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Qualitative Efficiency Assessment of Markets: An Institutional Approach to Training

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Abstract

We investigate the effect of institutions on efficiency of training markets. After setting up a theoretical institutional framework that shows how institutions affect efficiency, we apply this framework to the real world. An empirical analysis of institutions affecting training markets will enable us to determine the institutional efficiency of these markets, under the assumption that a positive relationship exists between efficiency and productivity. Finally, we compare institutional efficiency scores of national training markets to other measures of productivity and ask whether a particular set of institutions maximises efficiency.

keywords: institutions, vocational training, continuing education, labour markets, productivity, efficiency, production frontier

JEL classification: H3, H4, H5, I2 and J4

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1 Introduction

Many attempts have been made to measure productivity effects of training with no or unsatisfactory results. Those who succeeded in estimating significant positive returns to training usually limited their research to wage revenues (e.g. Mincerian wage equations) and ignored employers' shares in returns to training. Literature that proxies productivity by wages often ignores social returns to training as well. Others use sales as a proxy to output (Bartel (1991 and later); Lynch and Black (1995; 1996)), but data on actual output are rarely used. Usually, these approaches assume equality of marginal returns to labour and wages.

Too often, neoclassical theory is applied to research in the field of training, while interference by government and social partners is bound to bring about market distortions. An example is Becker (1964) who rejects every possibility of market failure and denies the occurrence of poaching and hold-up, the argument being that skills are either specific or general, rather then transferable. Another example is Mincer (1962 and later) who assumes that marginal returns to labour equal wage rates, leaving no scope for market failures on both training and labour markets. Yet, market failures do exist. Those who do recognise the existence of market failures, for example new (endogenous) growth theorists, often see market failures as a consequence of external effects and tend to overemphasise interference by the government as a remedy to fix them[1]. Yet, non-market failures have to be taken into account as well, together with tradeoffs between different institutional designs. This means that one needs to consider training within the institutional framework present in an economy. Furthermore, since institutional theory assumes the existence of market failures, one is not allowed to assume equality of wages and marginal productivity.

Therefore, an institutional approach can be a useful alternative to the neoclassical approach. Building forth upon existent so-called post-Beckerian literature (e.g. Acemoglu and Pischke (1998)), we postulate a simple theory of training with scope for market and non-market failures and a need for institutions to compensate for these failures.

This paper presents a qualitative method to determine the relative level of efficiency of a training market, relying on institutional theory. Before doing so, we need to select those institutions that are relevant to training markets, because the number of institutions that exist in an economy are seemingly indefinite. A number of criterions has to be satisfied for an institution to be relevant to the training market and as such to be included in our framework. Institutions have to be characteristic of their environment; be stable, i.e. exist sufficiently long to be effective; and exercise actual influence on economic behaviour with regard to human capital.

We will present a number of possible institutional characteristics of training markets. Each characteristic brings about particular effects, such as transparency of the market and budget accountability. Policy makers and other creators of the institutional environment of an economy have to be aware of these institutional effects because they affect dynamic, product, and cost efficiency. We will show that institutional design may imply a trade-off between different forms of efficiency.

[1] Husz (1998, p. 40) discusses the standard model for endogenous growth and shows that in such a model the accumulation of human capital is typically suboptimal, which makes a policy instrument for education necessary.

In an empirical investigation, we make a comparative institutional analysis by applying the theory to three training markets. We analyse institutions as observed on the German, Dutch and British training markets. First, we describe training policies in the three countries. This results in an overview, a profile, of national institutional environments with relevance to training markets. Once we have an overview of institutions present on the training markets, we classify these institutions in accordance with the theoretical institutional framework. We connect these observed institutions to efficiency as prescribed by the framework. In this way, we determine an efficiency score for each national training market. Although these efficiency scores indicate the rank of a country rather than an absolute measure of efficiency, the scores should predict economic performance of a country relative to other countries, in terms of productivity and returns to training.

As a final step, we compare these efficiency scores with several measures of human capital productivity, in an attempt to confirm our theory. The more efficient firms are, the higher their labour productivity is; the more efficient training institutes are, the more effective training is, in terms of returns to training and labour productivity. We expect to find a positive relationship between efficiency scores, which result from the institutional framework, and labour productivity, human capital productivity, and output elasticities of labour and human capital.

To compare institutional efficiency scores with other measures of efficiency, we calculate technical efficiency indices, using the thick frontier procedure. We apply this procedure to a production function, which is estimated from sectoral data. Our data include actual output, rather than a proxy, labour input, and several measures of human capital.

Accordingly the theoretical institutional framework and the comparative institutional analysis based on that framework, we claim that Germany has a generally efficient training market, whereas the Netherlands and the United Kingdom are relatively inefficient. The United Kingdom has a particularly low score on dynamic efficiency.

British technical efficiency as calculated from our econometric results, however, appears to be higher than German technical efficiency, whereas Dutch technological efficiency is even higher. Therefore, we tend to conclude that even though institutions facilitate well-functioning markets and institutions may affect productivity, there is no ex-ante efficiency maximising set of institutions.

2 Framework for Comparative Institutional Analysis

Before doing the actual analyses, we need to create a theoretical framework that defines the connection between institutions and returns to training. Before setting up the framework, we need to make a number of assumptions. First, people tend to create a virtually unlimited number of institutions, a relatively small number of which is actually relevant to the training market.

Second, most institutions consist of other institutions. This means that we can group institutions together into sets and still call these sets institutions. To distinguish the larger sets of institutions and other institutions that constitute them, we will speak of institutional characteristics and institutions. Institutional characteristics are sets of institutions that affect the functioning of the training market through equal mechanisms and can therefore be grouped together as one institution.

Third, the mechanisms through which institutions affect efficiency are called institutional effects and are distinguished from efficiency effects. We observe the following institutional effects: external flexibility, internal flexibility, transparency, diversity, internalisation of external effects, commitment, equity, economies of scale, accountability, and contractability. Some of these institutional effects can be directly traced back to the overview of training policy in paragraph 3. Most institutional effects are discussed in institutional literature such as CPB (1997), Hassel and Rehder (2001), Williams (1999), Dercksen et al. (1993), Vrancken and De Kemp (1996), Stevens (1996), Kessler and Lülfesmann (1999), Williamson (1985, 1996) and Teulings and Hartog (1999). For a more extensive discussion of institutional effects, we refer to Schonewille (forthcoming, chap. 2).

Fourth, although institutions are usually designed to lift market failures, they often cause new inefficiencies, which we call non-market failures[2]. When creating new institutions, policy makers have to be aware of these side-effects. Since lifting market failures enhances efficiency while new non-market failures cause inefficiency, there is a trade-off connected to every institution.

Fifth, efficiency can be considered in three different ways. There is dynamic efficiency, which considers investments aimed at future returns. There is also allocative efficiency, which determines whether inputs are allocated over production possibilities in such a way as to maximize output. The third type of efficiency is cost efficiency, meaning that a given amount of output is produced with a minimum amount of resources. Efficiency effects are the result of institutional effects and determine the values of the three types of efficiency.

Table 1 **Relations between institutional effects and three types of efficiency**

Institutional effect	Efficiency		
	dynamic efficiency	allocative efficiency	cost efficiency
external flexibility	-	+	o
internal flexibility	o	o	+
transparency	+	+	o
diversity	+	o	o
internalising external effects	+	o	+
commitment	+	o	+
equity	-	-	-
scale economies	+	-	o
accountability	o	+	+
contractability	+	+	o

- negative relation; + positive relation; o no (clear) effect

[2] The existence of trade-offs between different institutional designs due to market failures and non-market failures is one of the basic assumptions made by CPB (1997).

