The Determination of Key Skills from an Economic Perspective

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We review the 'key skills' concept and design a methodology to determine which skills are key skills. Notwithstanding a large research tradition on key skills, there exists no clear criterion that is suitable to guide this decision. HRD might gain from such a criterion since an optimal investment in skills requires information on which skills are 'key' in production. Following the theoretical part, we determine key skills empirically using a dataset of vocational education graduates.

Keywords: Key Skills, Economics

Key (or 'core') skills play a significant role in the current debates on the importance of skills and lifelong learning. A large literature on key skills notwithstanding, there does not seem to be not much agreement on the exact definition of key skills. In the UK, for example, key or core skills have been defined in many different ways. Some have seen them as the way out of the over-specialized A-levels, or as a way to bridge academic and vocational tracks. For Uk's Vocational Education and Training system some have argued that core skills are a means through which skills or qualifications can be transferred to multiple (vocational) contexts (Green, 1998).

To make it even more complicated, there seems to be an international linguistic confusion about the terms themselves. In the United States key skills are usually called "basic skills" (e.g. Bynner, 1997) or "generic skills" (Stasz, 1998), whereas in continental Europe (e.g. Germany or the Netherlands) one speaks of "key qualifications" or "key competencies" (Bunk, 1994; Nijhof, 1998; Onstenk, 1997; Reetz, 1989a, 1989b).

Typically, policy documents contain lists of key skills that seem plausible at first sight, but justification for which skills should be included are not given. Part of the confusion in the field of key skills has arisen due to the fact that *skills* have been studied from many different scientific backgrounds. Psychologists have treated skills as personal cognitive or physical fitness for task completion (Anderson, 1995; Gagné, Briggs, & Wager, 1988). In sociology, skills are perceived as means for workers to identify themselves with a certain vocational population. And for economists, especially those adopting the Human Capital theory, skills are personal attributes that are required in the process of value adding in the workplace (Attewell, 1990). In education skills are treated as trainable procedural personal proficiencies, which can be measured in performance tests.

One of the main issues in modern Human Resource Development (HRD) is keeping workers' skills up to date. Due to the ongoing changes in the workplace, workforce flexibility has become an important asset in keeping organizations competitive (Watkins & Marsick, 1993). Investing in workers' skills has therewith become part of company strategy in many organizations. An efficient investment in worker skills requires, however, that information is available on which skills are most important to invest in. Up until now, presumably, most organizations have relied on the current debate for deciding on which skills to invest in. Throughout the years, different key skills have been emphasized. With the emergence of new ways of organizing work, 'team working' skills have been stressed as key skills, while the diffusion of information technology in many workplaces has triggered the emphasis on ICT skills. Although there is a growing literature on key skills, both theoretical and empirical arguments for what skills are key skills and what skills are more 'key' then others, are lacking. In this paper, we attempt to bring some consistency in the debate on key skills by developing a methodology that enables the identification of key skills from an economic perspective. The central research question of this paper therefore is: *How can we determine which skills are 'key' skills in a theoretically sound manner?* The remainder of this paper is organized as follows: In the next two sections we review the key skill concept and develop a model for determining key skills. We then discuss the methodology used to determine key skills empirically. Using a dataset of working Dutch intermediate vocational education graduates, the results of this exercise are presented in the next section. The final section concludes and summarizes.

Theoretical Framework

Key skills: Some InsightsFrom the Literature

One of the early American examples of the use of key skills in practice can be found in 1983 in the district of Lewisville, Texas. A Superintendent's Advisory Committee conducted a study in order to determine the desired key skills of students graduating from high School. They developed a questionnaire, which was sent to community members and officials from the business and professional community. Respondents were asked to rate the skills they found important. The 62 surveyed skills fell into nine categories. The skill categories rated "important" or "extremely important" by 80% or more of the members of the business and professional community were: Decision-making Skills; Future Plans; Life Coping Skills; Physical, Social, and Personal Health; and Computational Skills (Killian, 1983). In this example key skills refer to the most *important* or *desired* skills. These skills are different from the key skills found in the UK, where key skills are of a *generic* and *transferable* nature.

