply the taximeter-principle for the internal allocation of funds over the various faculties. But it is applied in a less strict fashion, in order to prevent too large budget relocations between faculties. For example, at University of Copenhagen a growing department receives more money, but less than according to the taximeter-principle. It can be expected that the effects of the taximeter-model are mitigated when the internal allocation of resources is not brought in line with the external allocation principle.

Internal application of the taximeter-principle suggests that a department with reduced student performance (*i.e.* more students failing their exams) would receive less money. Can such budgetary consequences also translate into sanctions of underperforming academic staff? Copenhagen Business School reported that teachers who perform badly can be sanctioned. Staff cannot be fired but underperforming staff may be forced to teach less interesting courses or (in a more extreme case) to early retirement. But in practice the yearly performance evaluation with the manager is in most cases sufficient to signal problems and to try and solve them.

Aarhus mentioned that the taximeter-model implied a huge administrative burden. University of Aarhus developed its own information system. The implementation of an information system necessary to administrate the system according to the norms of the Danish General Auditor was very expensive. Also maintenance costs are regarded as high. But the other two universities we visited did not report any serious implementation problems. And we were told that University of Aarhus implemented a very sophisticated and student-friendly information system. This system should meet the rapidly increasing information requirements of students. The taximeter-model, as such, did not call for such an advanced information system.

Research funding is provided by the Ministry of Research and Information Technology. There is no formal link between the budget for teaching and the research budget. Surprisingly, there is no institute to evaluate the research output: the *Evalueringsinstitut* only evaluates teaching.

In the perception of government, universities used to spend too little time on teaching and too much on research. The taximeter-model provides high-powered incentives with respect to teaching. According to the people we interviewed, this has indeed led to an increased attention for teaching activities. So does this reshuffle crowd-out research activity? According to the

Copenhagen Business School, this has not led to an erosion of research output. On the contrary, research productivity has increased. Whether this is due to complementarity between education and research or to the removal of substantial inefficiencies is an open question.

So is the taximeter-model a good model? Let us recapitulate our findings in the form of three main conclusions:

- The taximeter-model only had a minor positive effect (if any effect at all) on student performance: there is no compelling evidence for changes in drop-out rates and completion rates;
- On average, no structural change in educational quality can be observed. But the taximeter-model has encouraged quality-differentiation across institutions. Some opt for a high- quality strategy and only admit the best students, other institutions accept all applicants and need to adjust their standards accordingly;
- Some institutions reported positive effects from the reform; our impression is that the taximeter-principle triggered a process of internal reorganisation at these institutions.

6 Public funding of academic research: the Research Assessment Exercise of the UK

Jos Koelman and Richard Venniker

6.1 Background

The previous three chapters looked at issues concerning education. In this chapter we turn to research. More specifically, we turn to the funding of research in institutions of higher education. During the last decade competition for research funds and the use of research evaluations have become key issues in technology and science policy in many OECD countries. A major factor behind this trend is the growing demand for accountability of public expenditures, including public research funding, by citizens. Governments and universities are pressed to make more efficient use of public resources, and to give better account of the use of these resources.

In this chapter, we discuss the pros and cons of output-based funding of the research activities of universities. We focus on how it affects the incentives of academic faculty with respect to research, teaching and knowledge transfer. We draw lessons from the UK, which has one of the most output-oriented university research funding systems. Since 1986, research by British universities is evaluated every four or five years in the so-called Research Assessment Exercise (RAE). The results of this exercise play an important role in research funding by the government: low-quality research is not funded at all, and research of high quality is rewarded with relatively generous funding.

In Section 6.2 we discuss the central issues and concepts. A description of the funding and evaluation system of academic research in the UK is given in Section 6.3. In Section 6.4 we discuss the effects of the RAE.

6.2 Research funding and economic theory

6.2.1 Pros and cons of output-based funding

The goal of introducing output-based funding (like the introduction of the RAE in the UK in 1986) is to increase the quantity and / or quality of research output.[1] Whether this increase will come about depends on various factors. Furthermore, introducing output-based funding may also influence activities other than research. In this section we describe the various possible effects, which are listed in Table 6.1.

[1] How to define and measure research output will be discussed in the next section.

Why would one expect a rise in research output? First, reallocation of resources to the most able and productive research groups may raise overall research output. This assumes that the measure of performance that is used accurately reflects marginal research productivity. Little is known about the production function of research, however. Although one of the few robust findings is that the distribution of average research productivity over researchers is very skewed, it is not clear what part of it may be attributed to the ability of researchers (see Stephan, 1996). Second, allocation of research funds between research units (universities, departments, research groups or even individuals) on the basis of performance would strengthen their incentives to provide research effort, and thereby raise their research productivity and eventually aggregate research productivity.

Whether these positive effects of performance-based funding will actually occur depends on several factors. First of all, introduction of explicit incentives for research effort may crowd out intrinsic motivation. Several examples outside the field of science where this crowding-out is supported by the data are described by Frey and Jegen (2000). The relevance for science is unknown.

A second assumption is that individual effort has a positive effect on aggregate research productivity. This relation need not apply due to the tournament character of science. The norm of "priority of discovery" is generally thought to play an important role in academic research: being the discoverer of new (path-breaking) knowledge enhances one's reputation and future research career (see Dasgupta and David, 1994). This importance of being first may give rise to acts of secrecy in the communication of intermediate research results with other researchers (the opponents in the tournament). This possibly tempers a positive effect of explicit incentives on aggregate research productivity.

Table 6.1 Theoretical pros and cons of output-based research funding at universities

Pro	Con
- allocation to (currently) most able researchers	- adverse incentives for non-measurable research effort
- incentives for measurable research effort	- no funds to new, talented researchers
	- crowding-out of intrinsic motivation
	- bias toward low-risk, short-term research and well-established research approaches
	- low comparability of output between scientific disciplines
	- adverse incentives for other faculty activities
	- academic "transfer market"

Whether output-based funding succeeds in raising research quality and / or quantity also depends on the quality of the output measures. Several imperfections of research output measures have been identified in the literature.

When part of the research output is not measurable, funding based on objective indicators may increase measured research output without increasing actual research output. It induces researchers to concentrate their efforts on the measurable outputs of research, which may be detrimental to actual output. Consequently, when non-measurable output is important, weak incentives on measurable output are desirable (Holmstrom and Milgrom, 1991).

Output-based indicators are necessarily based on past research accomplishments which may be misleading with respect to future productivity. Accomplishment-based funding tends to shift the distribution of funds toward older researchers and research units, at the cost of young researchers, re-entering women and new research units that may be more productive in the future, but have had less possibility to express their potential (Lazear, 1997). A similar reasoning applies to new research areas and new approaches versus established ones.

The length of the evaluation period is important as well. Research output is not only the result of effort and ability, but also of chance. Indicators that are based on short evaluation periods may result in one-time luck having long-time consequences due to the so-called Matthew effect[2]: successful research, whether due to ability or good luck, enhances reputation and the chance of obtaining future research funding, and thereby the probability of being successful in the future. Longer evaluation periods mitigate this influence of luck somewhat. A short evaluation period may also distract universities from path-breaking, high-risk research – with results only expected in the long-run – toward short-term and mainstream research with foreseeable output. This runs counter to the accepted view that university research should focus on research that would be under-provided by private parties due to external effects and high uncertainty.

Research is not the only activity of universities. They are also engaged in education and the transfer of research findings to the general public. The incentives on the three activities should be balanced in order to prevent that one of them will be crowded out. When education funding does not depend on education output and the effort academics put into education is hard to verify, strong financial incentives for research may go at the cost of the quality of education. The same applies for the transfer of knowledge, which is a legal task but is hardly rewarded explicitly.

Finally, individual institutions may use intrinsically unproductive strategies to increase their research output. These strategies do not increase the output of the total research system. A possible example that has featured prominently in public debates concerns poaching of researchers from other institutions shortly before an evaluation exercise (especially the timing is unproductive here, since mobility of researchers itself may be very productive).

[2] "To those who have more shall be given", from the Gospel of St. Matthew.

6.2.2 Research output and pitfalls in popular output measures

Evidently, output-based research funding requires a notion of what research output is. In general terms, the output of research is new knowledge. This initially takes the form of tacit knowledge, *i.e.* knowledge in the heads of researchers. Transfer of tacit knowledge requires face-to-face contact, which makes it a relatively expensive affair. To facilitate knowledge transfer, tacit knowledge may be written down on paper or in bits and bytes: it may be codified. Scientific papers, journal articles, patents and computer software are all examples of codified research output.

These codified outputs are the basis of attempts to evaluate the research efforts of universities, research groups and individual researchers. Evaluation of research has been a central component of research activity ever since science is conducted in specialised institutions, beginning in the late eighteenth and early nineteenth century. It has mainly served two types of decisions: funding research proposals and research organisations, and formulating a research strategy.

Various indicators of research output have been developed, all having their pros and cons The two main quantitative indicators are publication counts and citation analysis. Subjective peer review plays an important role as well. The remainder of this section discusses the pros and cons of the different indicators, and is largely based on the overview of international practices toward research assessment by Geuna *et al.* (1999).

The method of publication counts takes the sum of publications produced over a given period as a proxy for research productivity. To account for the quality of publications, different publications may be given different weights. Weights may differ between different types of publications (like books, journal articles, and working papers). Different journal articles may also receive different weights, depending on the journal in which they have been published. One possibility that has been used is to weigh articles according to the journal impact factor, which is the mean citation rate of all the articles contained in the journal, and is published annually in the Science Citation Index Journal Citation Report. Apart from the way quality is taken into account, several other decisions have to be made. Examples are the maximum number of publications that is taken into account, the length of the evaluation period, and the way co-publications are weighed (as a single-authored article, or inversely proportional to the number of authors, or otherwise).

Despite the different refinements of rough counts that have been applied, this performance indicator has several shortcomings as a measure of overall research output:

- Research output other than publications (like patents) is left out;
- The acceptance process for publications may be biased (*e.g.* toward established authors, or toward research within a familiar field or paradigm), and weighting schemes for journals may not be representative for the individual articles (Seglen, 1997);

- The choices about types and number of publications to be included, the weights to be used, the evaluation period, and the way co-publications are treated, are partially arbitrary.

The use of publication counts (and other indicators) for research groups, departments and whole institutions raises three additional issues. First, the proxy should be adjusted for the size of the research unit by taking the number of publications per researcher. Second, the output per researcher for a department may vary considerably depending on the number of staff in a department that is included in the indicator (only senior researchers, also Ph.D. students, maybe all types of faculty). And third, the output of a department may be altered significantly by the mobility of staff. The different manners of ascribing the output of a researcher to a department (based on the affiliation at the time of research, or based on the current affiliation) may have a strong impact on the output indicator.

Citation analysis concerns the counting of the number of times research publications of a researcher are referred to elsewhere in the literature. It is used to assess the quality of the research output. Citation indicators are mostly based on the *Science Citation Index* (SCI) of the Institute for Scientific Information. Besides the shortcomings mentioned above, particularly important shortcomings for citation counts are:

- The SCI tends to have a bias in favour of publications in the English language (and especially towards North American sources), and only the first author is reported in the SCI;
- Citation counts cannot distinguish between positive and negative citations, and may be distorted by citations to academic friends or by self-citations (although the latter are easier to recognise);
- The choice of citation windows (how many years are considered after the publication) is partially arbitrary, and may work out negatively for seminal or radical publications that take some time to be understood, accepted and referred to.

Peer review is the evaluation of research output by peers. Frequently, peers also use quantitative information about publications and citations in their assessments (sometimes referred to as *informed peer review*). In the Netherlands and in the UK, research assessment is mainly based on informed peer review. The most important shortcoming of peer review as a method of research assessment is that it is subjective, and may be insufficiently systematic and transparent. In principle, this may result in:

- Dishonest reporting when peers have a stake in the evaluation outcome;
- A bias in favour of large departments because they are usually better known and contribute to research in a large number of sub-disciplines;
- A bias in favour of a department or researcher at an institute because of the good reputation of the whole institute.