The relationships between institutional effects and efficiency are discussed by Schonewille (forthcoming). External flexibility facilitates exchange of labour units between firms. Internal flexibility enhances job mobility within the firm. Transparency makes information about training and qualifications easier to obtain and thus reduces risks involved in investments in human capital. Diversity causes a "survival of the fittest" and enhances competitiveness, and thus investments, as long as "the fittest" is not a monopolist. Internalisation of external effects makes investors aware of the actual cost of their investment, meanwhile allowing them to claim all returns. Commitment reduces risks involved with investments and reduces information asymmetry. Equity reduces competitiveness and cost-awareness and usually is a political rather than an economic choice. Scale economies directly increase the returns to an investment. Contractability reduces risk involved with an investment. Non-contractability is a consequence of information asymmetries, which cause non-transferability of skills (Stevens (1996) and Schonewille (forthcoming)). Increasing transferability affects job mobility positively. Table 1 gives an overview of the connection between institutional effects and the three types of efficiency.

Table 2 Institutional effects on the labour market

	External flexibility	Internal flexibility	Inter-nalizing external effects	Commit-ment	Contract-ability
Qualifications					
Clear definitions at national level	+	+	-	+	+
Restriction in qualification system	+	-	-	+	o
Contents					
Relative influence employees/employers	+	-	-	+	+
Control & guarding of examination standards	+	o	-	+	+
Quantity					
Obligatory participation of firms in programmes (e.g. training funds)	o	o	+	o	+
Public finance of job-related training	+	-	+	-	o

o no effect; - negative effect; + positive effect.

Tables 2 and 3 show the institutional effects of every institution that we distinguish on the training and labour markets. Table 2 contains the institutions that are relevant to employee-employer relations. Table 3 contains those that are relevant to educator/investor relations. Investors can be employees and employers.

The institutions included in the tables are the result of theoretical and empirical analyses (Schonewille (forthcoming)). An institution is only relevant if there is a theoretical, or hypothetical, connection with efficiency and empirical research shows that the institution actually exists on the labour or training market of a country.

Table 3 Institutional effects on the training market

	Transpa-rency	Diversity (e.g. method)	Equity	Scale economies	Ac-count-ability
Qualifications					
Clear definitions at national level	+	o	o	o	o
Restriction in qualification system	+	-	+	+	o
specialisation of institutes	+	-	o	+	o
Contents					
Control & guarding of examination standards	+	-	o	+	+
Quantity					
Obligatory participation of firms in programmes (e.g. training funds)	+	o	o	o	o
public finance of job-related training	+	-	+	+	-
Organisation and finance					
merging institutes	+	-	+	+	-
price competition	o	o	-	-	+
output-based finance	o	o	+	o	+
lump-sum finance	o	+	+	o	+

o no effect; - negative effect; + positive effect.

Clear definitions of qualifications mean that the qualification system is not inconsistent and that everybody, especially employers and trainees, can understand the definition of every qualification. Restrictions imposed on the qualification system prevent the number of qualifications growing unlimitedly and keep the market transparent. Specialisation means that individual institutes offer a limited number of qualifications and courses. Employees having a say in business decisions, including investment in training and personnel policies, may strengthen the career-based nature of investments in training and prevent skills from becoming very task-based. Control over examination standards makes sure that trainees obtain the skills in accordance with the definitions of qualifications. Firms being obliged to finance and participate in sectoral or national training schemes reduces free riding effects, poaching, and offers a solution to the prisoners dilemma with respect to training investments.

Public financing has a positive effect on investments and uniformity of training, but may cause overinvestments and neglect special needs of firms. Moreover, firms are likely to exploit the public budget. Merging institutes directly enhance transparency and obviously have a positive effect on scale economies. Price competition reduces costs, because institutes are free to buy secondary services from the cheapest supplier and have to offer their training services at the lowest possible price as well. Lump-sum financing forces institutes to stick to the budget and to keep costs low.

Having selected institutions that potentially affect efficiency of labour and training markets, we can now combine the theoretical framework with an empirical analysis. We need to know to what extent these institutions actually exist in the countries subject to our research, Germany, the Netherlands and the United Kingdom. We do this by observing a number of institutional characteristics. These characteristics are derived from our empirical analysis and extensively discussed by Schonewille (forthcoming). Once we have determined the presence of institutions, we can link institutional presence and institutional effects to efficiency and calculate total institutional efficiency by country. The institutional efficiencies can be used as hypothetical values and are compared to more traditional efficiency measures to test the theory.

3 Two Decades of Training Policy

United Kingdom

The United Kingdom has a four decades history of vocational education and in-firm training. In 1964, the Industrial Training Act received the royal assent, which induced the establishment of a Central Training Council and Industrial Training Boards (ITBs). The ITBs had to foster training in individual industries. Government, employers organizations and labour unions had common responsibility in the central Training Council. Since every firm was free to pursue its own training policy, however, the designation “Central” is virtually meaningless.

In the 1980s and 1990s, attempts were made to enhance quality and quantity of vocational education and continuing training (CEDEFOP (1999)). These attempts aimed at a number of measures. First, more efficient allocation of financial resources, for example by establishing the Industrial Training Boards (ITBs). Second, stronger effectiveness by quality enhancing measures, such as accreditation of courses by means of the NVQ system and reformation of the executive Councils and Agencies. Third, more efficiency by means of financial incentives, for example achievement-related finance. These measures, however, have not removed the skills gap. Qualifications are still task-based and narrowly defined, while vocational qualifications at higher educational levels hardly exist. There are NVQ qualifications at higher educational levels, but there is, except for technical colleges which offer a mixture of general and vocational education (Jarrat, Murphu and Lawry (1997)) no complete higher education system as it exists in the Netherlands and Germany. The fact that vocational education is hardly offered at higher levels could be one of the causes of the continuing skills gap. Apart from the measures described in this paragraph, one should note that policy sometimes pursued increasing responsibility of the national government and sometimes increasing freedom of local organizations.

Education in the United Kingdom is the responsibility of the Local Education Authorities. LEA's are local, elected bodies responsible for all publicly financed educational facilities in their region[3]. Besides LEA's, there are the Funding Agencies for Schools (FAS) in England since 1988, and the Welsh Office in Wales. There are no LEA's in Northern Ireland, where Education and Library Boards have been established instead. There is no special body for financing special (independent) schools, because there are only very few of those schools (CEDEFOP (1995)). Schools that are financed by the FAS are not under supervision of a LEA but under the control of their own governing board. The FAS does not interfere in policies of individual schools and hardly plays any role in local training policy.

Since LEA's are local organizations, they have an important decentralizing effect on the market of education and training. They also strengthen decentralization because they take the needs of entrepreneurs in their region as their starting point. They don't have to take account of labour surpluses and skill shortages in neighbouring regions. This brings about heterogeneity on the initial education market, because skills available to the local market are different in every region. Heterogeneity can be observed on the local market for continuing training as well, by consequence of the local orientation of the TECs.

The local orientation of TECs and LEAs may contribute to the heterogeneity and intransparency of the British education and training market. Qualifications as demanded by firms and supplied by potential employees are different in every region. Although the LEAs became less prevalent during the 1990s, the problem of heterogeneity and intransparency has not been reduced, because staff, parents and firms were given more control over local education. For instance, governing boards of educational institutes received more responsibilities. Furthermore, part of the curriculum is still decentrally determined.

In the United Kingdom, initial education is largely general rather than vocational. The share of students in lower vocational education is low relative to those in the Netherlands and Germany (Eurostat/Eurodyce (1997)).

Although the government's training policy became less strict during the 1970s, firms were still obliged to invest in schooling and training. Training policies of the ITBs was mainly directed at large firms. Consequently, small firms and thus a large group of employees did not benefit from ITBs' support, while it is this group which participates in training infrequently[4].

Furthermore, according to Williams and Goodwin (1999), only off-the-job training was supported, while employers expressed a preference for on-the-job training. The UK LFS shows that employees participated in general training more often than specific training, in both large and small firms. In large firms, 7.4% of employees participated in continuing education, whereas 6% of employees in these firms participated in training

[3] One often speaks of Local Authories (LA's) rather than LEA's. LA's are all elected public bodies at local level.

