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Original article

Employee education, information and communication technologies, workplace organization, and trade: a comparative analysis of Greek and Swiss firms

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Abstract

We investigated the effect of modern information and communication technologies (ICT), new forms of workplace organization, and trade (export) activities on the demand for employees with different levels of (vocational) education for Greek and Swiss enterprises. We found positive (negative) effects of the use of ICT for high-educated (low-educated) personnel in both countries and mixed effects for medium-educated employees. New forms of workplace organization do not have uniform effects on the workforce composition. A positive effect of exports for high-educated employees was traced only for Swiss firms.

JEL classification: J23, J24, 030.

1. Introduction

There is long-term empirical evidence that both the number and the employment share of high-skilled (or high-educated) workers have grown over time in many Organization for Economic Co-operation and Development (OECD) countries. In the last years many prominent economists were engaged in an intensive discussion on the reasons for the observed shift of labor demand toward high-skilled workers (see, e.g., Johnson, 1997 and the other contributions of the symposium in the spring 1997 issue of the *Journal of Economic Perspectives*; Acemoglu, 2002; Michaels *et al*., 2013).

An older alternative theoretical approach is the O-Ring theory (Kremer, 1993). If technical progress is denoted by a higher number of technologically fixed tasks per technology, it can be shown that firms combine the highest-skill workers with the technologies with the highest number of tasks (complementarity of skills and technology). Further, Finegold and Soskise (1988) in a paper analyzing the British education and training system emphasize the crucial role of supply of education and training in easing the transition of workforce skill mix to new technologies, thus helping to adjust to rapid technical progress. In a wider context, Finegold (1999) developed a framework for geographic clusters of high-technology companies, or what he called "self-sustaining high-skill ecosystems," a constitutive element of which is, besides other standard requirements, a high degree of interdependence among the actors in the ecosystem, and between high technologies and skills.

From a theoretical point of view a new branch of growth theory has integrated the notion of a positive relationship between human capital intensity and technical progress in models showing that innovation is a relatively more skill-intensive activity than imitation. As a country moves closer to the technological frontier, it relies more on innovation and less on imitation, which implies a reallocation from lower-skilled to higher-skilled labor (see Vandenbussche *et al*., 2006; see also Aghion and Howitt 2006 for embedding these ideas in a unifying framework that allows formulating growth policy recommendations).

One of the most popular explanations for the observed shift of labor demand toward high-skilled workers that have been offered by the economic literature is based on the so-called "skill-biased technological change"-hypothesis, according to which the reason for the upskilling of labor force is the non-neutrality of technological change, which favors the use of skilled labor more than the use of other labor inputs. Due to the complementarity of skills (education) and technology, an acceleration of the rate of technological change would cause an increase of the demand for skilled labor.[1] The reason for the most recent acceleration of technological change is assumed to be the diffusion of information and communication technologies (ICT), which seem to have given new impetus to the substitution process of low-skilled by high-skilled employees. Nevertheless, for some authors it is not clear, whether the observed shift of labor demand is caused mainly by within-sector technological change or by sector-biased technological change, i.e., technological change affecting only some specific sectors (see, e.g., Haskel and Slaughter, 2002).

However, on the whole, the technology hypothesis cannot explain the entire magnitude of the observed labor demand shifts toward high-skilled labor. This is the reason why some researchers have looked for other possible alternative or complementary explanations of this change of the composition of the labor force. For industrial and managerial economists such alternative explanations could be associated with the reorganization of production which took place parallel to the introduction of ICT (see, e.g., Aoki, 1986; Milgrom and Roberts, 1995). This reorganization includes the introduction of new forms of workplace organization, such as teamwork, job rotation, decrease of hierarchical levels, decision decentralization (see, e.g., Caroli, 2001). These new forms of workplace organization are regarded as a basic complement of ICT (OECD, 2003).

Furthermore, for trade economists alternative explanations could be related to the internationalization of economic activities (see, e.g., Wood, 1995; Feenstra and Hanson, 2001). The main argument is that the accelerated growth of world trade and foreign direct investment leads to a new international division of labor: the production of goods (and services) with a high content of low-skilled labor is dislocated to developing countries of the south, while activities with a high content of high-skilled labor are concentrated in the developed countries of the north. It is clear that this argument does not apply to the mainly intra-industry trade among most countries of the European Union or between European countries and the USA or Japan.

A combined investigation of all these three possible explanations, ICT-induced technological change, organizational change, and trade, particularly exporting, is the approach we are going to pursue in this article, using firm-level data from two countries, Greece and Switzerland, which are characterized by quite different levels of economic development (see Table A1 for key figures of these two countries).The analytical framework of this study is that of a demand function for employees with different education levels (heterogeneous labor) at firm level. Both the Greek and the Swiss part of this study are based on firm-level data collected through the same questionnaire and from samples of similar composition (concerning firm size classes and sectors), and also use the same variables and models specification, so they are comparable. Concerning the two countries considered in this study there is to our knowledge only one study for Switzerland that deals with these issues (Arvanitis, 2005a). In an earlier comparative study, Arvanitis and Loukis (2009) investigated the effects of two of the above three factors, ICT and new forms of workplace organization, and also of human capital, on labor productivity in the same two countries (Greece and Switzerland); this study revealed both similarities and also interesting differences as well between the two countries in the above effects and their complementarities, indicating that national context characteristics can influence these effects, so this has to be seriously taken into account in future studies.