6.2.3 Research funding and the relation with research assessments: international differences

Most countries use a dual support system to fund academic research: both funding of institutions (core funding) and funding of research projects. Countries differ in the extent to which research evaluations play a role. The following approaches to core funding of academic research can be distinguished (based on Geuna *et al.*, 1999):

- (Partial) allocation on the basis of research performance indicators, either directly (Australia, Poland) or via an informed peer review process (*UK,* Hong Kong);
- Allocation on the basis of university size (numbers of students and staff), either completely (Germany, Italy, Norway and Sweden) or in combination with a small part that is based on performance (Denmark and Finland);
- Allocation on the basis of negotiation with the relevant ministry, either without any research evaluation (Austria) or with the use of information from research (and teaching) assessment (France);
- Allocation on the basis of small adjustments to historical patterns (the Netherlands). Although research assessment is carried out, it is not linked to funding decisions.

6.3 The Research Assessment Exercises in the UK

The UK has one of the most advanced research evaluation systems in Europe. Since the middle of the 1980s the UK has had four nation-wide university research evaluations, the so-called Research Assessment Exercises (RAEs), carried out in 1986, 1989, 1992 and 1996. The next RAE is planned for 2001.

The results of the RAE have been used to allocate the research funds by the three UK higher education funding councils (for England, Scotland, and Wales) and by the Department of Education for Northern Ireland.[3] Table 6.2 shows that the funds of these funding councils form a large part of total research funding. The other major funding source concerns the research councils, who allocate funds on the basis of research proposals. The share of the funding councils in total research funding has declined sharply, but they are still the largest single source.

[3] Formally, the assessment of quality (the RAE) and the selective allocation of funds are two separate exercises. But, as McNay (1999) observes, most people outside the funding bodies treated the RAE as covering both the assessment and the allocation of funds. We will use the term RAE mostly in this last sense.

Table 6.2 Sources of research funding for UK higher education institutions (percentage of total funding, unless stated otherwise)

	1984	1991	1997
Funding Councils	58.8	47.8	35.1
Research Councils	17.2	20.3	24.1
Other government departments	7.5	6.4	10.4
UK industry	5.6	6	7
Overseas	n.a.	5.5	8.5
Charities	6.7	11	13.6
Other	n.a.	3	1.3
Total (million pounds)	859	1,989	2,942

Note: n.a. = not available.
Source: HEFCE (2000c).

In this section we describe the method of research funding used by the funding councils and the role of the RAE, the main changes through time, and the results of the 1996 RAE (the last evaluation exercise). Because the funding mechanisms and assessment methods of the four regions of the UK are practically the same, we concentrate on the funding of research carried out by the Higher Education Funding Council for England (HEFCE).

6.3.1 RAE-based funding and overall funding within the HEFCE

The HEFCE provides funds for both research and teaching. Table 6.3 shows the breakdown of the HEFCE-funds in teaching, research and special funding for 1999-2000.

Table 6.3 Breakdown of HEFCE funding in 1999-2000

	million pounds	% of total
Teaching	2,930	69.3
Research	855	20.2
- quality-related research funding	835	19.8
- mainstream	743.3	
- supervision of research students	65.6	
- London extra costs	26.1	
- generic research funding	20	0.5
Special funding	435	10.3
Transitional funding and flexibility margin	10	0.2
Total funding	4,230	100

Source: HEFCE (2000a).

The part of HEFCE-funding that is allocated on the basis of the RAE concerns the quality-related funds, which is almost 98% of the HEFCE research funding. The institutions are free in the internal allocation of the research funds they receive. The allocation of the mainstream quality-related funds between institutions takes place in two stages:[4]

- Allocation of total research funds over the subject areas identified in the RAE;
- Allocation of the funds per subject area over the various institutions.

Both allocations are affected by the quality-rankings resulting from the RAE. We first describe how the quality-rankings are determined, and subsequently turn to the translation of these rankings in funding decisions.

6.3.2 The Research Assessment Exercise of 1996

The quality of research is assessed by (informed) peer review in a Research Assessment Exercise (RAE).[5] In this section we discuss the RAE of 1996, which will inform funding decisions until 2001-02. This RAE involved the assessment of over 55,000 academics from nearly 3,000 departments in 191 institutions (Geuna *et al.*, 1999). Note that since the introduction of a unitary university system in 1992, the UK has no formal distinction between the former polytechnics and related institutions (comparable to the Dutch HBO) and the "traditional" universities (comparable to the Dutch universities). Hence, all institutions of higher education are assessed and funded according to the same rules.

At the beginning of the 1996-exercise, 69 subject areas were defined (called Units of Assessment, UOAs). In each subject area the research output has been assessed by one of the 60 assessment panels of on average six to ten experts. Panel members, some 560 in total, were selected on the basis of nominations by about 1,000 outside bodies (subject associations, learned societies, professional bodies and organisations representing users of research).

Institutions were invited to put forward one application in each subject area.[6] The crucial information for the research assessment has been the research output of the so-called *research active staff*. Institutions were free in the selection of researchers as research active staff. It is important to note that the academic staff that is not submitted as research active does not add to the research volume of institutions as well. Hence, institutions basically face a trade-off between quantity and quality. The 1996-RAE did not assess all the output of the research active staff, but considered up to four works (publications or other forms of assessable and publicly available output).

[4] The two other components of quality-related funding are also determined by the outcomes of the RAE, but in a slightly different way. This is not discussed any further.

[5] Teaching activities are assessed by a separate assessment exercise: the Teaching Quality Assessment (TQA).

[6] Sometimes multiple applications from one institution in one subject area were allowed. Since interdisciplinary research-units may be hard to relate to a single subject area, the RAE sometimes allowed for application in a second subject area. In these cases, a second assessment panel considered the submission as well.

The research assessment resulted in a rating for each research unit (see Table 6.4). These ratings reflect the extent in which research in a unit has achieved levels of national or international excellence. Rating 1 implies "research quality that equates to attainable levels of national excellence in none, or virtually none, of the sub-areas of activity" and rating 5* means "research quality that equates to attainable levels of international excellence in a majority of sub-areas of activity and attainable levels of national excellence in all others" (Geuna *et al.*, 1999). The ratings are thus meant to reflect the level of research quality, and not the position of a department in a research quality tournament where a higher rating of one department automatically means a lower rating for another department. In theory it is possible that all departments receive the highest rating of 5* or the lowest rating of 1.

Table 6.4 Distribution of 1996 RAE-ratings over departments

Rating	1	2	3b	3a	4	5	5*
Research department (% of total)	8.2	16	18.2	14.6	23.2	13.9	5.9

Source: RAE96-database (see www.rae.ac.uk).

The average ratings differ substantially between subject areas. The three lowest average ratings (after translating the rankings to a scale from 1 to 7) are 2.4, 2.8 and 2.8, whereas the scores of the three highest rated subject areas are 5.1, 5.4 and 5.6. The difference between subject areas may reflect true quality differences, but may also be the result of different perceptions by assessment panels of the quality-ratings. These differences in average scores have increased in importance, since from the 1996 RAE onward the allocation of the total budget over the subject areas depends on the quality-ratings (prior to this date the budgets per subject were determined before the assessment).

6.3.3 From RAE-ratings toward allocation of funds

As mentioned before, the allocation of the quality-related research funds proceeds in two stages: allocation of the total funds between the subject areas (Stage 1), and allocation of the funds per subject area between institutions (Stage 2). The RAE-ratings influence the outcome of both stages.

In Stage 1 the total funds are allocated between the different subject areas. The share of each subject area in total funding is proportional to the volume of research in the subject area times the relevant cost weight.

There are three cost weights, reflecting differences in costs of research: for high cost laboratory and clinical subjects (weight 1.7), for intermediate cost subjects (weight 1.3) and for other subjects (weight 1.0).

The volume of research is the weighted sum of five separate components:

- The number of FTE research active academic staff funded from general funds, in departments rated 3b or above, and selected for assessment in the RAE (weight 1);
- The number of FTE research assistants (weight 0.1);
- The number of FTE research fellows (weight 0.1);
- 1.75 times the FTE number of postgraduate research (PGR) students in their second and third year of full-time study, or third to sixth year of part-time study (weight 0.15);[7]
- The average of last two years' research income from charities, divided by 25,000 (weight 0.25). Income from charities is divided by 25,000 (in pounds the average salary of a researcher) to obtain a personal equivalent.

The number of research active staff is the most important measure of volume: it accounts for about two-thirds of the total volume. The volume of research active staff is fixed between two RAEs. The other components of research volume are updated annually.

In Stage 2 the funds per subject area are allocated over the various institutions. For each subject area, the share of an institution in the total funds is proportional to the volume of the research unit it has put forward for assessment in the subject area, times the funding weight of the research unit. The volume of research for each institution in each subject is measured as in Stage 1.

The funding weight follows from the quality-ranking of the research unit determined in the RAE. Table 6.5 shows how the ratings relate to the funding weight. Ratings 1 and 2, which amounts to 24.2 percent of the departments (see Table 6.4), generate no quality related funding. Each rating point between 3b and 5 attracts a weight 50 percent greater than the previous point, while the step from 5 to 5* implies a 20 percent premium.

Table 6.5 RAE ratings and corresponding funding weights

1996 RAE rating	1	2	3b	3a	4	5	5*
Funding weight	0	0	1	1.5	2.25	3.375	4.05

Source: HEFCE (2000a).

6.3.4 Changes in RAE through time and plans for the RAE of 2001

Through the years the HEFCE has continually evaluated and reviewed the research evaluation process and the funding system. This section describes the major changes since the RAE of 1989 (see Table 6.7). The first RAE (of 1986) will not be discussed, since it has been strongly

[7] The multiplier of 1.75 is used to scale the 2 years counted for funding purposes back to a total of 3.5 years, which represents an average period of study for a full-time research degree.

criticised for its lack of transparency and the subsequent changes have been very substantial. In discussing the changes we will follow Table 6.7.

A major change that does not concern features of the RAE itself, but has resulted in debates about the RAE, has been the introduction of the unitary system of higher education in 1992. The formal distinction between the polytechnics and other institutions (comparable to the Dutch HBO) and the "traditional" universities (comparable to the Dutch universities) was abolished, and all the institutions of higher education have subsequently been assessed and funded according to the same rules.

The inclusion of the "new" universities in the RAE has also led to a number of changes in the determination of research output relevant for the RAE:

- Grants for teaching and research were separated. Student numbers were removed from the research funding formula, and research students, research assistants and fellows were included. This change has been structural;
- The choice of which academic staff to include in the research assessment was decentralised toward the institutions. Before 1992 all academic staff was subject to evaluation. Ever since the institutions have been free to put forward so-called research active staff. In this choice institutions face a trade-off between quality and quantity: academic staff that is not submitted as research active does not add to the volume of research as well;
- The relation between ranking and funding was changed (see Table 6.6).

Table 6.6 RAE ratings and corresponding funding weights for 1989 and 1992

RAE rating	1	2	3	4	5
1989 funding weight	0.5	1.5	2.5	3.5	4.5
1992 funding weight	0	1	2	3	4

This change had the important consequence that the lowest ranked units no longer received quality-related funds, whereas previously all units received some funding;

- Basic research and applied research could be evaluated separately. This change has only lasted one period; in the 1996-RAE they were integrated again. The change was inspired by the possibility of an excessive focus of the review panels on output measures that were favourable to basic research (like publications in scientific journals), and thus for the old universities. Separate evaluation proved to be cumbersome and added little to creating a level playing field, and was thus cancelled in the next exercise.

The number of quality categories and the correspondence between quality-ratings and funding weights has been changed several times. The first change, described above, basically introduced a category of institutions receiving no quality-related research funding. In 1996, the number of

quality categories has been increased by two. Basically, both the old category 3 and the old category 5 have been split in two. Furthermore, the lowest two quality categories received no funding from 1996 onward. These changes occurred in response to the general rise in quality rating. Due to this rise the departments that had been able to maintain their position in the top category had nevertheless seen their funding per unit of research volume decline, which was considered undesirable.