[4] In 1983, the UK Labour Force Surbey asked employees about firm size, for the first time. This allows us to calculate that in small firms (<25 employees) 3% of the emplyees participated in a job-related course, whereas 6% of employees of large firms participated. Similarly, 12% of employees of small firms participated in any form of education, whereas 16% of employees of large firms were in education. It is remarkable that ITBs concentrated on a very small group of employees who participated in training relatively often.

offered by the firm; in small firms 5% participated in continuing education and 3.3% in training offered by the firm[5].

In the early 1970s, a central training programme was considered a necessity. Apparently, there was the opinion that the Central Training Council was improperly organized. In 1973, this problem was dealt with by issuing the Employment and Training Act, followed by the establishment of the Manpower Services Commission, which was replaced by the Training Agency in 1988. Meanwhile, increasing unemployment demanded a special programme for unemployed youngsters, which was launched under the name of the Youth Training Scheme. People who participate in the YTS work in a temporary job and spend 25% of their time on training. While the new programmes were introduced, old structures were broken down and by the end of the 1980s all ITBs had disappeared. The influence of the unions, still present in the ITBs, had disappeared as well. Training policies of the 1980s were dominated by the national government, LA's and individual employers. Coordination between social partners and government, either on national or sectoral level, was almost completely absent and employees were involved in policy design concerning schooling and training no longer.

Because training was mainly the national government's responsibility now, she was able to conduct a strong national training policy from the 1980s onward, under direct supervision by the Employment Department. Surprisingly, as a first step, it was decided to decentralize British training policy by delegating responsibility to local Training and Enterprise Councils (TECs), although the Employment Department kept final responsibility. After a period of centralization, a tendency to decentralization existed right after the process of centralization had finished.

More important may be that only a tenth of TEC's total budget was used for job-related training. Aalders (1994) claims that financial support by the government was insufficient, that annual budgeting rather than long-term policy caused strong uncertainty, and finally that TEC's conducted too strict a policy. Firms probably know best what they need and find themselves only hindered by strict regulation.

In 1986, a new important programme came into being, next to the existing YTS, namely the National Vocational Qualifications (NVQs). These qualifications were, and still are, awarded by so-called awarding bodies, under supervision of the National Council for Vocational Qualifications (NCVQ). The new system facilitated deregulation and was assumed to help creating a competitive market for training. The most important goal of the NCVQ was to integrate existing qualifications and organizations into the new system, including the School Curriculum Assessment Authority (SCAA), the School and Assessment Authority for Wales (ACAC) and the YTS as well as the Business and Technology Education Council (BTEC). Williams (1999) gives an illuminating view of these training systems and explains why the system failed (also see Vickerstaff (1988)). Briefly, organisatory complexity, intransparency of the qualification system and a lack of incentives to innovation and learning are causes of failure of the NVQ system (Schonewille (forthcoming)).

There are also indications of employees' interests being neglected, since neither individual employees nor labour unions were able to influence training policy in the late 1980s and onwards. This could be a reason why NVQs are task-based, i.e. directed at working with a particular machine or performing one particular service, rather then based-based. Robinson (see Goodwin (1999)) states that the NVQ system does not

[5] Calculated from the UK LFS by the author.

function as expected, because it did not replace existing qualifications (also see: Spielhofer 2000 and 2001).

NVQs have not brought about a coherent qualification system, but merely added another set of qualifications, only increasing confusing and intransparency. The NVQ system alone counts more than 800 different qualifications. This is more than twice the number of qualifications in the German Dual System. Adding the number of Scottish Vocational Qualifications (SVQs), the total amount of British qualifications becomes even much bigger. It is not clear that equally defined qualifications really imply equal skills. This causes lack of clarity amongst employers and trainees. The intransparency of the NVQ system also appears from the fact that the number of qualifications to be defined was unknown when the system was created. Originally, one expected to define a possible number of 2000 qualifications (Prais (1995, p. 31)). Although the total number of qualifications never reached such a height, the YTS and the SVQ and NVQ systems together count more than 1600 different qualifications. The government always strived for as large assortment as possible. When a reduction of the number of qualifications was proposed, the initiative always lay with parties having a commercial interest, such as firms and TECs[6].

A problem of NVQs is to be found in time-apprenticeship. A large share of NVQs is awarded on the basis of the length of the training period rather than the actual skills acquired by the trainee.

It is not always clear that qualifications obtained in Northern Ireland are equal to those acquired elsewhere in the United Kingdom, because the YTS in this part of the country has different names.

Germany

The current training system is the result of a process which started halfway the 19th century, when the German railways and other firms founded special working places, *Werkstatten*, for trainees. Although the Dual System finds its roots in the 19th century, it received official recognition not earlier than 1953. An employment act, the *Gewerbeordnung* of 1869, defined the status, rights and obligations of trainees, usually craftsmen at the start of their career (CEDEFOP (1981, p. 177)). At the beginning of the 20th century, special arrangements were added to this law, considering trainees in manufacturing (Handwerk) and trade and the working places in the manufacturing sector.

Already at the beginning of the 19th century, an attempt was made to coordinate the different training forms that existed in Germany. The goal was a number of consistent uniform programmes proving training for clearly defined professions. From 1925 onwards, organized employers defined qualification requirements for every profession that was included in the German Arrangement for Technical Education (DATSCH). Eventually, the DATSCH included approximately 1000 different professions. Five years later, examination standards were defined and shortly thereafter these qualifications were officially recognized by the minister of education. Nowadays, there are approximately 3000 different professions provided for by the Law on Vocational Education (BBiG), which replaced the DATSCH in 1969.

[6] This has been confirmed by the Qualification and Curriculum Authority, the umbrella organization responsible for accreditation of the larger part of all NVQs.

Meanwhile, employees were involved in the process of defining professions and their respective qualifications. Consequently, social partners play an important role in the development of the German vocational education and training system.

Besides national legislation regarding firm-based training, in particular the BBiG, there is also legislation at the level of the Länder. The Länder are responsible for the school system with regard to finance, housing and equipment, educational methods, and personnel for instance. This allows for regional diversity, while the market for skilled labour is still transparent. While schools compete on quality of education, all pupils throughout the country acquire uniform qualifications.

The Dual System is equally organized in every industry and in every region of the country. This is possible because it is the federal government that is responsible for implementation of the BBiG. Accordingly the BBiG, pupils start with theoretical lessons in Fachschulen and continue their education in one or more firms. In the firm, they receive on-the-job training while they continue to attend theoretical courses as well. In this way, one may obtain lower qualifications, equal to those of Facharbeiter, in one of thirteen professional areas. The number of officially recognized professional areas has not changed during the past 30 years and their definitions are almost completely unchanged as well (see CEDEFOP (1981, p. 169) and CEDEFOP (1995, p. 100)). In 2002, the number of vocational qualifications that can be acquired in the Dual System has been reduced from 452 to 350 (CEDEFOP (1981) and Bundesministerium für Bildung und Forschung (2003, p. 134)).

Fachhochschulen often closely cooperate with firms to provide for these firms' needs for training (Weihrich (1999)). Flexibility on the labour market is high, because pupils receive on-the-job training and therefore acquire knowledge as demanded by firms and because technical schools adjust their courses accordingly the need of employers.

Although the Dual System is uniformly organized, its implementation has been largely decentralized. At the level of the firm, it is the social partners who determine regional education policies. besides a few administrative tasks, they define standards, monitor pupils' performance and control actual training contents. They also organize examinations (Aalders (1994, p. 105)).

The German education and training markets are very transparent. Qualifications and examination standards are always defined at national level, which facilitated planning of school careers by pupils and which make it easier for employers to assess employees' qualifications. At regional level, however, there still is sufficient diversity to enable schools to compete on quality and facilities.