The contribution of the present study to empirical literature consists in (i) taking into consideration all three main factors forwarded in literature for explaining the shift of labor demand in favor of high-skilled labor in the same setting, which allows a comparison of their effects; (ii) investigating possible complementarities among these three

1 Yet it is also true that an increase in the supply of skills could also induce an acceleration of technological change; it is mostly assumed that in the long run the driving force from the demand side is the dominant one (see, e.g., Acemoglu, 1998); the empirical evidence seems to support this notion.

factors; and (iii) conducting a comparative study of the above effects between two countries, Greece and Switzerland, which are characterized by different levels of economic development, allowing a better understanding of the impact of national context characteristics on these effects.

The structure of this article is as follows: In section 2 the conceptual framework and the research hypotheses of this study is presented. Section 3 contains a review of the previous relevant empirical literature. Section 4 surveys aggregated economic information about Greece and Switzerland. In section 5 the data of both the Greek and the Swiss parts of the study are described and the specification of the model variables is presented. The results of the econometric estimates are presented and discussed in section 6. Finally, in section 7 conclusions are summarized and policy and research implications are discussed.

2. Conceptual background and research hypotheses

2.1 The "new firm" paradigm

The last 20 years have witnessed a constellation of important changes of the production process as associated with the extensive use of computer-aided production technologies, the advances in ICT, the emerging of new ideas on how to organize firms, changes in the skill requirements of labor, and changes in employee preferences toward more flexible working conditions. On this ground, many authors even postulated a shift to a new "firm paradigm." Some of them focused their attention mainly to technological changes (e.g., Milgrom and Roberts, 1990), some found the introduction of new organizational practices a central characteristic of this "paradigm change" (e.g., Lindbeck and Snower, 2000), while a third group concentrated primarily on the shift of firm demand to high-skilled labor in the last 20 years and analyzed the determinants of this shift (e.g., Bresnahan *et al*., 2002). Related empirical literature based on firm-level data focused mainly on the *direct effects* of such changes on firms' economic performance, mostly measured by average labor productivity (see, e.g., Black and Lynch, 2001 and Bresnahan *et al*., 2002 for US firms for two seminal studies; Badescu and Garcés-Ayerbe, 2009 for Spanish firms; Moshiri and Simpson, 2011 for Canadian firms).

2.2 The "skill-biased technical change"-hypothesis: the role of ICT

2.2.1 The effect on high-educated workers

The shift toward more high-educated workers, which can be observed since the late 60 s or possibly the early 70 s in many OECD countries, appears to have accelerated in the last 20 years (see, e.g., Berman *et al*., 1998; OECD, 1998). While many factors have contributed to this increase, most authors think that this effect is attributable primarily to skill-biased technical change.[2] The size, breadth, and timing of the labor demand shift have led many observers to seek skill-biased technical change in the largest and most widespread new technology of the last years, the ICT (see Bresnahan, 1999; Acemoglu, 2002; Bresnahan *et al*., 2002). On the one hand, high-skilled labor is a precondition for the use of ICT. For example, skills and training in use of computers, problem-solving, and statistical process controls can increase the benefits from ICT. On the other hand, highly computerized systems not only systematically substitute computer decision-making for human decision-making in routine work, but also produce a large quantity of data which need high-skilled workers, managers, and professionals to get adequately utilized.

The specific influence of ICT adoption and use on the composition of the workforce has been a particular subject of recent theoretical and empirical analysis. One important proposition is that ICT capital (i) substitutes for workers performing routine cognitive and manual tasks that can be accomplished by following given rules and (ii) complements workers in performing nonroutine cognitive tasks concerning generalized problem-solving and complex communications (see Bresnahan, 1999; Autor *et al*., 2003). This distinction of routine and nonroutine tasks leads to a further differentiation related to the possibility of different effects on the skill mix depending on the type of technology under study. In manufacturing firms with a large scope for factory automation technologies, increase of the share of high-skilled or high-educated workers may prove to be rather small in comparison to service firms, in which computer investment is mainly related to the work of non-production workers with administrative or managerial tasks (see Doms *et al*., 1997).

2 For comparative studies for several countries supporting this hypothesis see Berman *et al.* (1998); Autor *et al.* (1998); and Machin and Van Reenen (1998); for surveys of the theoretical and empirical literature on skill-based technological change see Sanders and terWeel (2000); Pianta (2005); Acemoglu (2002); Toner (2011); and Vivarelli (2012).

As a consequence of computerization, the demand for high-educated personnel that can perform nonroutine tasks may rise, while the demand for low-educated employees that perform nonroutine tasks may fall.

Therefore our first research hypothesis is:

Hypothesis 1a: There are considerable positive (negative) effects of ICT on the demand for high-educated (low-educated) employees.