In the context of vocational education in Britain, key or core skills particularly refer to the core of functioning at work. Core skills reside in the training and vocational branch of education (Tribe, 1996). The basic ideas of the UK core skills movement can be linked to a list set up by the Further Education Unit in 1979. According to this document, core skills were supposed to:

- bring about an informed perspective as to the role and status of a young person in an adult society and the world of work;
- provide a basis from which the person can make an informed and realistic decision with respect to his or her immediate future;
- bring about continuing development of physical and manipulative skills;
- bring about an ability to develop satisfactory personal relationships with others;
- provide a basis on which the young person acquires a set of moral values applicable to issues in contemporary society;
- bring about a level of achievement in literacy, numeracy and graphicity appropriate to ability and adequate to meet the basic demands of contemporary society;
- bring about competence in variety of study skills;
- encourage the capacity to approach various kinds of problems methodically and effectively, and to plan and evaluate courses of action;
- bring about political and economic literacy;
- encourage an appreciation of the physical and technological environments and the relationship between these and the needs of man in general, and working life in particular;
- bring about a development of the coping skills necessary to promote self sufficiency in young people;
- bring about a flexibility of attitude and a willingness to learn, sufficient to manage future changes in technology and career.

  (Tribe, 1996, p. 13-14)

Many lists of core skills have followed since then. Some aspects, however, come back in many lists. Core skills have been looked at as being skills that are generic and transferable, which means that they are applicable to a wide variety of occupations and transferable to many contexts. According to Tribe, most of the lists include: communications, numeracy, problem solving, teamwork, and technology skills. However, the question of which skills should be on the lists of key skills has not been approached using a scientific criterion. In practice, the skills on these lists tend to be those skills that are subjectively needed for education, everyday life and especially for work (QCA, 2000). Green (1998, p. 34-35) describes how core skills emerged in the UK:

"Core skills have emerged out of an historical absence in the UK. Alone amongst the major European nations in the 19th century, England developed a technical and vocational education that had no inherent connection with general education and schooling. Whilst on the Continent, and particularly in France and the German speaking states, the typical form of vocational training was the state-sponsored trade school, which combined workshop training with systematic instruction in vocational theory and general education, in England, with its voluntarist traditions, there were few such schools and vocational as opposed to skills training had to evolve in an ad hoc and relatively unsupported fashion [...]"

In reality in the UK, core skills refer to "just-enough" basic theoretical content. General academic education is brought into the vocational curriculum in an attempt to give vocational training a more profound general (theoretical) foundation (Tribe, 1996). Training in this sense becomes instrumental, especially to economic growth and prosperity. This has resulted in the criticism that core skills only represent the low level minimal standards of the academic content in UK's VET. General academic education is brought into the vocational curriculum as far as it underpins performance in expected work tasks and can be reduced to core skills (Green, 1998, pp. 28).

The core skills in the UK were renamed by the Qualifications and Curriculum Authority (formerly National Council for Vocational Qualifications (NCVQ) and the School Curriculum and Assessment Authority (SCAA)) into key skills. The QCA adopted a list from City and Guilds which consists of:

- Communication;
- Application of number;
- IT;
- Working with others;
- Improving own learning and performance; and
- Problem solving.

(QCA, 2000)

According to the QCA, key skills are widely applicable in work, education and everyday life. This does not help much in further defining the concept.

Across national boundaries, the literature reveals that reasons for including a skill as in a list of key or core skills have usually been political or practical. The National Institute for Literacy has recently published a study that describes the identification of key skills (Merrifield, 2000). In this study, common activities and generative skills (which appear to be closely related to the key skills concept) were defined by using an iterative procedure by a number of working groups of experts. In another document, in the context of California community colleges, the definition of core skills is left to faculty, since they "...agree on a body of skills that most or all of our students should master before graduating" (Palomar College, 1999). The European Training Foundation (Shaw, 1998) has relied on a survey among experts in the EU-countries in order to determine key skills. There have also been changes over time regarding the definition of key skills. Typically, inspired by developments taking place in the work place, employers, politicians or other stakeholders have emphasized the importance of certain skills, which has resulted in many different lists of key/core skills.

The debate on key skills would greatly benefit from a common definition. Not claiming to have found the perfect one, this is our point of departure. Within the scope of this paper we define key skills from an economic perspective. As a starting point we consider *skills* to be personal and related to productivity, restricting its scope to work. Secondly, most skills can be developed or shaped by means of education and training or experience. Some skills, however, are difficult to develop. These are usually connected to attitudes or personality. Thirdly, literature on expertise has showed that skills are especially context-bound, since they are developed and applied in specific contexts of human activity (e.g. in a specific job, with specific restrictions, or in a specific organization) (Chi, Glaser, & Farr, 1988). We may define skills as:

Individual (developed or innate) attributes representing context-bound productivity.