Netherlands

Early 20th century, there was no separate vocational education in the Netherlands. This country did not build upon its long tradition of on-the-job training, which was quite similar to the German training system at the time. In the Netherlands, internal firm-based courses had always been an important source of vocational skills. Just like Germany, the Netherlands finds the origin of its firm-based training system in the medieval ages. Yet, it appears that the transformation of a 19th century training system into a modern system occurred less smoothly than in Germany. A reason is the fact that social partners took account of the development of a training system themselves, whereas this was a task for the government in the Netherlands. The Dutch government

focussed on class-based education rather than workplace-based training. From the start of the 20th century onwards, Dutch vocational education contained many general components. When the Dutch training system was officially launched, it also included a dual system, besides a class-based system (see Wolthuis (1999)). After World War II, the importance of this dual system increased significantly, because the need for technically skilled employees raised. In the 1970s, when services gained weight and general education became more important again, mobility between the dual system and general education was improved.

From 1980 onwards, the Dutch government conducted a policy aimed at reducing government expenses. Education was one of the sectors facing a major budget cut (OESO (1991, p. 18)). During the 1990s, the component of general education increased, because all schools were obliged to offer exactly the same programme during the first two years, including history, mathematics, housekeeping and other subjects. After 1993, the Dutch education and training markets have been continuously subject to change and reform.

The Wagner Commission (1984) had great influence on the development of Dutch vocational education and training. The commission recommended to strengthen the connection between initial education, continuing education and the labour market. Regarding initial vocational education, social partners became more influent in several commissions who served as advisors to the government. They made recommendations considering sectoral professional profiles and defined clear training goals. Six years later, the Commission Rauwenhof recommended to provide more opportunities for vocational education institutes to cooperate with firms and to engage in commercial activities themselves. These recommendations have had great influence on the course of events during the 1990s.

In 1996, the new Education Law (WEB) induced more reforms (Steering a Course for BVE (MinOCW (2000)). The WEB is by far the most important law considering secondary education and vocational education and training. The law replaced nearly all previously existing laws with regard to this subject (CEDEFOP p. 14-15)).

The current Dutch structure of vocational qualifications is considered transparent by the Steering Group for Evaluation of the WEB (2001). However, the Group states that only educational institutes have a good overview of their opportunities. Pupils and trainees would have problems getting a clear view of the vocational qualification system.

The reforms of the Dutch educational system have a great impact on both the initial educational sector and continuing training. one of the goals of the WEB is to rationalize the unstructured pattern of educational institutes. Early 1998, 1900 secondary schools had merged into 46 Regional Education Centres (ROCs), which continue to merge (CEDEFOP (1999)). These mergers are supposed to induce transparency on the education and training markets and economies to scale. Currently, the public sector for initial and continuing education and training is very transparent: only 43 ROCs provide for the larger part of continuing vocational education and training. The remaining part of CVT is provided by 200 private training institutes and within firms (also see CEDEFOP (1999).

Another measure to enhance efficiency was to delegate responsibilities from centralised coordinating organizations to institutes at microlevel. In this way, financial accountability was increased and institutes experienced incentives not to exceed the available budget.

Introduction of the WEB also changed supervision over examinations. Now, ROCs bear main responsibility for examinations. Representatives of social partners and the government (National Bodies for Vocational Education, the Council for Vocational and Adult Education, the COLO, and the educational inspectorate) all have influence on education and training policies. It is expected that the WEB will reinforce the position of trainees, i.e. trainees and employees will be (better) able to influence organization and contents of job-related training.

The ROCs are stimulated to engage in commercial activities. Every ROC has to develop its own entrepreneurial strategy, which is supposed to lead to competitiveness and regional diversity. Competition is hampered, though, by local authorities who are compelled to buy training services for the underprivileged on the labour market from the ROCs.

By consequence of the apparent distinction between training for employees and training for other market segments, training for employees is financed exclusively by the private sector, an exception being the O&O (Research and Education) Funds, which are partly subsidized by the national government. O&O Funds are also used to finance part of the Dutch dual system (Leerlingwezen), which means that these funds buy training services at the ROCs. O&O Funds account for a minor share in total Dutch training investments.

Part of firm-related training is organized by sectoral organizations. There are sectoral organisations that offer training by themselves, such as BOVAG, there are also organisations, e.g. CEDEO, that certify courses offered by other private organizations. Generally, there are no obligatory requirements that have to be satisfied by suppliers of training services. Organisations that don't receive recognition or certification can still be present on the training market.

Effectiveness of the Dutch market for education and training was studied by the MDW group (2001). Transparency was one of the criteria for effectiveness. The MDW group stated that, although serious attempts were made to enhance transparency of the Dutch schooling and training markets, the Dutch markets are still perceived as intransparent. However, according to the group, the cause of intransparency appears to be an information problem rather than the qualification structure itself.

Continuing change of the Dutch training market during the 1990s caused risks and uncertainty. Consequently, firms and employees may tend to postpone investment in training and education until policy becomes less volatile.

Final Remarks about Training Policies

In the United Kingdom in the second half of the 20th century, training policy was inconsistent, due to the temporary neglect of vocational education followed by a policy to foster continuing training. Another inconsistency was the tendency to centralisation followed by decentralisation.

In Germany and the Netherlands, training policy was more consistent. Germany has a long tradition of vocational education and training. De government always had relatively strong influence, but initiative lay with the social partners. In the Netherlands, also having a long tradition of vocational education and training, initiative lay with the government and social partners were closely involved with training policy. The transition to a well-structured training system at the beginning of the 20th century did

not take place as smoothly as in Germany, exactly because it was the Dutch government that took initiative. Most of the Dutch reforms occurred during the last 20 years and it is not clear to what extent these changes are going to be permanent. It is possible that some of the changes will be cancelled and that more reforms will take place. Therefore, although Dutch training policy cannot be judged inconsistent, it is definitely less stable than German training policy.

The result of this empirical analysis is presented in the appendix. For every of the three countries, a table shows which institutional characteristics are present. A more extensive discussion of how the empirical analysis gives us the results as given in the appendix is provided by Schonewille (forthcoming).

4 Efficiency According to CIA

In this paragraph, we link market failures to inefficiency, taking actually existing institutions as our starting point. First, we observe the extend to which an institution is present in a country. As an illustration, we show how we obtained the score of Restrictions in the Qualification System. According to our theory, this institution has a relatively small number of causal relationships with efficiency. This makes the example easy to understand.

Schonewille (forthcoming) claims that Restrictions of the Qualification System are mainly affected by two characteristics of the training market: the number of available qualifications and the diversity of available courses. Schonewille concludes that the relatively small number of 350 qualifications indicates a sense of restriction. Therefore, a moderate positive contribution (+1) of this characteristic to the presence of the institution Restrictions of the Qualification System is observed.

Schonewille also claims that diversity of courses is increased by institutions enjoying the freedom to decide by themselves which courses they will offer, while no deliberate attempt is made to maximize this diversity. The characteristic of diversity of courses is thus observed having a neutral (0) effect on Restrictions of the Qualification System.

We assign scores to institutions accordingly to the contribution characteristics make to their presence. These scores range from –2 up to and including +2. The scores assigned to characteristics is referred to as I_{fg}, where the subscript f=1,2,...F represents the characteristic and g=1,2,...G stand for the institution. By adding up the scores of the characteristics Number of qualifications and Diversity, we get a score for the institution Restrictions of the Qualification system, as is shown in equation (1).

$$I_g = \sum_{i=1}^{2} I_{fg} = I_{1g} + I_{2g} = 1 + 0 = 1 \qquad (1)$$

The next step is to use table 1 to determine the connection between institutional effects and Restrictions of the Qualification System. In this example, we only consider institutional effects which are important to the training market. According to aforementioned table, the existence of restrictions affects transparency, equity and economies to scale positively (+1) and diversity negatively (-1), while the effect on accountability is neutral (0). Institutional effects are also assigned scores, ranging between –1 and 1. The result is a vector **F**, which reflects the connection between

institution and institutional effects. This vector can be written as follows (institutional effects are included on each respective line):

$$\mathbf{F} = \begin{bmatrix} 1 \\ -1 \\ 1 \\ 1 \\ 0 \end{bmatrix} \quad \begin{matrix} \textit{transparence} \\ \textit{diversity} \\ \textit{equity} \\ \textit{scale economies} \\ \textit{accountability} \end{matrix} \tag{2}$$

The last preparatory step is to write down all relationships between institutional effects and efficiency in such a way that we can do calculations with them. Table 1 shows how institutional effects are connected to dynamic, allocative and cost efficiency. The table shows, for instance, that transparency, diversity and economies to scale contribute positively to dynamic efficiency, that equity has a negative effect on dynamic efficiency, while accountability is neutral. Assigning scores to these relationships, we can create a matrix $\mathbf{M_D}$.

$$\mathbf{M_D} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{3}$$

We can create similar matrices showing the relationship between institutional effects and allocative efficiency $\mathbf{M_A}$ and cost efficiency $\mathbf{M_C}$[7].