2.2.2 The effect on medium-educated workers: the polarization hypothesis

However, many routine tasks are performed not only by low-educated employees but also by medium-educated employees (e.g., bank clerks, technicians) that may also be confronted with a falling demand. Autor *et al.* (2003, 2006) investigated this phenomenon both theoretically and empirically for the US labor market. The key statement of their model is that "computers do not appear to substitute directly for the lowest-skilled workers, rather they appear to displace a set of 'middle-skilled' routine tasks" (Autor *et al.*, 2006: 193). Due to continuous falling of the real price of computing power "computers complement non-routine cognitive tasks, substitute for routine tasks, and have little impact on non-routine manual tasks" (Autor *et al.*, 2006: 189). This model seems to rationalize sufficiently the observed pattern of employment in the 1990s (but not in the1980s) "polarizing into high-wage and low-wage jobs at the expense of middle-skill jobs," a phenomenon that has been characterized as the polarization of the labor market.

Spitz-Oener (2006) in a study based on German data for the period 1979–1999 demonstrated that "occupations have experienced a shift toward analytical and interactive activities and away from cognitive and manual routine tasks. This development . . . .occurred within occupations [and] within occupation-education groups . . . " (Spitz-Oener, 2006: 263f.), quite in accordance with the "routinization"-hypothesis of Autor *et al.* (2003). Moreover, the findings indicated that these shifts have been reinforced by the use of ICT in the workplace.In a study for the UK, Goos and Manning (2007) showed that the UK labor market has exhibited a "job-polarization" pattern significantly earlier than in the USA, namely already in the mid-70 s. In a descriptive study covering 16 European countries (including Greece) for the period 1993–2006, Goos *et al.* (2009) examined the development of the structure of employment with respect to a number of occupations and found declining shares of nine middle-skilled occupations for all 16 countries. In a further study, Goos *et al.* (2011) showed that the shifts described in the earlier study could be traced back primarily to the influence of ICT and to a lesser extent to offshoring.

In a recent study based on industry-level data on the USA, Japan, and nine European countries in the period 1980–2004, Michaels *et al.* (2013) found that industries with faster growth of ICT had greater increases in relative demand for high-educated employees and larger falls in relative demand for medium-educated employees, also in comparison with low-educated employees. These findings would speak clearly for a negative impact of ICT on the share of medium-educated employees.

In sum, the polarization hypothesis in its original version for the USA and the UK postulated a positive effect for the high-educated, a negative effect for the medium-educated, and no (or only slightly) negative effect for the low-educated employees. We concentrate here on the effects for the medium-educated employees.

Whether the impact of ICT use on the employment of medium-educated employees is positive or negative depends on the specific capability mix of this category of employees, which is quite different among countries due to differences of the vocational education system. The possibility of negative consequences of ICT use on the employment share of medium-educated would be especially relevant from the point of view of policy for countries such as Germany, Austria, or Switzerland that have a well-developed vocational education system based on apprenticeship. Moreover, it would be a challenge for these countries to upgrade the skills of medium-educated workers to be able to fulfill the higher skill requirements of technology.

Despite the significant differences with respect to vocational education between Greece and Switzerland (see section 4) we formulate here a common hypothesis for both countries for the medium-educated employees:

Hypothesis 1b: In accordance with the polarization hypothesis negative effects of ICT on the demand for medium-educated employees are expected.

2.3 The "skill-biased organizational change"-hypothesis: the role of new forms of workplace organization

A further hypothesis put forward in the literature recently refers to the influence of the increasing diffusion and application of intra-firm reorganization processes on the observed change of firms' skill requirements. The basic idea is

that a gradual shift from rigid "Tayloristic organization (characterized by specialization by tasks) to holistic organization (featuring job rotation, integration of tasks and learning across tasks)" is taking place within firms (Lindbeck and Snower, 2000: 353). This phenomenon first appeared in the USA and Japan and has spread later throughout Europe, although at a different pace from country to country.[3]

The main elements of reorganization at the workplace level according to economic, management, and sociological studies on this field are (see Ichniowski *et al*., 2000 and Caroli, 2001 for surveys of the literature on this subject): (i) decentralization of decision-making through delegation of relevant competences from management to lower hierarchy levels, increased involvement and autonomy of employees at the shop-floor level; (ii) new working practices such as teamwork (semiautonomous work-teams, quality circles, etc.), job rotation, other forms of multitasking, multi-skilling, etc. Many authors seem to share the idea that changes in work organization toward more "holistic" structures definitely require an upgrading of the skill content of most jobs related to these changes. Caroli (2001) presents a series of reasons for it. These organizational changes increase employees' responsibility for tasks and operations. This is not only the case for operatives, but also for supervisors and technicians, whose roles, hence required skills, are considerably modified by the new organizational practices. Interpersonal abilities that are often closely related to higher education, e.g., the ability to express himself/herself verbally adequately and precisely, also become more important owing to the increasing need for communication and coordination with colleagues. Thus, an important precondition for the successful implementation of most of these new organizational practices is the availability of a higher-skilled (or higher-educated) workforce.

Therefore our second research hypothesis is:

Hypothesis 2: There are considerable positive (negative) effects of new forms of workplace organization on the demand for high-educated (low-educated) employees.