Another feature that has been changed several times is the quantity of output that is evaluated. In 1989 there were no rules. In 1992 researchers had to mark with an asterisk the two pieces of output they considered to be best. In 1996, the number of outputs counting for the quality assessment was drastically reduced to four pieces. This change has been made in reaction to the publication explosion following the 1992 RAE. The new arrangement has reduced the incentive to maximise the number of articles by repetition, by lowering the quality standards, or through the breakdown of research into lowest publishable units (Cave *et al.*, 1997).

Until 1996, the distribution of funds between the subject areas did not depend on the quality ratings. Since then, the quality of research no longer only determines the distribution of funds within a subject area, but also influences the distribution of the total budget between the subject areas. As explained earlier in the chapter, the amount of funds allocated to a subject area depends strongly on the research volume, which only takes into account the number of research active staff in departments that exceed a minimum research quality (have a rating of 3b or above). This raises the question of the comparability of quality between different disciplines; a question that is especially interesting given the great spread of average ratings between subject areas. This structure may give assessment panels an incentive to overrate the average quality of research output in order to maximise the share of the own subject area in the total research budget.

Table 6.7 Differences between the subsequent RAEs

	1989	1992	1996	2001
Funding period	90/91-92/93	93/94-96/97	97/98-00/01	01/02 - ...
No. of subject areas	152	72	69	68
University system	binary (55 institutions)	unitary (170 institutions)	unitary (191 institutions)	unitary
Funding of teaching and research separated?	no	yes	yes	yes
Staff assessed	all staff	research active staff (selected by the institutions)	research active staff (selected by the institutions)	research active staff (selected by the institutions)
Funding weight as a function of the quality rating	see Table 6.6	see Table 6.6	see Table 6.5	see Table 6.5
Separate ratings for basic and applied research?	no	yes	no	no
No. of quality categories	5 (see Table 6.6)	5 (see Table 6.6)	7 (see Table 6.5)	7 (see Table 6.5)
Budget per subject area	set before exercise	set before exercise	endogenous	endogenous
Research output per researcher assessed	not specified	two publications + two other output + other research info	best four	best four

Sources: McNay (1999), Williams (1993), www.rae.ac.uk.

The last change, which will be made in the 2001-RAE (and does not appear in the table), concerns the rules for submitting staff that has left an institution shortly before the research evaluation exercise. A "research active researcher" who transfers between two institutions that are eligible to participate in the RAE within the twelve months preceding the census date will be taken into account in the judgement of quality for both institutions, but will only be counted in the research volume of the employing institution at the census date. This change has been made in reaction to references to an academic "transfer market", and should ensure that institutions will not be disadvantaged by staff leaving immediately before the RAE.

6.4 Evaluation of the RAE

What have been the consequences of the RAE? How effective has the RAE been in achieving its goals? And what about unexpected side-effects? This section discusses the impact of the subsequent RAEs. It is mostly based on the main evaluation studies of subsequent exercises:

Williams (1991)[8], Martin and Skea (1992)[9], McNay (1997 and 1999)[10], and the HEFCE Review of Research (HEFCE, 2000b) including the underlying reports.

First a short word about the costs. According to calculations by the HEFCE, an upper limit on the total costs of the 1996-exercise is £37,5 million, just 0,8% of the total funds allocated on the basis of the RAE-results (HEFCE, 2000b).

The total amount of money that changes departments due to the RAE is about 30% of the total funds. Despite these gross money flows, the share of the old pre-1992 universities and the share of the new universities in total funding remains approximately constant (HEFCE, 2000b). The financial consequences for departments may be larger than these figures indicate. This is due to the fact that the RAE-ratings not only determine HEFCE-funding, but also increasingly influence the allocation of other research funds (McNay, 1997). Firms, for example, use the ratings when choosing a research group for contract research or long-time research collaboration.

6.4.1 Research output

The first indications of changes in research output are the changes in quality ratings, reported in Tables 6.8 and 6.9. The changes indicate a steady rise in the quality of research. From 1989 to 1992, 50% of the submissions improved its rating and 35.4% consolidated its rating. The remaining institutions either saw their rating decline or dropped out. From 1992 to 1996 51.7% improved its rating and 31.1% received the same rating in both years.

Table 6.8 RAE grade movements from 1989 to 1992

1992 submissions / 1989 rating	1992 rating 0	1	2	3	4	5	Total
0		90	80	106	47	36	359
1	41	**13**	45	49	10	1	159
2	37	5	**107**	189	58	8	404
3	31	0	46	**284**	176	48	585
4	10	0	1	72	**181**	86	350
5	8	0	1	6	44	**143**	202
Total	127	108	280	706	516	322	**2,059**

Note: Rating 0 indicates "received no rating".
Source: HEFCE (2000b), Annex J.

[8] Williams (1991) interviewed senior staff at sixteen universities.

[9] Martin and Skea (1992) surveyed 117 academics from 25 departments at nine institutions.

[10] McNay (1997) performed a study commissioned by the HEFCE. The study considered the effects of the RAE on the management of research, the quality of research, unintended consequences, the balance between research and teaching, and the nature of research. It involved a literature study, case studies, questionnaires and interviews.

Table 6.9 RAE grade movements from 1992 to 1996

1996 submissions	1996 rating							
1992 rating	0	1	2	3	4	5	5*	Total
0		126	207	131	30	14	7	515
1	180	**78**	84	60	2	0	1	405
2	87	28	**130**	290	44	4	0	583
3	64	2	36	**370**	271	54	5	802
4	13	0	0	79	**254**	162	22	530
5	6	0	0	4	43	**150**	**120**	323
Total	350	234	457	934	644	384	155	**3,158**

Note: Rating 0 indicates "received no rating", rating 3 in 1996 includes 3a and 3b.
Source: HEFCE (2000b), Annex J.

Two questions remain: is the improvement suggested by the increase in ratings real, and can it be attributed to the RAE? The last question is a very difficult one. McNay (1997) emphasises that the effects of the 1992 RAE are hard to disentangle from the effects of other policy changes that took place at the same time: (i) the creation of the unitary system, discussed earlier; (ii) a freeze on the expansion of undergraduate student numbers; (iii) the introduction of teaching quality assessment (TQA), although without significant resource consequences attached; and (iv) more emphasis of government policy on the contribution of academic research to competitiveness and economic strength. Additionally, some rules of the 1992 RAE were changed unexpectedly shortly before the submission deadline.

An international comparison may provide some indications of the efficiency of UK academic research. In 1997, the UK had the largest number of papers and number of citations per dollar (PPP) of higher education R&D expenditures. On the other hand, research funding as a proportion of GDP and the proportion of research funding provided by the government are relatively low internationally (HEFCE, 2000b). At first sight this suggests that UK research does indeed make efficient use of the research resources (although differences in research systems, like the focus in Germany on public research in specialised research institutions instead of in higher education institutions, make firm conclusions difficult).

Additional evidence is provided by surveys of researchers and university administrators. This evidence has the major drawback that it is based on perceptions and opinions, which frequently differ between individuals (even apparently similar ones). Williams (1991), McNay (1997) and Adams *et al.* (2000a) found evidence of improvements in research management: more conscious and transparent planning and monitoring of research, and closure and merger of low-rated departments. Many insiders think research quality has increased, although this is accompanied by more stress among staff.

6.4.2 Funding bias against new researchers

Does the funding system work out negatively for researchers who did not have the chance to prove their abilities in the recent past, like young researchers and re-entering women? HEFCE (2000b) finds no evidence for a bias against young researchers. Two observations support this view. First, the age profile of research active staff submitted to the 1996-RAE is not related to the grade received. Moreover, research-intensive departments even recruit slightly more younger staff relative than the sector overall.

HEFCE (2000b) does find an under-representation of women in the highest-rated departments. The proposed solution is to recognise personal recommendations of peers as evidence in the RAE. When the absence of research output is due to a temporary retreat from the academic labour market, an alternative solution might be to consider the research output in the four years before this retreat.

6.4.3 Bias toward short-term research

McNay (1997) finds indications for several distortions of the nature and content of research. The evaluation period results in more short-term and mainstream research. He also reports a bias of review panels toward more favourable treatment of papers in established scientific journals, leading researchers to focus on more basic research, more mainstream research, and less interdisciplinary research. How severe these distortions have been does not become clear, however. HEFCE (2000b) found no relationship between the percentage of time researchers spend on interdisciplinary research and the rating of their 1996 RAE submission, which suggests the problem is not large.

6.4.4 Adverse incentives for teaching and knowledge transfer

Martin and Skea (1992) report on concerns among academic staff about the negative effect of the RAE on teaching. Jenkins (1995) evaluates the effect of the RAE on teaching in fourteen departments of geography in England and Wales. The paper presents evidence of more teaching by part-timers and postgraduates (particularly in the first postgraduate year), and clear pressures to give priority to research productivity in personnel policy, especially in appointments. Teaching programs tend to become more fragmented, and insufficient new (possibly IT-based) teaching material is developed. McNay (1997) finds similar effects plus a trend toward organisational separation of teaching and research. To what extent these effects influence the educational output remains unclear. Analyses based on proxies for educational output have not been found.

The (negative) effects of the RAE on teaching and the transfer of knowledge are not evident. J M Consulting Ltd (2000) found a widespread view that the RAE did not directly damage the quality of teaching. A negative effect on innovations in teaching, like new teaching material and the attention paid to student support and tutorials, might be present, although views on this are

widely differing. Possibly, a decline in teaching quality may yet have to show up. Even when there is a negative influence of the RAE on teaching and knowledge transfer, the HEFCE-report concludes that this problem should not be tackled by lowering the incentives on research. Rather the answer should be found in attaching greater financial consequences to the Teaching Quality Assessment (TQA), and improving its quality, about which there is much dissatisfaction. A similar argument applies with respect to knowledge transfer.

6.4.5 Academic transfer market

One of the most frequently mentioned aspects of the RAE has probably been the alleged "transfer market" for staff in the run-up to an exercise. The fact that institutions are assessed on the performance of the staff in post on the census date for the RAE has been said (among others in the survey by Williams) to encourage a frenzied transfer market in the period before an exercise. The data do not support this hypothesis. McNay (1997) calculated that only about 1% of total academic staff moved due to the 1992-RAE. The same figure applies to the RAE-related transfers in the two years up to the 1996-RAE, a period in which the entire sector grew by 25%. There has been some timing of retirement in the 1996-RAE: in the year following the RAE, the percentage of staff retiring or moving out of active employment rose from 1.84 percent to 3.30 percent. Mobility may have remained this low because institutions took steps to retain staff, like salary increases, relief from teaching, sabbaticals and provision of support staff.[11] Compared with the US-researchers and with industrial researchers, UK academic (RAE) researchers are relatively immobile (HEFCE, 2000b).

6.4.6 In conclusion

Based on all the above, we arrive at the following summary of the findings concerning the effects of the Research Assessment Exercises in the UK (see Table 6.10).

Table 6.10 Consequences of the UK system of output-based funding, the Research Assessment Exercise

Pro	
Research output (research management)	weakly positive effect
Con	
New researchers / re-entering women	no effect / some negative effect
Short-term, mainstream research	ambiguous
Teaching	weakly negative effect
Knowledge transfer	unknown
Academic transfer market	no negative effect

[11] On the other hand, the percentage of staff moving to another institution in the year after the 1996 RAE was significantly higher than in the two years before the exercise.

7 When factory meets faculty: university-industry co-operation in the US

Richard Venniker and Ben Jongbloed

7.1 Background

In many countries research relationships between universities and industry have become more important. Contract research and consultancy services provided by universities have generated increasing revenues, more and more strategic research collaborations have been initiated, and universities have increased their efforts to patent their research findings and license them to private firms.

There is, however, controversy about the desirable level of university-industry co-operation. On the positive side, closer interaction is said to increase the transfer of knowledge between universities and private firms, and thus to enhance the social value of academic research. On the negative side, fears of secrecy in academic research and of a distortion of the research agenda toward applied research, from which the benefits may be privately appropriable, have been expressed.