Now, we can calculate how every institutional effect of Restrictions of the Qualification System affects dynamic efficiency. We do so by multiplying the number I_{fg}, the vector $\mathbf{F}$ and the matrix $\mathbf{M}_D$ as shown in equation (4).

$$\mathbf{X}_g = I_g \mathbf{M}_m \mathbf{F}, \quad m \in \{A, C, D\} \tag{4}$$

The result is a new vector $\mathbf{X}_g$, containing five efficiency values. This vector is shown in equation (5). Each line of the vector represents the institutional effect as given on that line.

$$\mathbf{X}_g = \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \\ 0 \end{bmatrix} \quad \begin{matrix} \textit{transparantie} \\ \textit{diversiteit} \\ \textit{sociale gelijkheid} \\ \textit{schaalvoordelen} \\ \textit{accountability} \end{matrix} \tag{5}$$

[7] If we define $\mathbf{M}^*_m=[m_{nk}|p=q,0<p\leq Q]$ as elements on the diagonal of PxQ matrix $\mathbf{M}_m$, we can write $\mathbf{M}^*_D=[1\ 1\ -1\ -1\ 0]$, $\mathbf{M}^*_A=[1\ 0\ -1\ -1\ 1]$ en $\mathbf{M}^*_C=[0\ 0\ 1\ 0\ 1]$.

This process is repeated as many times as there are institutions connected to institutional effects that are relevant to the training market. Table 3 show that there are 10 institutions affecting the training market. For each institution, we can calculate a vector $\mathbf{X}_g$. The total effect on dynamic efficiency of the German training market, distinguished according to each individual institutional effect, is calculated by adding up these vectors. The result is a new vector ΣX_g, as shown in equation (6).

$$\sum_{g=1}^{10} \mathbf{X}_g = \begin{bmatrix} 7 \\ -5 \\ 4 \\ 2 \\ 0 \end{bmatrix} \begin{matrix} \textit{transparency} \\ \textit{diversity} \\ \textit{equity} \\ \textit{scale economies} \\ \textit{accountability} \end{matrix} \qquad (6)$$

This vector can be traced back in table A.1 of the appendix. This table consists of three panels. Panel 1 refers to Germany. Lines 6 up to and including 10 of column 1 of the first panel, which shows indices with regard to dynamic efficiency, contain the same numbers as shown in equation (6). Using these numbers, one is able to compare countries by efficiency. We can also use these numbers to do more calculations, the results of which are shown in tables 4, 5, and 6, all based on the figures in table A.1.

Table 4 Institutional effects on efficiency of labour and training markets

	Germany	Netherlands	United Kingdom
dynamic efficiency	10	3	-11
allocative efficiency	29	2	-19
cost efficiency	7	1	16

Source: calculated from table A1, A2, and A3 in the appendix.

Table 4 shows that Germany has generally high institutional efficiencies. Table 5 and 6 show that Germany performs very well in terms of allocative efficiency, on both the training and the labour market. Cost efficiency on the labour market is the only area where Germany performs worse than the two other countries.

Table 5 Institutional effects on efficiency of training markets

	Germany	Netherlands	United Kingdom
dynamic efficiency	8	0	-12
allocative efficiency	14	-3	3
cost efficiency	9	-2	6

Source: calculated from table A1, A2, and A3 in the appendix.

The British training market exhibits, just like the British labour market, a highly varying profile, as is shown by tables 5 and 6. The training market of the United Kingdom is dynamically inefficient, while this country has higher cost and allocative efficiency than the Netherlands, while lagging behind Germany in these respects.

Table 6 Institutional effects on efficiency of labour markets

	Germany	Netherlands	United Kingdom
dynamic efficiency	2	3	1
allocative efficiency	15	5	-22
cost efficiency	-2	3	10

Source: calculated from table A1, A2, and A3 in the appendix.

In view of the institutional efficiencies presented here, it is difficult to set up a hypothesis with respect to more traditional measures of efficiency. Given the high dynamic and allocative efficiency in Germany, one would expect to find high efficiency for this country if other measures are uses as well. Yet, given the relatively high British cost efficiency, one might expect that German and British product efficiency are not very different. The Dutch position is clearly different from that of the other two countries. Therefore, we expect to find a Dutch value for technical efficiency that is clearly different from the values observed for the other two countries.

5 Sensitivity Analysis

Because the empirical institutional analysis may be sensitive to subjectivity, we investigate how small changes in the assigned indices affect our conclusions. We use equation (4) as our starting-point. This equation contains three major components. The empirical component is I_g, the extent to which institutions are present. The other two components, effects **F** and contributions to efficiency $\mathbf{M}_m$, are theoretical. Changes in vector $\mathbf{X}_g$ can accordingly be divided into empirical and theoretical components, respectively ΔI_g and $\mathbf{F}^T\mathbf{M}_m$ (see equation 7).

$$\Delta \mathbf{X}_g = \Delta I_g \cdot \mathbf{M}_m \mathbf{F} \tag{7}$$

We can apply changes to the empirical component by setting ΔI unequal to zero, under the condition that $I_g + \Delta I_g \in \{-2, -1, 0, 1, 2\}$.

In the remainder of this section, we will only consider the consequences of changes in I_g. There are three reasons for doing so. First, although one might be able to observe the presence of an institution objectively, the interpretation of the institution by the observer still affects the value of I_{fg}. Second, the values of **F** are based on institutional literature and often there is consensus about the institutional effects and the trade-offs that are connected to institutions. The values of **M** rely on literature, too. These two components are thus less sensitive to subjectivity than I_g. The third reason is that $\mathbf{F}^T\mathbf{M}_m$ together represent the theory that we want to investigate the usefulness of. Those who support a different theory may want to change **F** and **M**. Since we are concerned with the theory presented in the preceding sections, we keep **F** and **M** fixed.

We use a reference country, which is the "average" of the other three countries. Since the indices are assigned to institutions in comparison to institutions in other countries, all indices are relative. The reference country is characterized by $I_g=0$. Table 7 shows the effects of changes in the assigned indices. The first column contains institutions, the second column contains the characteristics that constitute the

institutions. The next three columns show the consequences of a change equal to DIg=1, by characteristics and each of the dynamic, allocative and cost efficiencies.

Table 7 can be considered by institution or by type of efficiency. It appears that some institutions are relatively insensitive, such as output-based finance and specialisation of institutes. Although output-based finance increases equity and accountability (see table 3), these effects largely compensate each other. Only dynamic efficiency is affected negatively by this institution, because output-based finance has a positive effect on equity, which in turn negatively affects dynamic efficiency.