2.4 The trade hypothesis: the role of trade

The main hypothesis is that the accelerated growth of world trade and foreign direct investment leads to a new international division of labor: the production of goods (and services) with a high content of low-skilled labor is dislocated to developing countries of the south, while activities with a high content of high-skilled labor are concentrated in the developed countries of the north (see, e.g., Feenstra and Hanson, 2001). Firms from developed countries with high wages (as compared to developing countries) can become internationally competitive by selling products and services with a high content of high-skilled labor.[4] This results in an increasing relative demand for high-skilled personnel and a declining relative demand for high-skilled personnel in the firms of developed countries having trade (especially export) activities. In the study of Michaels *et al*. (2013) already mentioned trade openness is also taken into consideration as a factor influencing the demand of employees with different skill-levels. However, the authors found no evidence supporting the trade hypothesis, when it is controlled for technology. They assume that trade might influence the workforce composition indirectly, namely via technology, but no clear evidence was presented supporting this hypothesis. Hence, we stick to the notion of a direct effect of trade on workforce composition and formulate our third research hypothesis as follows:

Hypothesis 3: There are considerable positive (negative) effects of trade, especially exports, on the demand for high-educated (low-educated) employees.

The trade effect can be channeled either through the imports or the exports of goods and services of a firm or through both of them. The skill content of imports might influence the composition of the workforce through changes of the skill requirements for utilizing technologically and/or qualitatively advanced production inputs. Analogously, technologically and qualitatively more advanced exports might require high-skilled labor. We concentrate here on exports that are more relevant for the international competitiveness of both countries.

3 See Aoki (1986) and Greenan and Guellec (1994); see also Aghion *et al*. (1999: 1650) for a discussion of the characteristics of recent developments in the structure of European and US companies.

4 For a recent survey of theoretical and empirical literature on trade and its influence on wages see Harrison *et al*. (2011).

2.5 Complementarities: technical change related to organizational change and trade

The use of ICT, new organizational practices, and human capital build a "complementary system" of activities (Milgrom and Roberts, 1995: 191ff; Bresnahan *et al*., 2002: 341ff.). According to Milgrom and Roberts (1990: 514) "the term 'complement' is used not only in the traditional sense of a specific relation between pairs of inputs but also in a broader sense as a relation among groups of activities." Also for the organizational practices there exist interdependencies with other factors and inputs. Some of the changes of work design are associated with the introduction and diffusion of ICT within the firm. For example, Greenan and Guellec (1994: 173) showed in a theoretical paper, in which they investigated the relative efficiency of a centralized mode of firm organization, in which knowledge is confined to specialized workers, and a decentralized one, in which every worker participates in learning depends on the technological level of the firm, that: " . . . the centralized style is more efficient when the technological level is low, the decentralized one becomes more efficient when the technological level is higher." Garicano (2000: 898) postulated also a positive effect between information technology and organizational changes that "would increase the scope of decision-making by lower-level workers, increase the span of control of supervisors, increase the ratio of production workers to problem solvers, and reduce the number of layers of workers with specialized knowledge required." Acemoglu *et al*. (2007) analyzed the relationship between new technologies and the decentralization of firms and show that firms that are more technologically advanced (or closer to the technological frontier in the terminology of the authors) are more likely to choose decentralization. Aghion *et al*. (2013) postulated, among other things, a positive relationship between human capital and decentralization. Further, retaining high international competitiveness as expressed by high exports also necessitates more intensive use of ICT and new forms of workplace organization (see, e.g., Cassiman *et al*., 2010 and Van Reenen, 2011). Strictly spoken, complementarity is defined (and measured) in literature with respect to some performance or innovation variable (Athey and Stern, 1998). In this study we use the notion of complementarity in a similar way with respect to the education-related composition of workforce. In this sense, we postulate positive or negative interrelationships between technology, organization, and trade that indicate mutually strengthening or weakening effects of these factors on demand for employees with different education levels. Hence, our respective hypotheses are as follows:

Hypothesis 4a: There is a positive (negative) interrelationship between technology and new forms of workplace organization leading to a mutual strengthening (weakening) of the effects of these two factors on the demand for high-educated (low-educated) employees.

Hypothesis 4b: There is a positive (negative) interrelationship between technology and new forms of workplace organization on the one hand and exports on the other hand leading to a mutual strengthening (weakening) of the effects of these factors on the demand for high-educated (low-educated) employees respectively.

3. Survey of related empirical literature

A survey of the relevant empirical literature investigating the effect of at least two of the three main variables of this study (ICT, new forms of workplace organization and exports) on the demand for high-educated and low-educated employees is shown in Table 1. In particular, the choice of the studies reported in Table 2 was based on following criteria: consideration of at least two of the above three variables in the model specification, firm-level analysis, recent date of publication and also covering at least a large sector of the economy and not just an industry. There are three exceptions from these criteria: the studies of Maurin *et al*. (2002) and Klein *et al*. (2010) that investigated only the trade effect, which have been included because there are rather few studies dealing with this topic. In Table 1 we have grouped the studies by country in order to make the survey easier to read; for each study we can directly see which of the above three variables it has examined and the types of effects it has found (positive, negative, or statistically not significant) per education/skills category.