In this chapter we discuss the pros and cons of university-industry interactions, and ask whether the incentives for both parties to collaborate lead to socially desirable outcomes. We try to assess whether the fears of secrecy and a distorted research agenda are justified. In doing so we look at the United States. The US have introduced government policies to foster the transfer of technology between universities and firms many years ago and are said to provide many examples of successful university-industry ventures. We focus on academic patenting and licensing and on collaborative research by universities and firms.

In Section 7.2 we first present some empirical evidence of the increase in university-industry interaction in the US. Subsequently we turn to the incentives of universities and firms to collaborate, and the possible role for government. Two main US policy measures to stimulate knowledge transfer from academe to industry are discussed in Section 7.3. In Section 7.4 we evaluate the costs and benefits of these policy measures.

7.2 University-industry ties and the role for government

7.2.1 The increasing importance of university-industry ties

Interactions between universities and private firms have gained importance over the years, as is evidenced by a number of R&D-statistics.

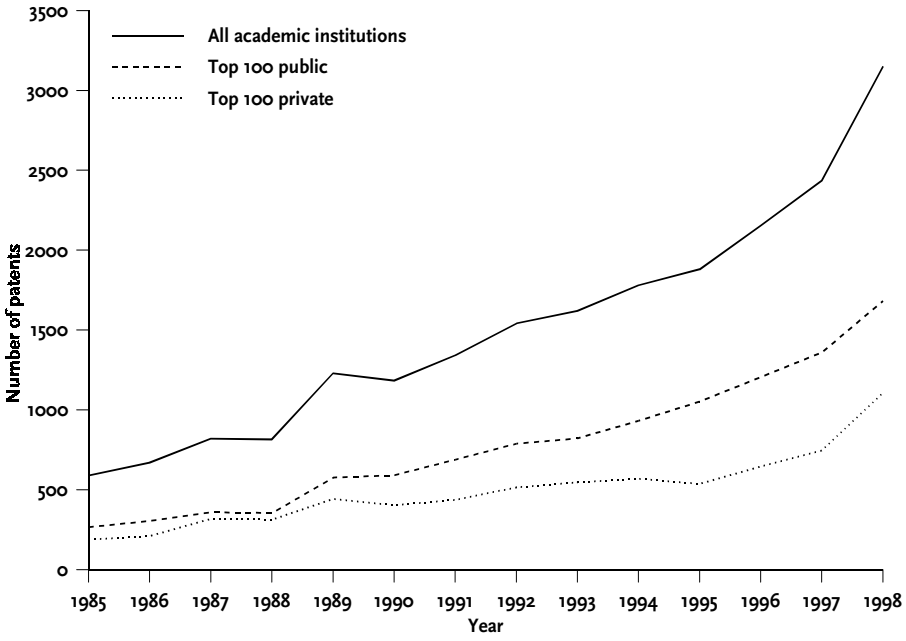
The share of industry in the funding of research performed by universities, both basic and applied, has increased steadily (see Figure 7.1). From 1980 to 1990, a decade of rapid growth for

total university research, industry's sponsorship increased from 4 percent to 7 percent of academic research expenditures. Since 1990 industry's share has remained around 7 percent.

Figure 7.1 Share of industry in US academic research expenditures

Source: NSB (2000).

Figure 7.2 US academic patenting 1985-1998



Source: NSB (2000).

Universities have also given increased attention to commercial application of their research. Figure 7.2 indicates that the number of university patents has increased continuously ever since 1985. Henderson *et al.* (1998) provide more extensive information. They show that the increase already started in the early 1970s, and that the increase has been more rapid than the increase in the overall number of US patents. They also show that the number of patents per US-dollar of research expenditures (the propensity to patent) has increased for universities, while it has declined sharply for overall domestic R&D. Furthermore, patenting activity has become more widespread: the number of universities obtaining patents has increased from about 30 in 1965 and 111 in 1985 to 173 in 1998 (see also NSB, 2000). Despite this increase, the distribution of patents across universities remains highly concentrated. In 1991, for example, the top 20 universities receive about 70% of the total patent grants.

More detailed information about the patenting and licensing activities of universities is provided by the annual Survey of Research Universities conducted by the Association of University Technology Managers (AUTM), see Table 7.1. Through the 1990s all indicators related to patenting – like license disclosures, patent applications, granted patents, and license revenues – have shown an increase.[1] Another indication is that the number of technology transfer and licensing offices, set up by universities to organise the process from invention to license agreement, rose from 25 in 1980 to 200 in 1990.

Table 7.1 Patenting and licensing activities of universities

	1991	1993	1995	1997
Invention disclosures received	4,880	6,598	7,427	9,051
New patent applications filed	1,335	1,993	2,373	3,644
Total new patents received	n.a.	1,307	1,550	2,239
New licenses and options executed	1,079	1,737	2,142	2,707
Number of revenue-generating licenses, options	2,210	3,413	4,272	5,659
Gross royalties (million $)	130	242.3	299.1	482.9
Startup companies formed	n.a.	n.a.	169	258
Survey coverage				
Number of institutions responding	98	117	127	132
Percent of total academic R&D represented	65	75	78	82
Percent of federally funded academic R&D represented	79	85	85	90
Percent of academic patents represented	n.a.	80	82	91

Note: n.a. = not available.
Source: NSB (2000), Text table 6.11.

[1] This is partly due to the improved coverage of the survey, as is shown in the bottom rows of the table. Moreover, the data do not reveal whether the propensity to patent and license has increased through the years.

Citations to published research articles on the front page of patent applications also indicate an increased importance of science for innovation. Applications to the US Patent and Trademark Office include citations to all "prior art" – that is previous patents as well as the other sources of information, such as research journal articles, on which the application is based. These citations are not a perfect measure of knowledge spillovers, however: some references are added ex post, *e.g.* to prevent law suits. Both the absolute number of citations and the share of patents citing research articles have risen sharply. The intensity of research citations differs between industrial product fields, and is particularly high and growing in patents for "drugs and medicines" (NSB, 1998).

Another indication for the ties between universities and industry is the significance of university-based startups. Table 7.1 shows a sharp rise in the second half of the 1990s in university-based startups. This is confirmed by the 1996 AUTM-survey where universities reported a total number of just over 900 startups since 1980 (see Rahm *et al.*, 2000). University-startups are mostly located close to the originating university, frequently on a so-called research park that provides them with all kinds of services to facilitate the startup. Over the past decades many universities have designated an adjacent land area and established a research park (Rahm *et al.*, 2000).

The importance of university-industry collaborative research has been studied by Cohen *et al.* (1998). They find that there were approximately 1,056 university-industry R&D centers in the US in 1990. More than 500 university-industry centers have been established during the 1980s. These centers spent about $2.9 billion on R&D, which amounts to almost one-fifth of all US academic R&D expenditures on science and engineering. About half of the private expenditures on academic R&D went to university-industry R&D centers.

Bibliometric indicators also illustrate increased interaction of academic and private researchers. Co-authorship of journal articles by US industrial researchers with either academic or federal researchers increased steadily across all fields. The proportion of industry-produced articles that were co-authored with at least one US academic researcher increased from 21.6 percent in 1981 to 40.8 percent in 1995. Again, the largest increase has been in biomedical research (NSB, 1998).

Publication activity of industrial researchers has changed significantly at the level of research fields. The number of "industry publications" in the engineering and technology field dropped steeply during the 1980s, accompanied by declines in industrial publications in physics, chemistry and mathematics in the first half of the 1990s. In biotechnology and clinical medicine the trend was exactly the opposite.

7.2.2 Benefits and costs of university-industry interaction

Evidently, universities and firms only collaborate when it is in their mutual interest. What are the benefits and costs to universities and firms?

First the benefits. Universities benefit from ties with industry for several reasons:

- Access to a source of complementary expertise and equipment;
- Access to a source of interesting new research problems;
- Channel through which to carry out the – legally assigned – objective of knowledge transfer to (regional) industry and the general public;
- Channel through which to provide students with experience in private research and to create a network for student job placement;
- Access to a source of income.

In other words, the ties add to fulfilling the academic tasks of education, research and knowledge transfer, and they generate income. The latter effect should not be considered to be a separate goal (universities are not profit maximisers). Clearly, increased importance of industry funds is likely to affect the incentives of universities towards research, as we will see further on.

The major reasons for firms to enter into collaborative agreements with universities are:

- Access to state-of-the-art knowledge and information, to university facilities, and to academic staff, and;
- Access to students as potential employees.

What about the costs? We distinguish three categories:

- Direct costs;
- Costs resulting from the different views of universities and firms on the dissemination of research results;
- Costs resulting from the different views of universities and firms on the research agenda.

First the direct costs. Evidently, universities and firms have to invest money, time and effort. Clear examples are the costs of setting up a technology transfer office to manage the patenting and licensing activities, and the overhead costs of cooperative research (like administrative costs).

Concerning the dissemination of knowledge, there exists a tension between the focus on open dissemination of knowledge at universities and the desire for secrecy by firms (Dasgupta and David, 1994). Secrecy – like delays in publication, partial dissemination of research results, or strict conditions on access to research material and technology by other researchers – helps

firms to protect the commercial value of products and processes eventually resulting from the inventions.[2] This induces them to incur the costs of further applied research and development.[3]

Academic researchers are hesitant to accept requests to hold research results partly or temporarily secret. These practices would run counter to the age-old scientific norm of free disclosure; a norm which has contributed to research quality, to the dissemination of knowledge and to the prevention of wasteful duplicative research.[4] And even when academic researchers are not intrinsically motivated to hold on to this norm, they may be induced to do so out of fear that giving in to commercial ties and secrecy harms their long-term research productivity and academic career. This would be the case when other researchers refuse to co-operate with staff interacting with industry because of fear for commercial use of their research results, or in reaction to initial acts of secrecy by the researcher with the commercial ties.

The second tension concerns the research agenda. Profit oriented firms may be more interested in applied research, the benefits of which are relatively easy to appropriate, than in basic research. The primary focus of universities should be on basic research that is hard to appropriate privately (or on research for which private appropriation of the benefits is undesirable). When universities substitute short-term applied "industrial" research for basic research due to closer ties with industry, this might hamper long-term research productivity, diminish spillovers from academic research, and eventually even harm long-term national innovativeness.

Several factors may have strengthened the incentives of universities and firms to collaborate. The public demand for justification of public research expenditures, often stated in terms of relevance for industry, has increased. Furthermore, the stagnation in government funding for higher education has stimulated universities to search for private sources of income. This effect is strengthened by the rising costs of advanced research equipment in many fields. Other causal

[2] Note that the demand for secrecy by firms may be socially excessive for all firms together. However, given the behaviour of other firms it may be in each firm's short-term interest to ask for secrecy. Furthermore, restrictions on open dissemination of research results are less important to firms when collaboration with universities results to a large extent in tacit knowledge, which gives firms a competitive lead even when complementary codified knowledge is fully disclosed.

[3] A firm may also demand secrecy when research results are likely to have a negative effect on the market demand for the firm's product, and consequently on its profitability. An example of such behaviour is given by Schachman (2000). He reports on clinical trials for a drug, financed by the firm selling the drug, which revealed that the drug was causing toxic effects rather than benefiting the patients. The quest for secrecy induced the firm to threaten the university with litigation and elimination of financial support.

[4] Note that although secrecy hurts spillovers from research in the first instance, their exists a partial counter-mechanism. Secrecy increases the marginal benefits from more applied research performed by firms, which also exhibits some externalities (although to a lesser extent than basic research). Hence, R&D expenditures and research spillovers are increased further down the road. The magnitude of this effect is not likely to be very large.

factors that have been mentioned in the literature (but are not evident and have not been substantiated precisely) is that firms rely more and more on public research due to the rising complexity of technology, intensified competition on the product market, and the shorter product cycles and hence shorter time horizons for private R&D. Furthermore, the distinction between basic research and applied research is relatively vague in new technology fields like ICT, biotechnology and new materials. Finally, governments increasingly encourage universities and firms to increase the knowledge transfer between academe and commerce.