Table 7 Effects ΔX due to changes ΔI=1 in the presence of institutional characteristics in the reference country

	.	Dynamic efficiency	Allocative efficiency	Cost efficiency
Price competition	Financial responsibility	0	-3	-2
Price competition	Coordiantion: equipment	0	-3	-2
Clear definitions at national level	Definitions of qualifications	1	3	1
Clear definitions at national level	Status and supply of training	1	3	1
Public finance of job-related training	Public investments	0	-1	-3
Public finance of job-related training	Participation	0	-1	-3
Output-based finance	Financial responsibility	-1	0	0
Stable policy	Participation	1	1	-1
Stable policy	Tradition	1	1	-1
Stable policy	Stability	1	1	-1
Restrictions in qualification system	Number of qualifications	-1	0	-2
Restrictions in qualification system	Coordination: number of courses by institute	-1	0	-2
Specialisation of institutes	Nature of training supply	1	0	0
Relative influence employees/employers	Supply of vocational skills	0	2	-1
Relative influence employees/employers	Social partners	0	2	-1
Guarding examination standards	Coordination: standards	1	3	1
Guarding examination standards	Time apprentices	1	3	1
Obligatory participation in training programmes	Participation	3	2	1
Merging of institutes	Nature of training supply	0	-2	-2

The figures in the table indicate the size of the effect on institutional efficiency of a changing institutional characteristic. The table can be calculated using equation (4) and tables 1, 2 and 3.

Allocative efficiency is both positively and negatively related to specialisation of institutes (see table 3). On the one hand, specialisation mainly has a positive effect on transparency, which is positively connected to both dynamic and allocative efficiency (see table 7). On the other hand, scale economies, which are also positively affected by specialisation, are negatively related to allocative efficiency. Consequently, the effect of specialisation on allocative efficiency equals zero. Since specialisation has a negative effect on diversity and diversity is positively related to dynamic efficiency, is also the contribution of specialisation to dynamic efficiency relatively small.

An institution with relatively large influence is Obligatory participation in training programmes. This large effect is caused by the non-negative relation of all three types of efficiency with each of the institutional effects of this institution. incorrect interpretation of this institution will have major consequences. Fortunately, clear and well-documented information is available about this institution[8], leaving little scope for subjectivity.

Clear documentation with regard to output-related finance is less abundantly available (Schonewille (*ibid.*)). Therefore, interpretation plays an important role and the influence of subjectivity may be large. The effect $\Delta I=-1$ on dynamic efficiency due to subjectivity, which may occur according to table 7, is sufficiently small to avoid a significant effect on the relative position of the three countries. Moreover, the theory does not recognize a connection between this institution and allocative and cost efficiency. So, these two types of efficiency are supposed to be insensitive to subjectivity with regard to output-based finance.

Considering table 7 by types of efficiency, we observe that allocative and cost efficiency are strongly affected by a number of individual institutional characteristics, e.g. Public finance of job-related training and Guarding examination standards. Dynamic efficiency is thus relatively insensitive to subjective assignation values to individual institutional characteristics. This clearly appears from table 8. For each type of efficiency, we have calculated the average change in the absolute value of the contribution $|\Delta X|$ of each institutional effect. This contribution to efficiency is largest for allocative efficiency, namely 1.6, slightly smaller for cost efficiency equalling 1.3, and smallest for dynamic efficiency amounting to no more than 0.7 (see table 8). This means that the absolute value of the average differential $|\Delta X|$ is largest in the case of allocative efficiency. Table 8 also shows the variance of ΔX. The variance indicates that the allocative efficiency does not only have the highest average, but also that individual values of this type of efficiency have the highest deviation from the average value. Subjective observations of institutional characteristics can therefore have major consequences for the observed value of allocative efficiency.

The size of the error possibly caused by incorrect interpretation of an individual characteristic is between –3 and 3. These are the minimum and maximum values in table 7. The distance between these values equals 6. This distance is too small to change the relative position of a country in such a way that we have to adjust our conclusions with regard to total efficiency indices, as the distance is always less than or equal to the efficiency differences between the three countries. There is only one case where the

[8] Schonewille (forthcoming, section 3.3.1) dicsusses some of the literature on Obligatory participation in training programmes.

maximum possible error might neutralize the total efficiency difference, namely the case of cost efficiency of Germany and the Netherlands (see table 9 col. 5).

Tabel 8 Sensitivity of X to changes in I

	Dynamic efficiency	Allocative efficiency	Cost efficiency
var(ΔX)	0,884211	3,628947	1,852632
average |ΔX|	0,7	1,55	1,3
$\Sigma(\Delta x)^2/N$	1,052632	3,736842	2,315789

Calculated from table 7 Var(ΔX) indicated the change in efficiency due to a change in the presence of an institutional characteristic. The average of |ΔX| is the average of the absolute values of changes in efficiency. The third row shows an alternative expression of efficiencies deviating from 0.

Considering the training market and labour market separately, we find the analysis to be more sensitive to subjectivity. Incorrect interpretation of an individual institutional characteristic could imply different conclusions with regard to the relative efficiency of the British and German training markets, because the difference in efficiency between the two countries equals 3 and is thus less than the maximum possible error. It also appears that dynamic efficiency of the labour market is particularly sensitive to subjectivity, because the distances between the values of dynamic efficiency of the labour markets do not exceed 2 and are thus smaller than the maximum possible error.

Tabel 9 Absolute afstand tussen efficiëntiewaarden

	Dynamic efficiency		Allocative efficiency		Cost efficiency	
	Netherlands	United Kingdom	Netherlands	United Kingdom	Netherlands	United Kingdom
Training markets						
Germany	8	20	17	11	11	3
Netherlands	-	12	-	6	-	8
Labour markets						
Germany	1	1	10	37	5	12
Netherlands	-	2	-	27	-	7
Total						
Germany	7	21	27	48	6	9
Netherlands	-	14	-	21	-	15

Source: calculated from tables 4, 5 and 6.

The expected effect of the “average” error may be more important the effect of an individual interpretation error. The total effect of DI on dynamic, allocative and cost efficiency equal 8, 17 and –16 respectively. These numbers are the sum of the columns

of table 7. The expected sigh of an error due to subjectivity is positive in the cases of dynamic and allocative efficiency, but negative in the case of cost efficiency.

"Over-estimation" of the presence of an institutional characteristic causes over-estimation of dynamic efficiency as well as allocative efficiency of a country, whereas cost efficiency would be under-estimated. "Under-estimation" of the presence of an institutional characteristic obviously causes opposite effects. Of the three types of efficiency, dynamic efficiency has the lowest sensitivity to under- and over-estimation.

Over-estimation of the presence of an institutional characteristic means, in case of the United Kingdom, that the profile of that country is too similar to the profile of the Netherlands. If subjectivity indeed influences our analysis, the distance between the Dutch and the British profiles should be larger than reflected by our tables. Under-estimation would have an opposite effect, implying that the actual profiles of the United Kingdom and the Netherlands are more similar than appears from our analysis.

Under- and over-estimation of the presence of institutional characteristics causes the profiles of the Netherlands and the United Kingdom to be more, or less, similar than in reality. Yet, Interpretation errors cannot cause the observed German profile to converge with the profiles of the other two countries. The only possibility is that German allocative and dynamic efficiencies approach to, or move away from Dutch and British values, while cost efficiency moves in the opposite direction.

The preceding considerations show that subjectivity may cause difficulties, particularly with regard to labour markets. Efficiency indices of particularly dynamic efficiency may give an incorrect view of labour markets. Subjective interpretation of individual institutional characteristics does not, however, affect our conclusions with regard to efficiency of training markets. Nor are total efficiency indices of labour and training markets together affected in such a way that our conclusions are deemed to be unreliable. The effect of subjective interpretation on the analysis as a whole does not cast any doubt on our results. It is possible, though, that the United Kingdom and the Netherlands are more, or less, similar than appears from this analysis.

6 The Thick Frontier Procedure

We use the thick frontier procedure to estimate the technical efficiency of an economy. Currently, this and similar techniques are frequently used in research on efficiency of banks (e.g. Lozano Vivas (1997) and Bikker (2003)). A more extensive discussion of frontier procedures is provided by Coelli (1997). The result of the thick frontier procedure is a series of efficiency indices that indicate the distance between the actual production set of a country and the common production possibilities frontier of the three countries together.