Most of the reviewed studies use as dependent variables either the employment shares or the wage bills shares of employee categories with different education or skill levels. It should also be noted that there are considerable differences among the reported studies as to the specification of the three variable blocks corresponding the three main hypotheses of this study, and, even more important as to the cross-sectional or longitudinal character of the studies. Given these differences, which of course account for much of the divergence in the results, the studies shown in Table 2 have the same conceptual framework as our study, in the sense that all studies try to test (some) of our three main hypotheses with respect to ICT, organization, and trade.

Table 1. Survey of recent empirical literature

Study	Dependent variable	ICT; TECH/R&D	ORG	EXPQ	Complementarity ICT;TECH*ORG
USA:					
Bernard et al. (1997):					
- *longitudinal*	Employment share of high-skilled workers	negative	n.c.	positive	n.c.
Capelli and Carter (2000): - *Longitudinal*	average wages of:				
	managers/professionals	positive	pos./neg.	n.c.	n.c
	supervisors	positive	pos./neg.[a]	n.c.	n.c.
	technical workers	positive	n.s./neg.[a]	n.c.	n.c.
	office workers	positive	pos./neg.[a]	n.c.	n.c.
	production workers	positive	pos./neg.[a]	n.c.	n.c.
Bresnahan et al. (2002):					
- cross-section	human capital investment	positive	positive	n.c.	n.c.
UK:					
Caroli and Van Reenen (2001):					
- longitudinal	*changes in the wage bill shares of:*				
	unskilled manuals	n.s.	negative	n.c.	not robust
	semi-skilled manuals	n.s.	n.s.	n.c.	not robust
	skilled manuals	negative	positive	n.c.	not robust
	clerical workers	ns	n.s.	n.c.	not robust
	supervisors/foremen	positive	n.s.	n.c.	not robust
	managers/technical staff	positive	n.s.	n.c.	not robust
France:					
Caroli and Van Reenen (2001):					
- longitudinal	*changes in the wage bill shares of:*				
	unskilled manuals	n.s.	negative	n.c.	n.s.
	skilled manuals	n.s.	positive	n.c.	n.s.
	clerical workers	n.s.	n.s.	n.c.	n.s.
	middle managers/technician	n.s.	n.s.	n.c.	positive
	senior managers	n.s.	n.s.	n.c.	n.s.
Caroli et al. (2001):					
- longitudinal	*probability of employment increase for:*				
	managers	n.a.	n.s.	n.c.	n.c.
	intermediate workers	n.a.	negative	n.c.	n.c.
	operatives	n.a.	negative	n.c.	n.c.
Maurin et al. (2002):					
- longitudinal	*change rate of the employment share of:*				
	white-collar workers	n.c.	n.c.	positive	n.c.
	blue-collar workers	n.c.	n.c.	n.s.	n.c.
Greenan (2003):					
- cross-section	*employment shares of:*				
	executives	n.s.	negative	n.c.	n.c.
	middle management	negative	n.s.	n.c.	n.c.
	clerks	n.s	n.s.	n.c.	n.c.
	skilled blue workers	n.s.	negative	n.c.	n.c.
	unskilled blue workers	pos./neg.[b]	positive	n.c.	n.c.

(continued)

Table 1. Continued

Study	Dependent variable	ICT; TECH/R&D	ORG	EXPQ	Complementarity ICT;TECH*ORG
- cross-section	*growth rate of employment shares of:*				
	executives	n.s.	positive	n.c.	n.c.
	middle management	n.s.	n.s.	n.c.	n.c.
	clerks	negative	negative	n.c.	n.c.
	skilled blue workers	n.s.	negative	n.c.	n.c.
	unskilled blue workers	n.s.	n.s.	n.c.	n.c.
Askenazy and Moreno Galbis (2007):					
- cross-section	*gross labour flows of:*				
	managers	n.s.	negative	n.c.	n.c.
	intermed. Professionals	n.s.	negative	n.c	n.c.
	white-collar workers	n.s.	negative	n.c.	n.c.
	blue-collar workers	n.s.	negative	n.c.	n.c.
Germany:					
Gerlach and Jirjahn (1998):					
- longitudinal	*employment share of:*				
	workers with vocational degree	positive	n.s.	n.c.	n.c.
	foremen/technicians	n.s.	n.s.	n.c.	n.c.
	university graduates	positive	positive	n.c.	n.c.
Kaiser (2001):					
- cross-section,	*employment share of:*				
	academics	positive	n.c.	n.s.	n.c.
	skilled workers	negative	n.c.	negative	n.c.
	unskilled workers	negative	n.c.	n.s.	n.c.
Falk (2002):					
- cross-section	*probability of employment increase for:*				
	university graduates	positive	positive	n.c.	n.c.
	masters/technicians	positive	positive	n.c.	n.c.
	vocational degree	n.s.	positive	n.c.	n.c.
	unskilled workers	n.s.	n.s.	n.c.	n.c.
Hujer et al. (2002):					
- longitudinal	*employment share of:*				
	high-skilled	positive	n.s.	n.c.	n.c.
	low-skilled	negative	n.s.	n.c.	n.c.
Bauer and Bender (2004):					
- cross-section	*Job/worker flow rates of:*				
	high-skilled	n.s.	n.s.	n.c.	n.c.
	skilled	n.s.	negative	n.c.	n.c
	unskilled	n.s.	negative	n.c.	n.c.
Klein et al. (2010):					
- longitudinal	*average daily wages of:*				
	high-skilled	n.c.	n.c.	positive	n.c.
	medium-skilled	n.c.	n.c.	negative	n.c.
	low-skilled	n.c.	n.c.	negstive	n.c.
Italy:					
Manasse et al. (2004):					
- longitudinal	*wage boll share /employment share*				
	white-collar workers	positive	n.c.	negative	n.c.