Key skills, as we saw in the discussion above, have appeared due to the fact that some underpinning foundation of transferability is needed at the present labor market. Stasz (1998) argued that the modern workplace is changing because of technological innovations, flatter organizational hierarchies, and increasing globalization of markets. These changes have caused a higher demand on the flexibility of the workforce, which is reflected in hiring decisions of employers. Employers increasingly demand "generic skills" next to job-specific skills. Although research by (Bishop, 1997) showed that job-specific skills are still among the most wanted and productivity-related skills, he admits that the more general and underpinning skills are important as well. Bishop, focusing at the productivity effects of skills, reflected in wage and employer satisfaction, argues that skills like reading and mathematical skills "contribute to productivity by helping the individual learn the occupational and job specific skills that are directly productive. This implies that key skills impact productivity indirectly, rather than directly. If this is the essential characteristic of key skills, they may be defined as:

Skills that have stronger indirect effects than direct effects on productivity.

The remainder of this paper is devoted to finding skills that have this characteristic. This implies a better justification of developing a list of key skills. Rather than making political statements, those skills that have a larger indirect contribution to productivity than their direct contribution may be identified as key skills.

Identifying Key Skills: An Economic Framework

The contribution of skills to economic success, and in particular to productivity, can be measured in several ways. For example, one could determine the relative importance of skills to employers, for instance by studying selection criteria. One could also relate wage inequities of groups within a population to skills profiles. Usually the educational qualifications of groups earning higher wages are compared to the qualifications of those earning less. Another methodology might be an ethnographic approach, in which one studies in detail which changes took place within production or service industry work and their consequences for skill requirements. A final example is to determine skills effects in a mathematical way by relating skills to wages (Levy & Murnane, 1999).

In economics the determination of skills that matter for wages has a rich history in the literature. In the well-known human capital literature (Becker, 1962; Mincer, 1974), skills are essentially divided into being either general or specific. Later, attention has been paid to skills that fall in between, so-called 'transferable skills' (Stevens, 1994). The attention for skills as such, opposite to composites of human capital, has led to the development of research that addresses the contribution of different types of skills to productivity or wages. This literature has usually focused on a mathematical linear relation between skills and wages of the form:

$$\ln W_i = \beta_0 + \beta_1 S_{1i} + ... \beta_N S_{Ni} + \varepsilon_i, \quad (1)$$

This approach has two drawbacks. Firstly, it does not focus on the relation *between* different skills, which seems essential when one tries to determine what skills are key skills. Secondly, the results of the regression analysis presented in (1) may be blurred by serious multicollinearity, since different skills tend to be strongly correlated.

In this paper, we present a different approach for determining key skills. In order to focus on the 'key' nature of the skills, we explicitly take into account the relations that exist *between* the different skills distinguished. We do this by finding the relationships between the different skills first, before performing any kind of wage regression. When key skills are considered to be skills that make other skills more productive, we may set up the following model:

$$S_{in} = c_n + \sum_{j=1}^{N, j \neq n} \beta_{jn} S_{ij} + \varepsilon_{in} \quad (2)$$

For all skills (S_n,n=1...N) this equation relates S_n to a constant and all other skills (S_j, j=1...N and j≠n). Now, in order to find the indirect effect of a skill j, we add up all the contributions of this skill to other skills, or in formal terms:

$$\gamma_j = \sum_{n=1}^{N, j \neq n} \beta_{jn} \quad (3)$$

In a second step, we set up a skill-wage equation:

$$\ln w_i = \alpha + \beta_n S_{in} + \varphi_j \sum_{j=1}^{N, j \neq n} S_{ij} + \varepsilon_i \quad (4)$$

This equation relates a skill n and the summation of all other skills to wages. We then use (3) and (4) to determine the marginal effect of a change in the skills. The direct wage effect of a marginal change in S_{in} is β_n. A change in S_{in}, however, also has an indirect effect on all other skills, namely γ_j (equation 3). Since we are dealing with marginal changes, γ_j can also be considered as the total change in $\sum_{j=1}^{N, j \neq n} S_{ij}$, implying that the total indirect wage effect is $\gamma_j \cdot \varphi_j$. In other words the skill-wage equation is composed of two skill effects: a direct effect of a certain skill to wages and a total indirect wage effect of the same skill. Now we can calculate both effects for each skill.