The model to be estimated in the next paragraph is based on a standard Cobb-Douglas production function. The only major adjustment is that we divide both sides of the production function by the size of the sectoral labour force. For the thick frontier approach, we use a simple OLS equation with output per labour unit Y/L as dependent variable and assuming constant returns to scale. In this model, we include three variables representing job-related training, namely with lags of zero, one and two periods. Furthermore, we add a trend variable en a series of sector and country dummies D. The equation looks as follows.

$$\ln \frac{Y_{ijt}}{L_{ijt}} = \ln \hat{A} + \hat{\alpha} \ln \frac{K_{ijt}}{L_{ijt}} + \hat{\theta}_2' \ln S_{2ijt} + \hat{\theta}_3' \ln S_{3ijt} + \\ \hat{\tau}_t' \ln V_{ijt} + \hat{\tau}_{t-1}' \ln V_{ijt-1} + \hat{\tau}_{t-2}' \ln V_{ijt-2} + \mu t + \hat{d}' \overline{D} + \hat{u}_{ijt,tot} \tag{8}$$

where Y_{ijt} is output of sector i in country j in period t, K_{ijt} is capital stock, L is the number of employees, and A refers to total factor productivity. Initial education is represented by $S_{\theta ijt}$ and job-related training, measured as participation, by V_{ijt}-T ($0 \leq T \leq 2$). The term $\hat{u}_{ijt,tot}$ is de total error, *i.e.* the difference between the actual values of Y/L and the values as predicted by the estimated model. The coefficients θ'_q and τ are labour productivity elasticities of respectively initial education and job-related training.

After estimating above regression equation, we can distinguish efficient and inefficient industries. We assume that industries with a high error $\hat{u}_{ijt,tot}$ are efficient. Every industry is assigned a value $D_{ijt,ineff,}$ which equals 1 if $\hat{u}_{ijt,tot}$ is smaller than the 75th percentile $\hat{u}_{.75}$ and 0 otherwise. $D_{ijt,ineff}$ is thus defines accordingly

$$D_{ijt,ineff} = \begin{cases} 0 & if \quad \hat{u}_{ijt,tot} \geq \hat{u}_{.75} \\ 1 & if \quad \hat{u}_{ijt,tot} < \hat{u}_{.75} \end{cases} \tag{9}$$

This dummy is included in the equation shown below.

$$\ln \frac{Y_{ijt}}{L_{ijt}} = \ln \hat{A} + \hat{\alpha} \ln \frac{K_{ijt}}{L_{ijt}} + \hat{\theta}_2' \ln S_{2ijt} + \hat{\theta}_3' \ln S_{3ijt} + \\ \hat{\tau}_t' \ln V_{ijt} + \hat{\tau}_{t-1}' \ln V_{ijt-1} + \hat{\tau}_{t-2}' \ln V_{ijt-2} + \mu t + \hat{d}' \overline{D} + \hat{d}_{ineff} \overline{D}_{ijt,ineff} + \hat{u}_{ijt,rand} \tag{10}$$

The dummy explains the component of the error term which is due to inefficiency. De remaining error term $\hat{u}_{ijt,rand}$ only contains a random error without industry and country specific effects and is not affected by inefficiency. Now, we can calculate which part of $u_{ijt,tot}$ is due to inefficiency, using the following equation:

$$\hat{u}_{ijt,ineff} = \begin{cases} 0 & if \quad \hat{u}_{ijt,tot} \geq \hat{u}_{.75} \\ \hat{u}_{ijt,tot} - \hat{u}_{ijt,rand} & if \quad \hat{u}_{ijt,tot} < \hat{u}_{.75} \end{cases} \tag{11}$$

Te increase readability and to facilitate interpretation of the results, we recalculate $\hat{u}_{ijt,ineff}$ into percentages using the next formula.

$$\hat{TE}_{ijt} = 1 - \frac{\hat{u}_{ijt,ineff}}{\min(\hat{u}_{ijt,ineff})} \tag{12}$$

TE_{ijt} is the technical efficiency of industry i in country j in period t.

7 The Data

The data come from a number of sources. The British education and training data have been derived from the UK Labour Force Surbey (UK LFS). Sectoral employment for each of the three countries was calculated by estimating sectoral employment shares from a labour survey and multiplying these shares by the total number of persons in the working population of the respective countries. The shares were estimated using data from the UK LFS, the German Socio-Economic Panel (G-SOEP) and the Dutch labour supply panel of the Institute for Labour Studies (OSA). Total annual employment figures are from Eurostat.

The length of the time series is limited by availability of the data. The start of the series is determined by the point in time when surveyors started asking consistent information about education and training. This 1988 in the United Kingdom, 1984 in Germany, and 1986 in the Netherlands. The end of the series is determined by the ISDB, which was not continued after 1997, and by reforms of the surveys which would make data inconsistent if the most recent data were included in our own data set.

The data contain annual observations for Germany and the United Kingdom. The number of Dutch observation is further reduced by the fact that the OSA panel is conducted only bi-annually, in even years.

We have divided initial education into three categories, lower, secondary, and higher education, making educational data as comparable as possible. The lower category is not included in the equation to keep the variables independent.

While Schonewille (2001) applies a trend correction to all series, we have decided not to do so. Instead, the regression equation includes a time variable to take account of trend effects. Apart from a slightly different specification of the regression equation, this is causes our results regarding the United Kingdom to be different from the results published by Schonewille (2001). This means that a considerable amount of multicolliniarity affects our estimates, especially amongst the training variables, but the coefficients are not skewed by a trend correction procedure.

Another difference between the results presented by Schonewille (2001) and the results following below is that we have omitted a distinction between on-the-job and off-the-job training. Instead, we have measure total participation in training. This is the only way to proxy training investments in all three countries in a consistent way, because all surveys use different training measures.

The variables as used in the estimated regression equation are all measured at sector level and are defined as follows. Output is measured as gross value added. Capital equals accumulated investments in physical capital, calculated by the OECD. Output and capital stock data were derived from the OECD International Sectoral Database (ISDB). Labour is the number of employees working in a sector, estimated using the above described procedure. The three initial education variables denote the sectoral employment shares of the respective education levels. Higher education is defined as university and non-university degree level qualifications. Intermediary education includes secondary education, up to and including pre-university level. Lower education includes those workers who have not obtained any secondary education qualifications. Some of these workers may have obtained no more than a certificate of the YTS, for instance.

Table 7 Production functions without and with efficiency dummy

	Original model	Extended (efficiency dummy)
Constant (A)	-3,75** (6,91)	-3,38** (-10,75)
Capital (β)	0,82** (22,12)	0,79** (32,84)
Intermediage education (θ_2)	0,47** (3,94)	0,47** (8,14)
Higher education (θ_3)	0,18** (3,45)	0,14** (5,32)
Training (τ_{ijt})	-0,07 (-0,97)	-0,10** (-2,11)
Training (τ_{ijt-1})	-0,12* (-1,94)	-0,09** (-2,35)
Training (τ_{ijt-2})	-0,06 (-1,19)	0,01 (0,36)
Agriculture	0,24 (1,34)	0,02 (0,21)
Mining and quarrying	0,60** (4,91)	0,60** (7,58)
Manufacturing	0,93** (10,38)	0,94** (15,54)
Energy & water	-0,6 (-0,42)	-0,15 (-1,52)
Construction	1,97** (20,14)	1,88** (30,60)
Trade, hotels and restaurants	1,03** (10,31)	1,03** (18,97)
Transport, storage and communication	0,43** (3,63)	0,30** (4,54)
Financial services and insurance	0,53 (3,21)	0,26** (3,26)
Real estate and business services	0,01 (0,08)	0,06 (0,70)
Social and personal services	0,45** (3,44)	0,26** (3,06)
Government services	0,66** (4,89)	0,50** (7,84)
Other	-	-
Germany	1,99** (19,74)	2,16** (40,94)
Netherlands	0,98** (10,15)	1,05** (19,83)
Trend (t)	0,10* (1,71)	0,19** (5,97)
Efficiency dummy (d_{ineff})	-	-0,614** (-16,43)

The sector Other is reference sector and the United Kingdom is reference country. The efficiency dummy has been included in model in the right-hand column, which means that the coefficient d_{ineff} does not appear in the original model. One asterisk (*) means that the coefficient is significant at 90% while two asterisks (**) means that a coefficient is significant at 95%. De labour coefficient can be calculated as $\alpha=1-\beta$.