(continued)

Table 1. Continued

Study	Dependent variable	ICT; TECH/R&D	ORG	EXPQ	Complementarity ICT;TECH*ORG
Piva et al. (2005):					
- cross-section	*log of difference of the number of:*				
	white-collar workers	n.s.	n.s.	n.c.	positive
	blue-collar workers	n.s.	negative	n.c.	negative
Denmark:					
Munch and Skaksen (2008):					
- longitudinal	*Hourly wage rate of:*				
	unskilled workers	n.c.	n.c.	negative	n.c.
	workers with vocational education	n.c.	n.c.	negative	n.c.
	workers with further education	n.c.	n.c.	n.s.	n.c.
Norway:					
Salvanes and Forre (2003):					
- longitudinal	net job creation of:				
	high-educated empl	positive	n.c.	n.s.	n.c.
	medium-educated empl.	n.s.	n.c.	n.s.	n.c.
	low-educated empl.	n.s.	n.c.	positive	n.c.
Switzerland:					
Arvanitis (2005a):					
- cross-section	*employment share of:*				
	high-educated empl.	positive	positive	n.c.	negative
	medium-educated empl.	n.s.	n.s.	n.c.	n.s.
	low-educated empl.	negative	n.s.	n.c.	negative
Japan:					
Tanaka (2012):	*employment share of:*				
- longitudinal	Non-regular workers	n.c.	n.c.	n.s.	n.c.
Turkey[c]:					
Meschi et al. (2011):					
- longitudinal	*labour cost share of:*				
	skilled workers	positive	n.c.	positive	n.s.

Notes:

[a]Positive: teamwork, reduction of management levels, regular meetings; negative: job rotation.

[b]Partly positive, partly negative coefficients.

[c]Turkey: trade effect refers to both exports and imports; the insignificant interaction refers to R&D*imports/exports.

ICT: information and communication technologies; ORG: workplace organization; "positive" ("negative"): statistically significant (at the test level of 10%) positive (negative) coefficient of the variables(s) for ICT, ORG, and the interaction term of these two variables respectively; n.s.: statistically nonsignificant (at the test level of 10%); n.c.: not considered; n.a.: not available (for cases in which the corresponding variables are included in the models, but the results are not explicitly presented).

In most of the surveyed German studies, positive effects for both the technological and the organizational factors for the high-educated are found. Interaction terms for organization and technology were investigated in some cases, but no statistically significant effects could be identified. The results for the medium-educated employees were mixed for both the technological and the organizational factor. For low-educated employees, in most studies negative effects of ICT are found; interaction terms were in most cases statistically insignificant.

For French and Italian firms the influence of technology on the employment shares of employees with different skills or education is less important than that of organization. Most studies could not find any discernible effects of technology. With respect to organizational factors there is a tendency for a positive impact for the high-educated and a negative one for the low-educated employees. Interaction terms were in some cases significantly positive for the high-educated and negative for the low-educated employees.

Table 2. Key figures for Greece and Switzerland

	Greece	Switzerland
Innovation status[a]	"moderate"	"leader"
Business R&D intensity[b]	0.3	3.1
Tertiary-level graduates[c]	33.2	41.4
IT equipment[d]	10.9	20.3
Exports and imports[e]	28.0	51.0
High-tech exports[f]	30.5	75.9
Foreign direct investment[g]	0.9	12.3

Note:
[a]As classified in European Innovation Scoreboard (2008).
[b]As percentage of value added in industry 2007.
[c]Tertiary-level graduates as percentage of total employment 2007.
[d]IT equipment as percentage of fixed non-resident investment 2007.
[e]Total exports and imports as percentage of GDP 2007.
[f]High-tech and medium-high-tech exports as percentage of exports of goods 2007
[g]FDI outflows as percentage of GDP 2007. Sources: EIS (European Innovation Scoreboard) (2008); OECD (2009).

Studies for the USA and the UK demonstrate mostly the expected effects of technology on the employment of high- and low-educated employees respectively. A US study that refers to the 80 s showed a negative effect of computer investment per employee on the employment share of high-skilled workers, but a positive effect of R&D/sales (Bernard *et al*. 1997), presumably because the ICT effect had not come through by this time. The impact of organization is less clear than that of technology, but in most cases it is as expected.