7.2.3 What role for government?

Various policy documents consider the transfer of knowledge and technology from academe to commerce to be insufficient. Why might this be the case? We discuss three candidate explanations: the incentive structure, uncertainty, and lack of transparency.

First, most university inventions are little more than a "proof of concept", and require substantial further research to generate new products and processes (see Jensen and Thursby, 1998). Since part of the knowledge is tacit, *i.e.* in the heads of researchers, further research based on the invention requires active involvement of the inventor. To elicit the effort of academic researchers, they should have a stake in the commercial success of further research. The current academic reward system may not leave enough room for such incentive contracts, and patenting policy may play a useful role.

Second, the expected value of collaboration may be highly uncertain. This may induce risk-averse parties to turn down opportunities that are socially valuable. Governments may correct for this by subsidising university-industry collaboration (possibly with reimbursement of the subsidy in case of commercial success, although this will be hard to implement).

Third, the "knowledge transfer market" may suffer from a lack of transparency: firms do not know where to find knowledge, and universities do not know where their knowledge might be valuable. This problem need not apply to large firms, which have their own research capacity and access to the scientific network. But it may be a problem to smaller firms. And private parties may not have enough incentives to gather and bring together supply of and demand for knowledge. Patent policy may enhance transparency by providing a data-base of academic research findings that have the potential to result in profitable products after some further research and development. Subsidies to collaborative research may make it more worthwhile to search for research partners.

Eventually, policy instruments to stimulate knowledge transfer should only be implemented when the social benefits outweigh the costs. Hence, the positive effect of stronger collaboration between universities and industry on the use of public knowledge should outweigh the possible negative effects on the research agenda and on secrecy. And incentives from patenting rules on public research should not distort the attention of universities from their primary mission of

open and basic research that would have been insufficiently performed by private firms due to the limited possibilities for appropriability.[5] Furthermore, the instruments that are implemented should be effective in bringing about more collaboration. This may not be the case for the following reasons: (1) subsidies may co-finance collaborations that would have taken place anyway; (2) subsidies to formal collaborations may drive out equally or more efficient informal contacts; and (3) governments may be tempted to use R&D policies for subsidising national firms, and policy competition may render the national policies ineffective. The next section will discuss the main policies implemented in the US for stimulating university-industry collaboration.

7.3 University-industry collaboration in the US

The higher education landscape in the US is very diverse. Universities and colleges (about 3,500 in total) vary in size, ownership, endowment and character (see also Chapter 4). The generally accepted classification by the Carnegie Foundation distinguishes some 10 types of higher education institutes, including 6 types of universities, ranging from research universities (offering a full range of undergraduate and graduate programs and giving a high priority to research) to Master's colleges. The universities that are engaged in research collaboration with the private sector belong (mostly) to the group of research universities.

The US have a long tradition of university links with industry. This tradition started with the land-grant colleges. In 1862 every state was offered a sizeable piece of federal land for the purpose of establishing colleges dedicated to agriculture and mechanics (the Morrill Act). Other policy initiatives to improve agriculture by linking university researchers with farmers followed: a national bureau for assistance to farmers, federal support for agricultural experiment stations based at land-grant colleges (1887), and federal funding of state co-operative extension services (1914). After WWII science policy was characterised by an intimate linkage of universities with the defence sector, and a broad political consensus that the country would reap large social benefits from university research. Federal funding of academic research was not disputed. The productivity slowdown during the 1970s prompted many policy analysts to emphasise the need to enlarge the benefits of academic research for the competitiveness of domestic firms. This desire resulted in a number of policy initiatives during the 1980s and 1990s, listed in Table 7.2.[6]

[5] Notice that another justification for patenting is to prevent private ownership of research findings. An example is the Cohen-Boyer patent covering the fundamental techniques of gene splicing. Private ownership of this patent might have resulted in exclusive licensing involving very large royalties, thereby impeding important new avenues of research.

[6] US technology transfer policy has not been limited to universities. Many policy initiatives in the same period address the federal laboratories. See the sources mentioned in Table 7.1 for details.

The two most influential, industry-university cooperative research centers and the Bayh-Dole Act, will be described more extensively in the remainder of this section.

Table 7.2 Principal US federal policy legislation toward university-industry technology transfer

1975	Industry-University Cooperative Research Centers program of the National Science Foundation: partial funding by the NSF of university research programs enlisting industrial firms as participants in collaborative research activities.
1980	Bayh-Dole University and Small Business Patent Act: permits universities, small companies and non-profit organisations to obtain the property rights to innovations resulting from federally-funded research. In 1984 certain restrictions regarding the kinds of inventions and the right to assign property rights to other parties were removed.
1981	The Economic Recovery Tax Act: extends the industrial R&D tax breaks to company-financed academic research.
1984	National Cooperative Research Act: establishes the "rule of reason" standard for determining anti-trust prosecution for collaborative R&D efforts of firms, universities and federal laboratories. This means that collaborations are not automatically forbidden, but only if there is an "unreasonable" restraint of competition.

Sources: Bozeman (2000), NSB (2000), Rahm *et al.* (2000), Cohen *et al.* (1998), Henderson *et al.* (1998).

The Bayh-Dole Act represented an important change in patent policy. Prior to passage of the Bayh-Dole Act, it was the policy of government agencies to take title to all inventions that were made in whole or part through the expenditure of federal funds. The agencies, however, were unsuccessful in transferring the technology represented by those inventions to the public. The bureaucratic red tape that accompanied any attempt at innovation, cumbersome procedures that differed between the agencies, impeded companies to license directly from the government. As a consequence, government agencies obtained and held patents on many inventions, but the technology represented by most of those inventions and patents was never transferred to the public.

The Bayh-Dole Act gives universities and other non-profit organisations the first option to retain title to inventions made under federally-funded research programs. It requires universities to set up technology licensing offices, and researchers are required to report research findings that are thought to be eligible for patent grants to these offices. Universities are allowed to profit from the patent rights directly, or assign the rights to others through licenses (including exclusive licenses). Universities distribute the licensing revenues between the technology transfer offices, the university, and the individual inventor. All in all, Bayh-Dole was intended to facilitate industrial application of university research, and it endorsed the principle that exclusive licensing of publicly funded technology was sometimes necessary to achieve this goal.

Industry-University Cooperative Research Centers (IUCRCs) are small academic centers designed to foster research that is of strategic importance to industry. The purpose of the

IUCRCs is to strengthen the relationship between industry and academic institutions, especially the colleges of engineering. At the federal level, the NSF has stimulated such centers since the late 1970s through a special program. Furthermore, IUCRCs have also been stimulated by state governments. Within the NSF-program, universities and industry have to make joint proposals for a IUCRC. The NSF provides seed money, 50 percent of total funding, and after 10 years the centers are expected to be self-financing.

IUCRCs have to satisfy a number of requirements. We highlight several interesting ones. Centers have to obtain a minimum amount of cash from membership fees annually, coming from a minimum of six center-members to encourage a more generic research program. In general these members are industrial firms, but this need not be the case. The membership fees may differ between the different members, but at least three members have to contribute a minimum fee level or more. Membership categories with lower fees have been introduced to encourage smaller firms to become a member as well. Finally, involvement and education of graduate students is emphasised.

From the IUCRC-experience other co-operative NSF programs evolved. Among these are the Engineering Research Centers (ERC) Program initiated in 1985, and the Science and Technology Centers (STC) Program established in 1987.

ERCs[7] are university-industry partnerships in the engineering disciplines. They were designed to create long-term collaborations between universities and industry, to create new industry-relevant knowledge at the intersections of the traditional disciplines, and to improve undergraduate and graduate engineering education through practical experience in ERCs. Each new center receives support for at most 11 years, with a phasedown in years nine and ten. The 5-year agreements are renewed on the basis of a formal review. The central idea is that firms become member of a center (or more centers). Such center-membership usually involves payment of a fixed annual fee that is pooled with cash from other members and sponsors for support of the center's research and research-related activities. Centers set their own membership rates and often have associate memberships for small firms that cannot afford the cost of full membership, or for larger firms that are not yet ready to make a commitment for full membership.

STCs are similar to ERCs. The main difference is that the STC-program concerns open competition among research fields, whereas the ERC-program entails a competition restricted to the engineering directorate of the NSF. Hence the STC-program has a somewhat stronger focus on multi-disciplinary research. There have been three rounds to establish STCs to date: in 1989 (11 centers), in 1991 (14 centers) and in 1999 (5 new STCs). Currently 17 centers still receive NSF support, and a fourth competition is taking place.

[7] The subsequent information is extracted from NSF (1997).

7.4 Evaluation of American linkage policies

In this section we discuss whether the US knowledge transfer policies have been effective in raising knowledge transfer and the social value of public research. We also look for evidence of distortions in the research agenda or increases in secrecy.

A first indication of the overall effect on the research agenda can be taken from aggregate statistics. These do not support a shift in the research agenda. The shares of basic research, applied research, and development in total university research have been relatively stable over the past fifteen years. Ever since the 1980s the share of basic research hovers between 65 and 70%.

7.4.1 Academic patenting

What have been the effects of the Bayh-Dole Act? As shown in Section 7.1, university patenting has increased steadily over the past three decades, and more rapidly than overall US patenting. Between 1991 and 1996 license revenues have grown by 23% per year on average. However, this has not (yet) made license agreements an important source of income for universities. In 1996, the gross earnings from licenses were on average only 1.5% of total research expenditures. Moreover, the income from license agreements differed strongly between universities, ranging from 0% to 17.5%. For about half of the universities, license income was less than 0.5% of total research expenditures (Rahm *et al.*, 2000).[8]

How much of the increase in patenting activity can be attributed to Bayh-Dole? Circumstantial evidence, like the number of universities establishing technology transfer and licensing offices directly after the passage of the Bayh-Dole Act[9], suggests an important role of the act. But it is hard, if not impossible, to disentangle the effect of Bayh-Dole from the effect of alternative explanations:

- An increase in industry funding of academic research (see Figure 7.1);
- Important advances in some research fields (particularly the rapid advances in biotechnology starting in the 1970s, well before Bayh-Dole);
- The establishment (in 1982) of the Court of Appeals for the Federal Circuit as the court of final appeal for patent cases;
- Judicial decisions in favour of strong patent protection (Mowery and Ziedonis (2000) report such a decision with regard to a broad biotechnology patent).

Since the increase in university patenting has begun before the implementation of Bayh-Dole, this act is surely not the only causal factor. The growth in university patents has indeed accelerated in the late 1980s, hence after Bayh-Dole, but this is also the case for overall US

[8] These figures do not take account of the costs of patenting and licensing, like legal fees, costs of technology transfer personnel and administrative overhead.

[9] AUTM Licensing Survey (reported in Cohen *et al.* (1998)) and Henderson *et al.* (1998).

patenting. The changes in patenting of Stanford University and the University of California (UC), two universities that were actively patenting before 1984, were to a large extent linked to advances in biomedical research, which were primarily a consequence of the rapid growth of federal funding in biomedical research, notably under the auspices of the National Institutes of Health, and especially the War on Cancer program of the early 1970s (Mowery and Ziedonis, 2000). For the entire US, patents in the life sciences and biotechnology in 1998 account for 41 percent of the academic patents, up from 13 percent in 1980 (NSB, 2000). Despite these caveats, most researchers agree that the Bayh-Dole Act has been an important determinant of the sharp rise in academic patents.

The aim of the Bayh-Dole Act has been to increase the transfer of technology from universities to industry without distorting the commitment toward basic research and openness too much. Has it been successful in this respect? First, increases in patents cannot be translated directly into increases in technology transfer. This is shown by the relationship between granted patents and license agreements and income. For the University of California and Stanford University the ratio of license agreements over patents has increased, but the share of licenses yielding no royalties has increased as well and the average license income per patent has declined (Mowery and Ziedonis, 2000). Similar results of a decline in the license agreements and revenues per patent are obtained by Thursby and Thursby (2000) for a wider sample of universities. However, this only means that these marginal patenting and licensing activities are less profitable, not that they are not profitable at all.