8 Thick Frontier Results

Table 10 shows the estimates of above production functions. The column on the left shows the estimates of the original equation, whereas the column on the right contains the estimates of the extended production function which included the inefficiency dummy. The technical efficiencies which are the result of the estimated models are shown in table 11.

Table 11 Technical efficiencies accordingly the thick frontier method

	Germany	Netherlands	United Kingdom
Production sectors	0,63	0,89	0,74
Service sectors	0,72	0,59	0,65
Entire economy	0,69	0,74	0,69

Source: error terms of the extended model and recalculated using equation (11).

According to the procedure followed in this paragraph, the Netherlands is the most efficient country of the three. Although Germany is a country of heavy industry, it shows good performance in service industries, while the Netherlands perform badly in these industries. The United Kingdom is relatively inefficient if its economy as a whole is considered, but appears to keep a modest position if the figures concerning services and production industries are considered separately.

9 Conclusions

Our comparative institutional analysis predicts that the Netherlands is moderately efficient in all three respects studied in this paper. On the training market, Germany has higher efficiency indices than the other two countries, whereas the United Kingdom has a low index for dynamic efficiency. The labour market shows a high score for allocative efficiency in Germany and a low score for the United Kingdom. According to this analysis, the United Kingdom performs rather well in terms of cost efficiency on the labour market.

The frontier procedure shows that the Netherlands produces most efficient, while Germany and the United Kingdom lag behind by approximately 5 percentage points. Although Germany is an industrial country, the efficiency of its production sectors is lower than those of the other two countries, while the efficiency of its service sectors is higher. This might tell us either that we need to be careful interpreting the results of the frontier procedure, or that the comparative advantage of each of the three countries is not due to efficiency.

The Dutch moderate institutional efficiency indices could be connected to the Dutch high technical efficiency scores. Concentrating equally on institutions that equally affect all three forms of efficiency may positively affect technical efficiency, which we could take as a hypothesis for further research. Since there is no striking difference between the German and the British technical efficiency scores, we cannot conclude that concentrating on a particular kind of institutional efficiency positively affects technical efficiency. Neither can we state that there is an ex-ante set of institutions clearly enhances technical efficiency. We can only postulate a new hypothesis, that equally concentrating on all three types of efficiency may have a positive effect on technical efficiency.

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Appendices

A.1 Scores by institution in Germany, the Netherlands and the United Kingdom

A.1.1 Germany

Effects	Dynamic Eff.	Allocative Eff.	Cost Efficiency
External flexibility	-5	5	0
Internal flexibility	0	0	1
Internalizing external effects	-10	0	-10
Commitment	7	0	7
Contractability	10	10	0
Transparancy	7	7	0
Diversity (e.g. method)	-5	0	0
Equity	4	4	4
Scale economies	2	-2	0
Accountability	0	5	5

A.1.2 Netherlands

Effects	Dynamic Eff.	Allocative Eff.	Cost Efficiency
External flexibility	-2	2	0
Internal flexibility	0	0	1
Internalizing external effects	0	0	0
Commitment	2	0	2
Contractability	3	3	0
Transparancy	-3	-3	0
Diversity (e.g. method)	4	0	0
Equity	1	1	1
Scale economies	-2	2	0
Accountability	0	-3	-3

A.1.3 United Kingdom

Effects	Dynamic Eff.	Allocative Eff.	Cost Efficiency
External flexibility	10	-10	0
Internal flexibility	0	0	7
Internalizing external effects	9	0	9
Commitment	-6	0	-6
Contractability	-12	-12	0
Transparancy	-17	-17	0
Diversity (e.g. method)	13	0	0
Equity	6	6	6
Scale Economies	-14	14	0
Accountability	0	0	0

A.2 Presence of institutions in Germany, the Netherlands and the United Kingdom multiplied by institutional effects

A.2.1 Germany

	Characteristic	Dynamic Eff.	Allocative Eff.	Cost Eff.
Restrictions in qualification syst.	Number of qualifications	-1	0	-2
Clear definitions at national level	Definitions of qualifications	1	3	1
Clear definitions at national level	Status and supply of training	1	3	1
Specialisation of institutes	Nature of education supply	-1	0	0
Relative influence employees/employers	Social partners	0	2	-1
Obligatory particip- ation of firms in existing programmes	Participation	3	2	1
Public finance of job-related training	Public investments	0	0	0
Output-based finance	Financial responsibility	1	0	0
Price competition	Financial responsibility	0	3	2
Relative influence employees/employers	Supply of vocational skills	0	0	0
Stable Policy	Tradition	2	2	-2
Control & guardening of examination standards	Coordination: standards	1	3	1
Price competition	Coordination: equipmen	0	3	2
Restrictions in qualification system	Coordination: number of courses by institute	0	0	0
Stable policy	Participation	0	0	0
Stable policy	Stability	2	2	-2
Merging of institutes	Nature of education supply	0	2	2
Public finance of job-related training	Participation	0	1	3
Control & guardening of examination standards	Time apprentices	1	3	1

A.2.2 The Netherlands

		Dynamic Eff.	Allocative Eff.	Cost Eff.
Restrictions in qualification syst.	Number of qualifictions	2	0	4
Clear definitions at national level	Definitions of qualifications	1	3	1
Clear definitions at national level	Status and supply of training	0	0	0
Specialisation of institutes	Nature of education supply	-1	0	0
Relative influence employees/employers	Social partners	0	4	-2
Public finance of job-related training	Public investments	0	0	0
Output-based finance	Financial responsibility	1	0	0
Price competition	Financial responsibility	0	-3	-2
Relative influence employees/employers	Supply of vocational skills	0	2	-1
Stable Policy	Tradition	0	0	0
Control & guardening of examination standards	Coordination: standards	1	3	1
Price competition	Coordination: equipmen	0	-3	-2
Restrictions in qualification system	Coordination: number of courses by institute	1	0	2
Stable policy	Participation	-1	-1	1
Public finance of job-related training	Participation	0	0	0
Obligatory particip- ation of firms in existing programmes	Participation	0	0	0
Stable policy	Stability	-1	-1	1
Merging of institutes	Nature of education supply	0	-2	-2
Control & guardening of examination standards	Time apprentices	0	0	0

A.2.3 United Kingdom

		Dynamic Eff.	Allocative Eff.	Cost Eff.
Restrictions in qualification syst.	Number of qualifications	1	0	2
Clear definities op nationaal niveau	Definitions of qualifications	-1	-3	-1
Duidelijke definitions at national level	Status and supply of training	1	3	1
Specialisation of institutes	Nature of education supply	0	0	0
Relative influence employees/employers	Social partners	0	-2	1
Public finance of job-related training	Public investments	0	1	3
Output-based finance	Financial responsibility	0	0	0
Price competition	Financial responsibility	0	0	0
Relative influence employees/employers	Supply of vocational skills	0	-2	1
Stable Policy	Tradition	-2	-2	2
Control & guardening of examination standards	Coordination: standards	-1	-3	-1
Price competition	Coordination: equipmen	0	-3	-2
Restrictions in qualification system	Coordination: number of courses by institute	2	0	4
Stable policy	Participation	-1	-1	1
Public finance of job-related training	Participation	0	1	3
Obligatory particip- ation of firms in existing programmes	Participation	-6	-4	-2
Stable policy	Stability	-2	-2	2
Merging of institutes	Nature of education supply	0	4	4
Control & guardening of examination standards	Time apprentices	-2	-6	-2