The study of Ben-Ner and Urtasun (2013) deserves special mention because it adds some more differentiated insights as to the effects of computerization on skills. Based on data of 819 US firms in 2000, the authors investigated the role of task complexity in generating skill gains and losses due to ICT and found that occupations with higher task complexity were associated with subsequent adoption and intensity of ICT, and that the use of ICT affected most categories of skills (e.g., content skills, process skills, technical skills, complex problem-solving skills) positively. Contrary to this, for simple, low-complexity tasks ICT did not affect skills or affected them negatively.

There are relatively few studies taking the trade effect into account in combination with technology and/or organization and their results are ambiguous. On the whole, the results with respect to trade are ambiguous and allow no clear-cut conclusions as to the trade impact.

Four out of nine studies reviewed here found a positive effect of exports either on the employment share or on the average wage of high-skilled (or high-educated) employees. A study based on data for US firms for the period 1980–1987 found a clearly positive effect of foreign shipments on the employment share of high-skilled workers (Bernard *et al*., 1997). Further, a study based on data for French firms found also a (partly) positive effect of trade on the employment of high-skilled employees of French enterprises (Maurin *et al*., 2002). Finally, a study using matched employer–employee data for German manufacturing firms in the period 1993–2007 estimated a statistically significant export wage premium for high-skilled workers, but statistically significant export wage discounts for medium-skilled and low-skilled workers, respectively (Klein *et al*., 2010). Finally, a paper based on Turkish firm data found a positive effect of trade (exports and imports) on the employment share of skilled workers but no significant effect of the interaction term of imports and R&D (that served as technology variable in this study) (Meschi *et al*., 2011).

The rest five studies found no effect or even a negative trade effect with respect to high-skilled employees. A further German study based on a cross-section of service firms came to the conclusion that export activities could exercise a negative influence on the employment share of medium-educated workers but have no effect on the employment shares of academic education and unskilled workers (Kaiser, 2001). Salvanes and Forre (2003) found a positive effect of trade only on the employment of low-skilled employees for a sample of Norwegian firms. One Italian study (Manasse *et al*., 2004) found a negative effect of exports for white-collar workers. A Danish study could not detect any effect for workers with further education (Munch and Skaksen, 2010). The same study found a negative effect of exports on the average hourly wage of unskilled workers and workers with vocational education. Finally, Tanaka (2012) explored in a study based on Japanese firm data for manufacturing and wholesale the effects of exporting on

the employment share of non-regular workers (part-time and dispatched workers) and could not find any significant effects.

On the whole, the results are indicative but not completely comparable because some of the observed differences can be traced back to differences with respect to the sectors and industries covered in the studies, their national contexts (which include characteristics that might affect firms' workforce composition, such as structure and quality of educational system), the specification of the organizational variables, and the nature of the investigations (cross-sectional versus longitudinal approach). Further empirical research is required, including all these three factors proposed in the literature for explaining the shift of labor demand in favor of high-skilled labor (ICT, new forms of workplace organization, and trade), and also covering and comparing between countries of different levels of development and based on similar samples, variables, and models, so that meaningful comparisons can be made.

Our study builds on the above previous relevant empirical literature (using the basic conceptual framework of a demand function for employees with different education levels at firm level) and at the same time adds to this literature the following new elements: (i) all three main factors discussed in literature for explaining the shift of labor demand in favor of high-skilled labor are taken into consideration in the same framework, which allows to test together the three main hypotheses and compare their effects; (ii) possible complementarities among these three factors are investigated; and (iii) it is a comparative study of the above effects between two countries, Greece and Switzerland, which are characterized by different levels of economic development, allowing a better understanding of the impact of national context characteristics on these effects.

4. Differences between Greece and Switzerland

Greece and Switzerland are characterized by quite different levels of economic and technological development. Table 2 shows a series of indicators referring to the economic and innovation performance of the two countries in 2007. The overall picture is quite clear, for every indicator Switzerland shows a significantly better performance than Greece. This is the case not only for the economic indicators that can be seen as measures of international competitiveness (imports and exports, particularly high-tech exports, and Foreign Direct Investment (FDI) outflows, all of them as a percentage of Gross Domestic Product (GDP)), but also for the innovation indicators (business R&D intensity and "innovation status" according to the European Innovation Scoreboard).

There are differences with respect to the educational systems of the two countries that are also reflected in the classification of the employees according to their formal education. We remark that the definitions of high-educated and low-educated employees are quite similar in both countries (see also section 5.2.1). More details on the definition of high education in each country can be found in the European Education Directory (2010a,b). The main differences refer to the medium-educated employees' definitions, because of the different structure and relevance of the vocational education systems of the two countries. The Swiss dual vocational education system combines apprenticeship in a company and attendance of part-time courses at public vocational schools (similar systems are found also in Germany and Austria). Vocational education in Greece is primarily provided by Technical-Vocational Schools with full-time school attendance but little practical training in companies. The category of employees with some vocational education but without a formal degree is found only in Switzerland. The vocational education in this category is based only on some kind of short apprenticeship ("Anlehre"), but the labor market position of persons in this category is significantly much lower than that of persons with a formal degree.