Has Bayh-Dole changed the composition of research? The economic literature has not provided a satisfactory answer to this question. Some indication is given by two patent quality measures (introduced in Henderson *et al.*, 1998):

- "Importance": the number of times other patents cite the patent within five years after the patent has been granted. This is a useful proxy for spillovers;
- "Generality": the extent to which citations come from patents in different patent classes. University patents tended to be both more important and more general than industrial patents in the 1970s, but the difference had disappeared since the mid 1980s. This change does not apply to all universities: the importance and generality of Stanford and UC patents has not declined relative to industrial patents, and the importance may even have increased (Mowery and Ziedonis, 2000). At universities where the change does apply, it may reflect both a change in the composition of research underlying the patents, and a change in the propensity to patent (and thus a trend toward patenting inventions of lower quality). The relative importance of these alternatives is still an open question. All in all, these analyses do not yield conclusions about the research agenda.

Zucker and Darby (1998) suggest that closer ties to industry do not necessarily deter basic research by the academic researchers: commercial activities of top-researchers may increase their scientific productivity. They find evidence of this mechanism for top-researchers in the

field of biotechnology. Top-researchers at universities who perform research and write articles with researchers from firms in their region produce significantly more articles in these periods. Furthermore, the number of citations to these papers, a measure of quality, does not decline, and even increases significantly for scientists who are affiliated with a firm (which they have frequently started themselves). According to Zucker and Darby (1998), this positive effect on research productivity should be attributed to the habit of scientists to partly use the revenues from commercial ties to advance their scientific career. Another mechanism through which industry scientists stimulate academic research productivity is by providing a different perspective on a problem and suggesting refinements of experiments (Siegel *et al.*, 1999). It is not yet clear whether these findings are specific for the biotechnology field, where basic and applied research are hard to separate, or whether they apply more generally. Ongoing work of Zucker and Darby on similar studies for semiconductors and interactive media may reveal to what extent their conclusions generalise to other fields of research.

The effect of patenting activity of universities on secrecy has not been studied empirically. There does, however, exist a lot of "anecdotal evidence". The effect is likely to depend on the design of the license agreements and the rules for sharing the revenues. For instance, universities and academic staff are more likely to give in to acts of secrecy when they accept equity shares in start-ups as opposed to cash payments for patents and licenses.

7.4.2 Co-operative research centers

We now turn from patenting policy to the programs for collaborative research between universities and firms (and frequently also government laboratories), especially the NSF-programs.

There have been several official evaluations of the NSF-programs, which have been rather favourable to continuation. NSF (1997) has reviewed the effects of the ERC program of the NSF. The major input of the evaluation study has been a survey among the employees of firms participating in the program that were most closely involved with the centers. Overall, the 355 respondents were positive about the effects of center membership, although the outcomes differed between centers. Outcomes improved with the length of center membership and with the active involvement of industry researchers, articulating the importance of tacit knowledge. Interestingly, the share of industry representatives reporting to have little or no influence on the research agenda is 31%, compared to 16% in 1988.

The evaluation of the STC-program in 1996 is also positive (Fitzsimmons *et al.*, 1996), and even provides some quantitative evidence. Bibliometric data reveal that the STC-program as a whole has compiled a creditable publication record. STC-articles were cited 1.69 times as often as the average US academic paper for the same journals for the same years. STC-papers achieved especially high relative citation rates in physics, biomedical research, and engineering and technology, with the average citation rates of center papers exceeding the norms in these

fields by factors of almost 1.8. Analysis of the centers' 1989-1995 papers revealed that as a group the centers are publishing in journals with a somewhat higher impact than the average journal. STC-papers in mathematics and chemistry have unusually high representation of industrial organisations in their authorship, and STC-papers overall have relatively high industrial representation among citing organisations.

The first (and very recent) econometric analysis of the effects of IUCRCs is Adams *et al.* (2000b). They find that UICRC laboratories are 2.5 times larger than private laboratories that do not participate in a UICRC, and are more science-oriented. This suggests that small firms are less likely to benefit from UICRCs. They also find that IUCRC-membership is positively related with private laboratory patenting, and with private R&D expenditures. Their analysis does not allow firm conclusions, however. First, the effects are rather small. Second, the effects are not always statistically significant. And finally, more effort needs to be put in identifying to what extent IUCRCs actually cause an increase in industry-university technology transfer. The effects that are found may also result from the fact that private labs that perform more R&D and produce more patents are also more likely to participate in IUCRCs.

Evidence of the effect of the co-operative research centers on the academic research agenda is also scarce. Cohen *et al.* (1994) find that most university-industry engineering centers tended to focus on relatively short-term research problems and issues faced by industry, at the cost of productivity in terms of academic papers. Together with the increase in the number of centers this might indicate a shift in the overall research agenda. On the other hand, Fitzsimmons *et al.* (1996) find that STC-papers tend to be published in journals oriented more toward basic than applied research. There is no evidence that STC-research is tilted toward the applied end of the spectrum compared to the average papers in the centers' respective fields. Clearly, the picture is diffuse. And maybe more important, a causal effect of participation in co-operative research centers on the research agenda can not really be concluded from these data. The finding of Cohen *et al.* (1994) might also be explained by the fact that universities that have always been more focussed on applied research now undertake this research in the context of co-operative research centers.

Recent evidence of restrictions on the disclosure of research results is more pervasive. In reaction to mounting anecdotal evidence of secrecy, Blumenthal *et al.* (1997) mailed a survey in 1994-95 to 3,394 life-science faculty in the 50 universities that received the most funding from the National Institutes of Health in 1993. The responses by 2,167 US life-science researchers indicate that withholding of research results and publication delays were significantly associated with participation in academic-industry research relationships and engagement in the commercialisation of research. On the other hand the responses indicate that practices of secrecy were not (yet) widespread, although underreporting may have taken place.

The review of collaborative research by Cohen *et al.* (1998) provides some indications for secrecy at research centers. Cohen *et al.* have asked respondents at IUCRCs about the policies

regarding restrictions placed on publication and informal communication, and about the prevalence of restrictions on sharing information with internal and external peers and the public in general (see Table 7.3). The responses indicate that secrecy occurs, and is more likely at centers that consider contributing to industry's productivity as part of their mission.

Table 7.3 Research disclosure at US university-industry research centers

	% of all centers	% of centers committed to industry	% of centers not committed to industry
Information can be deleted from publication	34.8	44.7	22.2
Publication can be delayed	52.5	58.7	47.3
Both restrictions are possible	31.1	39.9	19.7
Ever restricted in sharing information with faculty within the university	21.3	27.0	14.0
Ever restricted in sharing information with faculty at other universities	28.6	35.6	17.8
Ever restricted in sharing information with the general public	41.5	48.9	30.6

Source: adapted from Cohen *et al.* (1998).

The figures might indicate that an increase in the share of researchers and institutes that collaborate with industry will lead to decreasing public dissemination of research results. But it might also simply indicate that currently those researchers and institutes that are more willing to forgo open disclosure are also more likely to enter into collaborations with industry. Increasing the level of university-industry collaboration might then only be possible by inducing researchers that are less inclined to give in to requests of secrecy to collaborate with private firms. In this case, the larger number of collaborations may increasingly concern more basic research and less secrecy. We have not seen any data providing insight in the development of open disclosure versus secrecy through time, however, which makes it hard to infer a causal relation with US policies.

It is important to note that the figures do not give a complete picture of the importance of secrecy. The first three rows in the table concern the policy of research centers, and not the actual incidence of restrictions. The last three lines show whether communication restrictions have ever been imposed, and not how frequently. Both these caveats suggest that the figures overestimate the problem of secrecy. On the other hand, faculty participation in firms and university spin-offs is not considered in the surveys, which probably causes the figures to underestimate the extent of secrecy and delay accepted by faculty.

Concluding, the US policies toward academic patenting and toward cooperative research centers seem to have been effective in increasing the knowledge transfer from academe to commerce and the commercial application of academic research findings. Satisfying empirical analyses are hard to find, however (especially concerning the research centers). Consequently, it has been

difficult to be precise about the effectiveness of these policies. For instance, the introduction of Bayh-Dole was followed by a number of other changes working in favour of knowledge transfer. This may have resulted in an overestimation of the effects of Bayh-Dole. That Bayh-Dole has had an effect is beyond doubt, however.

What about the drawbacks? Distortion of the research agenda and, especially, the incidence of secrecy, have featured prominently in recent discussions about US transfer policies. Are these concerns supported by empirical evidence? One conclusion is that there do not exist satisfying empirical analyses on these issues as well. The increase in secrecy seems to be supported empirically, but the evidence is still weak and the extent of the problem does not become clear.

8 The Dutch higher education system: options for policymakers

Erik Canton and Richard Venniker

This chapter draws upon the conclusions in previous chapters in order to answer the question: what can be learned from international experiences, and what are the options for Dutch policymakers to get the incentives right?

8.1 Tuition fees

Tuition fees are the private contributions to a training program. Two (interrelated) issues with respect to tuition fees stand out:

- Splitting the costs of higher education between public contributions and contributions from students;
- Deregulation of tuition fees.

8.1.1 Public versus private contributions

The first issue is about the efficient and equitable distribution of educational costs between public and private contributions. This is one of the key issues in our discussion of the Australian HECS in Chapter 3. In principle, public contributions can be justified from imperfections in the higher education market (*cf.* Chapter 2). For instance, when knowledge spillovers lead to under-investment in higher education by the private sector, the government may try to establish a more efficient level of investment through subsidisation. At the same time it should be noted that this may be an expensive policy, as students hardly seem to be responsive to financial incentives (*cf.* Chapter 3). In fact, a large proportion of the student population would have enrolled in higher education even without any public subsidisation, so for this group taxpayers' money is not spent in an effective way. Furthermore, it can be questioned whether such a policy is equitable, as it implies an income transfer from today's average taxpayers to tomorrow's well-off graduates.

Subsidies may be needed to preserve access to higher education. However, the Australian case (Chapter 3) showed that access can also be guaranteed without expensive generic public support. A student loan scheme combined with income-contingent repayments enables students to pay for their tuition fees, while repayment of their debt starts when the benefits – in terms of earnings after graduation – show up. In this scheme, students do not have to worry about repayment in case of insufficient income due to unemployment, sickness or other special circumstances beyond their control, because repayment rates are directly linked to graduate income.

Finally, it has been argued that government support to higher education could help to reduce income disparities in the economy (*cf.* Teulings, 2000). The idea is that the skill-premium will be reduced when there are relatively more skilled people in the labour force. As a consequence, wages will go down for skilled workers and up for unskilled workers (other things being equal). However, income redistribution along this mechanism (instead of through progressive income taxation) may be rather ineffective, again because students do not seem to be very sensitive to tuition fee levels so that substantial public support is needed to raise enrollment. In addition, the effect of an increase in the supply of high-skilled workers on the skill-premium is uncertain. Some even claim that there is a perverse relationship between the supply of skilled labour and the skill-premium: an increase in the supply of high-skilled workers could be accompanied by an *increase* in the skill-premium (*cf.* Acemoglu, 2000; Nahuis and Smulders, 2000).[1] Finally, little is known about substitution-possibilities between high-skilled and low-skilled workers.

By-and-large, the arguments for substantial generic subsidisation of higher education are not very convincing. In the Netherlands, about 80% of the direct cost of higher education is paid by the public sector. Nonetheless, the empirical case for human capital spillovers is weak (*cf.* Chapter 2). And in combination with the fact that most students are not very responsive to changes in tuition fees, we are inclined to conclude that private contributions could be increased without reducing access. But we hasten to add that little is known about the price responsiveness of students in case of more than marginal changes in tuition fees, so increases in private contributions will have to be incremental and the students' responses should be monitored carefully.

Policy option: Replace part of the public subsidies to the higher education sector by private contributions.

A natural starting point to implement such a shift toward higher private contributions would be to replace the grants in the student support system by loans.[2] The common counterargument to such a policy change is that Dutch students are debt averse, and often prefer to take a part-time job instead of a student loan. This may have negative effects on study performance. However, the "debt-aversion" phenomenon often vanishes into thin air once students have graduated. The observed reluctance to borrow could also be due to the characteristics of the Dutch student loan

[1] The intuition is that an increase in the supply of skilled workers also fosters demand for these skilled employees. In Nahuis and Smulders (2000) the key assumption behind this result is that skilled labour is employed in non-production activities that both generate and use knowledge. In that case, skill premiums may rise with the supply of skilled labour when knowledge spillovers are not too strong.