Research Questions

The research questions that evolve from the previous discussion are:

1) Which skills may be considered 'key skills', in the sense that their indirect effect on productivity is larger than their direct effect?
2) What are the direct and indirect productivity effects of these 'key skills'?

A key skill has been defined as a skill that has a larger cumulative indirect effect on other skills than on itself. In terms of equation (3) a skill is a key skill when $\gamma > 1$. The second research question is on the productivity effect of key skills. We calculate this productivity effect using equations (3) and (4), as explained above.

Methodology

In order to determine which skills are key skills, we use data from a graduate survey of Dutch intermediate vocational education graduates. The respondents where approached approximately 1 year after they graduated. During October-December 1999, 18.513 questionnaires were sent out, of which 9068 were returned. A little over 1.000 questionnaires were not suitable for data-entry, so that 7.889 cases remained. In order to focus on a group that is relatively similar in terms of activities, we selected those respondents who were working full-time (at least 35 hours) in an organization (we excluded self-employed graduates). This left us with 1702 cases for analysis.

The part of the questionnaire that is of particular interest for this paper is the list of skills. For fifteen different skills, respondents where asked to indicate on a 5 point Likert scale to what extent the listed aspects are required in their work. Using the data from these fifteen skill measures we approached skill by the so-called 'competence-in-use' concept (see Ellström, 1998), implying that skills are measured by the interaction between individual capacities and job requirements. Table 1 gives an overview of the skills investigated together with their average scores.

Table 1. *Skills in the graduate survey and their average scores*

Skills	Score
Professional theoretical knowledge (S1)	4.21
Understanding of ICT (S2)	3.84
Understanding of operational management (S3)	3.60
Putting theoretical knowledge and techniques into practice (S4)	4.07
Written presentation, writing skills (S5)	3.48
Oral presentation, speaking skills (S6)	3.95
Transfer of knowledge (S7)	4.00
Planning, coordinating and organizing activities (S8)	3.85
Problem-solving skills (S9)	4.36
Contactual skills (S10)	4.31
Co-operating, working in a team (S11)	4.47
Independence (S12)	4.60
Initiative, creativity (S13)	4.47
Adaptability (S14)	4.37
Accuracy, carefulness (S15)	4.67

Results

In this section, we apply the model previously developed to the data. In order to find the indirect skill effects, we performed for each skill a separate regression on all the other skills. In table 2, we provide the regression estimates of the parameters of the explanatory skills in the regressions.

The results in the table reveal that from the 210 coefficients estimated, 78 are not significant and therefore not displayed. Twenty coefficients have a negative effect, while 112 coefficients have the expected positive effect. The final column shows that skills that have a cumulative effect on other skills, which is larger than 1 are: Problem-solving skills, independence, oral presentation/speaking skills, accuracy/carefulness, initiative/creativity and contactual skills. According to our criterion defined earlier, these six skills may be considered key skills. When these outcomes are compared to several lists of key skills published in the literature, we find a number of skills that are comparable. A notable exception to this are ICT-skills. While these are often cited as being key skills, our methodology fails to find evidence for this.

Table 2. *Regression estimates of the parameters in the skill regressions*

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15	γ_j
s1		0.1330	NS	0.4700	-0.0886	NS	0.1230	-0.0577	0.0751	NS	NS	0.0293	NS	NS	0.0436	0.7278
s2	0.0895		0.2570	-0.0438	0.2040	0.0406	NS	NS	NS	0.0399	NS	0.0339	-0.0291	NS	0.0403	0.6324
s3	NS	0.2590		-0.0378	0.1120	0.0787	0.0596	0.1400	0.0477	NS	NS	NS	NS	-0.0315	NS	0.6278
s4	0.4160	-0.0578	-0.0495		0.0524	NS	0.1510	NS	0.0622	NS	NS	NS	NS	0.0348	0.0450	0.6540
s5	-0.0678	0.2290	0.1250	0.0447		0.2890	NS	0.1700	NS	NS	NS	NS	NS	NS	0.0279	0.8178
s6	NS	0.0564	0.1090	NS	0.3570		0.1730	0.0761	NS	0.2090	0.0555	-0.0234	0.0343	0.0312	NS	1.0781
s7	0.1180	NS	0.0840	0.1630	NS	0.1780		0.1270	0.0624	0.0500	0.0609	0.0295	NS	NS	NS	0.8728
s8	-0.0408	NS	0.1470	NS	0.1590	0.0577	0.0942		0.1540	0.0326	-0.0559	NS	0.0774	NS	-0.0407	0.5846
s9	0.1110	NS	0.1040	0.1040	NS	NS	0.0962	0.3220		0.1920	NS	0.0450	0.1040	0.0646	0.0926	1.2355
s10	NS	NS	0.0801	NS	NS	0.3030	0.0708	0.0626	0.1760		0.2300	NS	-0.0386	0.1180	NS	1.0020
s11	NS	NS	NS	NS	NS	0.0721	0.0771	-0.0956	NS	0.2050		0.0357	0.0716	0.1010	0.1060	0.5729
s12	0.0722	0.1240	NS	NS	NS	-0.0618	0.0760	NS	0.0751	NS	0.0726		0.3700	0.2120	0.2540	1.1940
s13	NS	-0.0863	NS	NS	NS	0.0733	NS	0.2180	0.1400	-0.0567	0.1180	0.3000		0.2510	0.1050	1.0624
s14	NS	NS	-0.0791	0.0667	NS	0.0569	NS	NS	0.0744	0.1480	0.1420	0.1460	0.2140		0.1320	0.9009
s15	0.0900	0.1240	NS	0.1050	0.0764	NS	NS	-0.1190	0.1300	NS	0.1810	0.2130	0.1090	0.1610		1.0704