[2] Note that this would remove the performance-contingent character from the student support system (the debt no longer depends on study performance). But there are other ways to encourage students to finish their study, *e.g.* institutions could ask deposits at the moment of entrance which are returned to the students after graduation.

system. Recall from Chapter 1 that the repayment of student loans in the Netherlands is characterised by a grace period of two years after graduation, a minimum monthly installment of Dfl.100, and a maximum repayment period of 15 years. Any remaining debt after 15 years is acquitted. This essentially makes the student loan system similar to a mortgage-type system, and students may perceive this as problematic. A prolongation of the repayment period may help to spread the repayment burden. As graduates will benefit from higher education during their entire life, and their salaries typically rise with age, this increased flexibility could bring the repayment system more in line with individual preferences. Automatic repayments through an income-contingent scheme administered by the tax authorities may facilitate the debt repayment. It also prevents people from falling into such "embarrassing" situations as a means test to request a temporary reduction or halt of monthly installments.[3] Finally, payments through the tax system are not as visible as out-of-pocket payments. This characteristic might help to make loans more acceptable to students.

Policy option: Let student debt repayments be based on an automatic income-contingent repayment scheme, where minimum monthly installments increase with income. Loans can be repaid through the tax office (*Belastingdienst*).

A final comment is in order. When the maximum repayment period is extended (to about the length of the graduate's working life) and monthly installments are income-contingent, the system has features in common with a graduate tax system. An important difference between graduate taxes and loans with income-contingent repayment is that actual study costs do not matter for individual private contributions in the former system (when the graduate tax rate does not depend on subject), but costs do matter in the latter system (students attending an expensive program end up with a higher debt). In addition, under a self-financing graduate tax system, solidarity is imposed between those who attend higher education: successful graduates pay for those who dropped out or are unable to repay their debt. And in the Australian student loan system with income-contingent repayments, the default risk is borne by society. But in intermediate versions of both systems, the default risk is shared between the former students and society.[4]

[3] It should be noted that an income-contingent repayment schedule with high marginal tariffs for people with a low income could lead to a poverty-trap. This is counterbalanced in the Australian system by linking repayment *rates* to the graduate's income: repayments start at a relatively low rate, and repayment rates increase with income.

[4] We leave a more elaborate discussion on the incentive structure of a loan system with income-contingent repayments versus a graduate tax system for future research (the reader is referred to Van Wijnbergen (1998), García-Peñalosa and Wälde (1999), and Jacobs (2001)).

8.1.2 Deregulation of tuition fees

Deregulation of tuition fees has at least two advantages. First, institutions could charge higher tuition prices for more expensive study programs. This will lead to a more efficient choice of programs (as students are confronted with cost differentials[5]).[6] Second, tuition fee deregulation facilitates quality-differentiation (see Chapter 4). Higher education institutions engaging in competition to strive for excellence in teaching and / or research are more costly as these institutes have to offer competitive salaries to attract the best staff. Because students will benefit from attending high-quality programs[7], there is no reason why students should not pay (part of) the additional costs.

At this moment, the Dutch government regulates tuition fees for regular full-time students. However, higher education institutions have recently been allowed to set differentiated fees for students not eligible for public student support (*e.g.* part-time students). As was shown in Chapter 1, most institutions do make use of this policy instrument and tuition fees for part-time students vary up to 30% across universities.

Opponents of tuition fee differentiation fear that parental income will (again) determine access to higher education. However, the experience with tuition fee differentiation in Australia has shown that this fear is not justified when a well-designed student support system is in place (*cf.* Chapter 3). In order to gradually introduce differentiated tuition fees in the Netherlands, an option would be band-width tuition fees.

Policy option: Permit institutions to set their own tuition fees within some price range specified by the government.

It is important to note that deregulation must not come at the cost of transparency. Information on tuition fees and program quality should be readily available to students. If higher education institutions do not provide this information in a suitable form, the government may need to intervene.

An additional comment is in order. Tuition fee differentiation could refer to price differentiation across institutions but also within the higher education institution. This means that *net* tuition fees may vary between students in the same institution and program. In this respect we would like to point to the notion of cross-subsidisation between students as applied

[5] Though we would expect that students are not very responsive to tuition fee differences across subject areas, as tuition fees only form a minor component of total cost (compared to forgone earnings).

[6] When more expensive study programs generate larger social benefits, the government may decide to directly support the programs in question (if tuition fee differentiation leads to a reduction of cross-subsidisation of these disciplines). This could be the case for *e.g.* science, engineering or medicine.

[7] Dale and Krueger (1999) demonstrate that the average tuition price is significantly related to the students' subsequent earnings.

in the US (*cf.* Chapter 4). In particular, tuition fee revenues can partly be used to support the needy students.[8] Because support is targeted at those who need it, such a policy could actually lead to an *increase* in student enrollment when gross tuition fees are increased.[9] This would strengthen the case for the policy option (proposed in Section 8.1.1) to raise private contributions.[10]

8.2 Admission

In Chapter 4 we observed that the best universities in the US adopt the most selective admission policies. In competing for students, quality-differentiation would be promoted when institutions have the freedom to adopt admission strategies supportive to their mission.

The Dutch open enrollment policy ensures that many people can attend a higher education program.[11] However, open admission also has its drawbacks. First, providers cannot differentiate themselves by means of selective entry policies. When educational quality and selective entry are interrelated, higher education institutions could be restricted in their strive for excellence if they have to accept all applicants. Second, under an open enrollment policy, errors will be made because less-qualified students are also admitted. The presence of these students in the classroom may very well reduce effective teaching time, thereby negatively affecting educational quality (*cf.* Lazear, 1999). These are two arguments in favour of selective entry.

However, a major difficulty with student selection is that admission criteria have limited predictive value: in some cases well-qualified applicants may fail the entrance exam, while in other cases unsuitable people may pass. Empirical research should provide the answer on how large these errors are. The only Dutch study we are aware of is Mellenbergh (1995), reporting on an experiment with selection tests among first-year psychology students at the University of Amsterdam. It was found that 6% of the students are wrongly rejected (type I error) and 21% are

[8] This also raises the question whether the student support system needs to be decentralised in the Netherlands. We leave this issue for future research.

[9] Note that, to some extent, student support is targeted at the needy students in the Dutch system. But targeted student support is not used as an instrument in connection with admission strategies, like in the US.

[10] When support is merit-based, higher tuition fees may discourage poor and below average talented students who are not eligible for substantial discounts. If these students have access to student loans and rates of return to educational investments are large enough, their participation in higher education may not be endangered. However, private rates of return to higher education will be lower for this group than for equally talented rich students who receive financial support from their parents. Perhaps some kind of additional financial support for this group of students is needed, though this may lead to poverty traps. This issue is left for the future research agenda.

[11] As we have seen in Chapter 1, a few fields of study for which a *numerus clausus* applies (*e.g.* medicine) recently received some room for student selection in the Netherlands (*cf.* Van der Bijl, 2001).

wrongly admitted (type II error).[12] In the present situation of open admission, on average 40% of the university students drop out and about 30% of students in HBO-programs leave before graduation. Although the numbers are not directly comparable, it seems that drop out rates in an open admission regime are substantially larger.

To gain more insight into student selection, and the willingness to make use of it, we suggest the following experiment.

Policy option: Permit institutions to select a certain percentage of their new students. Evaluate the outcomes after a number of years (say, 5 years). Increase this percentage if the evaluation is positive, otherwise abolish student selection.

The proposed form of student selection could be implemented by exposing all students to an admission test (designed by the institution). Higher education institutions are permitted to select a certain percentage of their students on the basis of this admission test. In case of study programs which now have open admission, all students that do not pass the admission test would also be admitted. When a *numerus clausus* applies, the remaining student slots are randomly assigned. If it is believed that the less talented students do not take the admission tests seriously (because the outcome of this test does not have any negative consequences), some kind of tuition fee discount connected to the individual test scores could be offered. In this set-up, information is collected on type I and type II errors in conjunction with student selection, and type II errors under open enrollment. Selection is successful if the costs associated with these errors are smaller than the costs associated with type II errors under open admission.

Note that in this experimental set-up, no information is collected on the effects of selective entry on educational quality as all applicants are admitted. In other words, our experimental set-up is blind to customer-input effects, *i.e.* the fact that student performance is influenced by interactions between students. In particular, the presence of less talented students could negatively affect the performance of the other students. This would suggest a possible upward bias of type II errors connected with student selection.

8.3 Public funding of teaching

In Chapter 5 we studied the pros and cons of the Danish taximeter-model in which the government allocates teaching grants to each institution based on the educational achievements of its students: funding is based on the number of passed exams. While the taximeter-system

[12] By "wrongly rejected" Mellenbergh refers to persons who are not admitted but who would pass at least ¾ of their exams after the first year (measured in credits); "wrongly admitted" refers to admitted students who pass less than ¾ of the exams in the first year. In this definition, there is no direct connection with actual drop outs so comparison between open admission and student selection is hampered.

allows for more financial flexibility, the Danish experience also shows that financial flexibility is not a *sufficient* condition for competition. In Chapter 5 we stated that there is no compelling evidence that competition in the higher education sector has become more intense after introduction of the taximeter-system. More generally, flexibility without consumer choice (supported by diversity and information) will not result in the desired increase in competition between higher education institutions. In addition, the fact that study programs are to a large extent indivisible is another reason why student mobility during a program is limited.

It is sometimes claimed that a taximeter-system is something in between the present Dutch funding structure and a voucher-model (*cf.* OCenW, 2000b). In a pure voucher-system students can choose whether to attend a public higher education program or to buy their higher education from private providers. But it is a fallacy to argue that this type of flexibility calls for a voucher-system or an incremental output-based funding model like the taximeter-system. The present output-based funding model can also be applied to the fully private higher education institutions, and this would encourage new providers to enter the higher education market.

An important advantage of the Dutch funding model, where "the price is paid at the end of the ride", is that it provides institutions with strong incentives to dismiss incapable students as soon as possible, and to assist capable students in graduating without unnecessary delay. In the wake of the Bologna-agreement and the implementation of a two-cycle structure, the Dutch government is rethinking the funding structure for the higher education institutions. In particular, the Ministry of Education is considering the introduction of a new funding model for the HBO-sector closely resembling the Danish taximeter-system. However, from the above discussion we are inclined to conclude that the current output-based funding system needs no substantial revisions, and could be maintained under a two-cycle program structure.

Therefore, universities and HBO-institutions may be funded on the basis of the number of Bachelor- and Master-degrees conferred. For the Master-program, current policy proposals envisage that institutions will be granted more freedom to set tuition fees and to select their students. It is therefore likely that differentiation in training programs will predominantly take place at the Master-level. A natural moment for students to switch to another institution is between the Bachelor- and Master-phase.[13]

How much should the government contribute to the Bachelor- and Master-program, respectively? The popular view nowadays seems to be that the Master-program should be

[13] To foster competition for Master-students, the government could consider to (partly) reimburse the cost of moving when students decide to do their Master's at another institute (as an alternative to the public transport pass (*OV-studentenkaart*)). This would promote student mobility (switching costs are reduced).

financed privately.[14] However, research-oriented Master-programs preparing students for a Ph.D. may yield social returns that substantially exceed private returns. These programs deliver the scientists and innovators of tomorrow. As this argument may be less valid for Master-programs with a professional (or vocational) character, public support could be targeted at specific programs which are expected to yield substantial spillovers.

A related argument to target public subsidies at research-oriented graduate programs is due to Romer (2001), who suggests to offer generous fellowships to promising young students in natural sciences and engineering.[15] The idea in Romer is that when the supply of scientists is inelastic, government subsidies to foster R&D would result in higher wages for R&D workers, and thereby crowd-out the intended positive effects in terms of volume of R&D workers. Therefore, it would be more effective to encourage the supply of R&D workers, by making it more attractive for students to choose a research-oriented graduate program. This connection between science policy and R&D policy, and the implications for government support to certain fields of study is an interesting topic for future research.