In table 3 below we provide the direct and indirect wage effects from the wage regressions we performed. We also calculate the total indirect effect $\gamma_j.\varphi_j$.

Table 3. *Direct and indirect wage effects from skills*

Skill	β	φ	γ	$\varphi\gamma$
Professional theoretical knowledge	NS	0.0019	0.72780	0.0014
Understanding of ICT	NS	0.0020	0.63239	0.0013
Understanding of operational management	NS	0.0031	0.62778	0.0019
Putting theoretical knowledge and techniques into practice	NS	0.0027	0.65404	0.0017
Written presentation, writing skills	0.0214	NS	0.81781	NS
Oral presentation, speaking skills	NS	0.0026	1.07806	0.0028
Transfer of knowledge	0.0202	NS	0.87276	NS
Planning, coordinating and organizing activities	0.0238	NS	0.58455	NS
Problem-solving skills	0.0251	NS	1.23552	NS
Contactual skills	NS	0.0023	1.00198	0.0023
Co-operating, working in a team	-0.0192	0.0036	0.57285	0.0021
Independence	-0.0280	0.0041	1.19403	0.0048
Initiative, creativity	-0.0224	0.0039	1.06236	0.0042
Adaptability	-0.0166	0.0036	0.90085	0.0032
Accuracy, carefulness	-0.0294	0.0042	1.07036	0.0045

The table shows that writing skills, transfer of knowledge, planning/coordinating/organizing activities and problem solving skills all have positive direct wage effects of around 2%. In contrast, co-operating/working in a team, independence, initiative/creativity, adaptability, and accuracy/carefulness all have negative direct effects on wages. Column 2 shows that of the 15 skills distinguished, 11 have significant and positive effects on wages in the range of 0.2 – 0.4%. The final column displays the total indirect wage effect from key skills. It reveals that these effects are largest for independence, accuracy/carefulness and initiative/creativity. Since problem-solving skills does not have a significant indirect effect on wages, the total indirect wage effect from this skill cannot be calculated.

Conclusions

This paper has tried to bring some consistency in the debate on key skills. Instead of making political statements by relying on ideas inspired by developments taking place in many workplaces, we have attempted to approach the key skill concept from a quantitative perspective. When key skills are defined as those skills having larger indirect effects on productivity than their direct effects, we may identify them using an economically inspired framework.

When we apply our theory to a sample of graduates, we find six key skills: problem-solving skills, independence, oral presentation/speaking skills, accuracy/carefulness, initiative/creativity and contactual skills. It is comforting that in many lists of key skills, similar aspects are included as being key skills. The often-cited IT skills, as being key in the modern workplace can, however, not be identified as a key skill using our methodology. A shortcoming of our analysis is that we cannot justify the choice of the fifteen skills we used in testing our methodology.

Although the empirical outcomes we obtained are intuitively appealing, our research methodology needs further investigation for adequacy, reliability and validity across countries, types of education and occupations in order to

improve on the methodology for defining and determining key skills. This would imply a significant advance in the usefulness of the debate on key skills and the application of this debate in educational curricula and continuing professional education. When key skills are those skills that make the difference in peoples' careers, more research in this area is also something that HRD in general should be concerned with.

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