Policy option: Provide public support to Master-programs (or Master-students) in those disciplines from which substantial spillovers to society can be expected.

8.4 Public funding of research

In Chapter 6 we have studied the way core public research funds are allocated to the universities in the UK. The UK funding authorities allocate the core funds by means of a performance-based mechanism, based on the so-called Research Assessment Exercise (RAE). This output-based research funding system has been in place from the end of the 1980s, and the lessons learned since have been used in perfecting the design of the system. The system seems to have been beneficial to research output. Apparently the positive effects from a better-informed allocation of research funds and the explicit incentives for research effort outweigh the negative effects of a loss of intrinsic motivation of researchers and increased tendencies toward secrecy about research results. Potential drawbacks of the system that were widely discussed, like the

[14] Advocates of privately financed graduate programs may argue that credit market imperfections are less of a problem for Master-students, while Bachelor-students typically face substantial difficulties in obtaining loans from commercial banks. However, as we have discussed in Chapter 2, these credit market imperfections do not call for government subsidisation: the provision of student loans by the government helps to solve the capital market imperfection.

[15] This idea finds support in the data. For instance, Goolsbee (1998) finds for the US that a 10% increase in R&D expenditures translates into a 3% wage increase for R&D employees. For the Netherlands, Marey and Borghans (2000) find that a 10% increase in R&D expenses induces in the short-run a 5% increase in hourly wages of R&D personnel. See also Cornet (2001) for a discussion of this issue in the context of the WBSO (*Wet Bevordering Speur- en Ontwikkelingswerk*).

"frenzied" academic transfer market and the bias against young researchers, receive no empirical support.

What lessons can be learned for the Netherlands? The largest component of the Dutch universities' public research funds is direct institutional funding, the so-called first flow of research funding. This first flow is not based on evaluations of research output, but is basically an extrapolation of historical patterns in research funding. Although research assessments do take place in the Netherlands for every scientific discipline at regular (4-5 year) intervals, the outcomes of these assessments are not incorporated into the funding decisions of the Ministry of Education.[16]

The mechanical way of allocating the largest part of the research budget to universities gives rise to a priori doubts about the efficiency of public research funding. These doubts receive some support from bibliometric data about scientific productivity. Although the data often point at a high productivity of Dutch academic researchers, they also reveal that the UK outperforms the Netherlands on several indicators of research productivity (SPRU, 2000). For example, in 1997 the UK produced 16.0 papers per million "research dollar", while the Netherlands produced 10.3 papers. Also measured by the number of citations per million research dollar the UK was more productive than the Netherlands: 70.5 citations versus 48.7. Of course one should be very careful in drawing conclusions from these general figures. In combination with the historical determination of the research budget allocation the data at least suggest to seriously consider the following policy option.

Policy option: Strengthen the link between research funding and research performance. Two possibilities (or a combination of them) can be considered:
1. Create a direct link between first flow research funding and the results of research assessment exercises.
2. Increase the amount of project-based and individual-based research funding (the second flow of research funding) at the expense of the first flow of funds.

The first possibility, a stronger link between research performance and core funding in the Netherlands, may entail a drastic change. The effect on the distribution of funds between universities could be large, given its historic determination up to now. Hence introduction, if it takes place at all, should proceed carefully. The costs of setting up an evaluation process are likely to be limited, since the Netherlands is one of the few countries that already assesses the quality of academic research.

[16] However, open dissemination of the outcomes may affect the reputation of universities, and thereby influence the incentives to increase the quality of research.

To the extent that the first policy option is implemented, interesting lessons can be learned from the UK. First, transparency of the funding system and the evaluation exercise is very important. In the UK this has contributed to the current, rather broad, acceptance of the system, and it has led to several improvements. Second, the amount of research output that is subjected to the research assessment can be limited. In the UK no more than four items of research output per researcher are evaluated. This limits the incentive to write a lot of mediocre research articles instead of a few outstanding papers. Third, incentives for research and education should be well balanced. Although the RAE has been said to have reduced the attention paid to the quality of education, convincing empirical support for such a negative effect does not exist. And even when the effect does occur in practice, linking the outcomes of the Teaching Quality Assessment to education funding may prevent this diversion of attention away from teaching.

Nevertheless, some improvements to the RAE may be possible. One possible improvement relates to the recent change in the RAE-system toward using the quality ratings also for the allocation of research funds *between* the scientific disciplines, albeit in a less influential way than for the distribution *within* scientific disciplines. This raises the question of the comparability of research output between disciplines. The large differences in average ratings between different disciplines raise some doubts about this comparability. These may be real, but may also reflect different perceptions of national and international excellence between review panels. Whether it is desirable to let social relevance of research play a role in the allocation of funds between disciplines is still an open issue, and cannot be settled on the basis of information from the RAE. Although it has been suggested as one of the changes for the next RAE, it will not be implemented.

The second, or possibly complementary, policy option is to increase the relative importance of project-based or individual-based funding. In other words: allocate a larger share of the public research budget to research proposals and individual researchers. This so-called second flow of funding is relatively small in the Netherlands compared to the US and most European countries. Like RAE-style funding, it introduces more competition between researchers for research funds. An advantage of the second flow of funding is the larger flexibility in the allocation of research funds. It is easier to redirect research to new scientific opportunities or target the funds directly at specific researchers who hold great promise to produce new and innovative research.

However, the second flow of funding is not without its own problems. A possible disadvantage relates to the integrity of peers when assessing the research proposals and research ability of fellow researchers and advising or deciding on acceptance or rejection of proposals. Anecdotal evidence of misconduct in this respect surely exists.[17] An implicit "agreement"

[17] This possibility of misconduct is not limited to project funding. It also applies to the peer review process of the RAE and to decisions like acceptance of papers for publication.

between peers about a "fair and even" distribution of research funds may undermine the potential competitive nature of project funding. One possible way to correct for this mutual dependence of academic researchers without affecting the essence of project funding is to give foreign researchers a say in the judgement of research proposals. Another disadvantage is that research frequently takes a different route than the one foreseen in research proposals. This makes one doubt whether proposals are indicative for the quality and the novelty of the subsequent research. Moreover, the writing of proposals is a time-consuming business, although it may also be seen as part of the first face of the actual research. This disadvantage relates primarily to project funding, and argues more in favour of individual-based funding primarily based on past performance. This is rather similar to the RAE-system, but is focussed on the level of individual researchers instead of on academic departments.

8.5 Public-private cooperation

Chapter 7 distilled some lessons from US policy toward university-industry interaction in the area of research. The chapter focussed on two types of policies: the government's patenting and licensing regulations concerning public research, and the subsidisation of university-industry co-operative research centers. These policies are likely to have stimulated knowledge transfer from academe to commerce, although the empirical evidence is not very strong. Two potential drawbacks of closer ties between universities and industry have been heavily debated: (1) a distortion of the research agenda towards short-term research at the cost of fundamental research, and (2) too many limitations on the open disclosure of the results of public research. Satisfying empirical analyses on these effects hardly exist. The empirical evidence that does exist relates to the dissemination of public research results, and tends to confirm the tendency towards secrecy.

What are the lessons for the Netherlands? Dutch universities are currently allowed to obtain patents on publicly financed research. However, the patenting activity of Dutch universities is not high. Some universities do see patenting and licensing as one of the mechanisms for knowledge transfer, but other universities consider it a violation of the principle of open science. In many cases Dutch universities leave the process of applying for a patent to private firms (SEO, 1998).

First, we remark that it is not in the public interest when universities consider raising revenues from patents as a main goal, and adjust their research efforts towards this goal. The goal of patenting by universities should be to prevent private firms from obtaining and financially exploiting a patent on research findings with a large social value (think of the Cohen-Boyer patent on gene splicing, which has been tremendously important for subsequent research), or to stimulate the transfer of commercially interesting research findings that result

as a by-product of the academic research. From this perspective, the low profitability of patents by itself, which is a major reason why universities are somewhat hesitant toward patenting (SEO, 1998), is not an issue.

As discussed in Chapter 7, the potential negative consequences of more active patenting by universities on the research agenda and on the openness of science should be taken seriously. The existing empirical analyses on the practical relevance of these two drawbacks are limited in number, not very convincing, and tend to support the negative effect on the open dissemination of research findings. Given this caveat one should be careful in implementing policies that might affect the rather special scientific reward system that has existed for so many years. Hence the following policy option.

Policy option: Carefully stimulate universities to recognise the commercial value of research results and to implement a patenting and licensing policy. Strictly monitor the condition that the long-term focus and the open dissemination of knowledge are not impeded.

An option suggested by the US experience is to make the disclosure of inventions by academic researchers to technology transfer officers mandatory. Another possibility is to let public research funding not only depend on the number (and quality) of publications, but also on the number (and quality or social value) of patents. This is already allowed in the research assessments carried out by the VSNU in Dutch universities, but is not done systematically. A practical problem is how to weigh these patents (relative to each other and relative to other research outputs). For example, the commercial value of patents is not a good guide. It induces researchers (or technology officers) to maximise the commercial value of patents, which may go at the cost of spillovers and therefore the social value of the patents. Simply counting the number of patents does not induce researchers or university administrators to consider the social value of applying for a patent and put in effort to maximise this value as well. A final possibility to stimulate patenting is to lower the application costs by setting up a national office where the patenting and licensing of public research results from all universities is organised. In this way potential returns to scale may be realised, and the costs of patenting may be decreased. Closer examination of these possibilities, and their likely effects on secrecy and the research agenda, is needed before actual implementation, however.

The US experience might also suggest some regulations toward patenting that serve to mitigate the tendency toward secrecy. For instance, Rahm *et al.* (2000) suggest that secrecy is more likely to prevail when universities (and academic researchers) are paid with equity shares instead of cash money. On the other hand, this method of payment may stimulate the introduction of start-ups (*e.g.* by academic researchers), a way of knowledge transfer that may bring about spillovers through the subsequent research that is being done in these companies.

The analysis of the university-industry co-operative research centers does not give rise to strong suggestions for policy changes in the Netherlands. The policy focus on strategic alliances between universities and private firms, aimed at longer-term research and comprising several research groups and firms within each alliance (like the Technological Top Institutes (TTIs) and the Innovation Oriented Research Programs (IOPs)), is similar to the US policies towards establishing co-operative centers. Evaluations of these centers in the US have been generally positive, although very recent econometric analysis shows that a causal effect can hardly be concluded. Furthermore, a potential positive effect primarily concerns the larger and more science-oriented private research laboratories. And absent satisfying empirical analyses concerning excessive secrecy one should again be careful in stimulating university-industry cooperation.

8.6 Incentives in higher education; some final words

The higher education sector is a complicated one, with a myriad of stakeholders and a variety of different objectives. In this study we have tried to sketch the important issues in the debate on higher education. We discussed the various topics in separate chapters, but we emphasize that the different policy instruments should not be judged in isolation. Rather, a complete overview of the higher education system, comprising the key relationships between the different actors, is needed to understand its workings, and to think of new policy. With this book, we hope to have contributed to that full picture by studying the workings of specific instruments in various settings and across time.

One of these interactions was discussed in our analysis of the Danish performance-based funding model. The policy to promote competition between providers of higher education by introducing a financially flexible output-based model for funding higher education institutions turned out to be unsuccessful. Student mobility *during* the program proved to be at odds with student selection and quality-differentiation between higher education institutions. In another example of important interactions we pointed at the role of high-powered incentives in higher education. While such incentives in one direction (say, teaching) could distract efforts in another direction (research), complementarities between various activities may alleviate these crowding-out effects.

The higher education sector is one of the pillars of our knowledge economy. Therefore, it is important to increase our understanding of this complex system. Especially through learning from others we can increase our knowledge and contribute to improving the performance of the higher education sector. Hopefully this book contains some lessons and suggestions on how to get the incentives right.

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