5. Data, model specification, and method

5.1 Data

All data used in this study were collected in the course of two surveys among enterprises that were conducted in both countries. The Swiss survey was based on a disproportionately stratified (with respect to firm size) random sample of firms with at least 20 employees covering all relevant industries as well as firm size classes (on the whole 26 industries, and within each industry three industry-specific firm size classes with full coverage of the upper class of large firms). The sample, which represents appropriately the Swiss population of enterprises with more than 20 employees (measured in full-time equivalents), contained about 4400 firms. Valid answers were received from 1710 firms (response rate: 39% of the firms of the underlying sample) and 1688 of them could be used in the econometric

estimations. The response rates do not vary much across industries and size classes with a few exceptions (overrepresentation of machinery, underrepresentation of hotels, catering, and retail trade).

The data used in the Greek part of the study were also collected through a survey among Greek enterprises, which was based on a sample similar to that of the Swiss part of the study concerning proportions of firm sizes and industries. The idea has been to construct a firm sample that could allow a comparison of comparable entities with respect to industry affiliation and firm size. In this sense, the Greek sample is not representative of the entire Greek business sector, but only for this part of it that can be compared with the Swiss business sector in terms of industries and firm size classes. In this way, the part of the Greek economy, which is more technologically developed showing a similar industry structure with the Swiss economy, is taken into consideration in this comparison among the two economies. Otherwise, the comparison would not refer to firm behavior but would be dominated by the differences with respect to industry structure, even if it is controlled for industry and firm size.

Also the same questionnaire was used (translated in Greek). Three samples of 300 Greek firms each were randomly selected from the ICAP (one of the largest business information and consulting companies in Greece) database. All three samples included firms from the same industries and size classes, and the proportions of industries and size classes were the same as in the Swiss sample. The questionnaire was sent by post to the firms in the first sample. Firms that refused to participate to the survey were replaced by structurally similar firms (i.e., from the same industry and size class) from the second sample. In the few cases, in which we have exhausted the firms in the second sample, we exploited the companies in the third sample. Following the above procedure, which aimed at maintaining the proportions of industries and size classes, we finally achieved responses from 281 Greek firms. The data of 266 of them could be used in the econometric estimations.

For the Swiss part of this study a nonresponse analysis was performed, based on a follow-up survey of a sample of the nonrespondents, which did not indicate any serious selectivity bias with respect to the use of ICT, new organizational practices (teamwork, job rotation), and export. The reference period for the qualitative data is the period 2003–2005 unless otherwise mentioned. The reference year for the quantitative variables is 2004. In Table A1 in the Appendix we can see the composition of the Greek and the Swiss data sets by industry and size class. Further, Tables A2–A4 provide information on the descriptive statistics of and the correlation between the variables used in the study.[5]

5.2 Model specification

5.2.1 Dependent variables

The analytical framework we adopted in this study is that of a demand function for employees with different education levels (heterogeneous labor) at firm level. Formal education is used as a proxy for skills, for which no data were available in this study. Of course formal education is not the same as professional skills, but it is becoming in technologically advanced economies increasingly a necessary precondition for skills. Education defines increasingly also the employees' performance potential. Many empirical studies use rather crude skill-based measures (e.g., distinguishing among skilled and unskilled manual or nonmanual workers), or role-based measures (e.g., distinguishing between white- and blue-collar workers), or measures based on hierarchical position (e.g., managers, middle managers, supervisors) (see Table 1). We decided to use education-based measures because they reflect more precisely human capital intensity than the above crude skill measures. In particular, we considered in this study three categories of employees: high-educated (employees with education at the tertiary level, including universities and technical and business colleges), medium-educated (for Switzerland: employees with a formal degree in vocational education based on apprenticeship; for Greece: employees with technical upper secondary education), and low-educated (employees with some

5 It looks prima facie indeed rather astonishing that the average share of high-educated employees is higher in the Greek sample than in the Swiss sample, as an anonymous referee critically mentioned (see Table A2). There is an economic argument that may explain this: due to the fact that strong vocational education in the sense of apprenticeship-based education is scarce in Greece, while there is a large supply of tertiary-educated persons, it is a widespread phenomenon that formally high-educated persons are employed for jobs with a much lower qualification profile, e.g., persons with a bachelor degree in economics work as bank cashiers. This weakness of the Greek medium education leads to high shares of employees with tertiary-level education, even if the qualification requirements of the offered jobs are rather low and do not correspond to this high education level.

vocational education but without a formal degree or without any formal vocational education). More details on the definition of high education in each country can be found in the European Education Directory (2010a,b).

The employment share for each of these categories was used as a dependent variable in our model estimations (variables H_EDUC; M_EDUC; L_EDUC). For each of them we constructed a separate model; all three models contained the same independent variables, which are described in the following paragraphs. In Table 3 we can see the definitions of all models dependent and independent variables.

5.2.2 Independent variables

ICT input. As measures for technology input, particularly ICT input ("ICT capital"), we used the intensity of use of two important network technologies, Internet (a network technology linking to the outside world) and Intranet (a network technology linking within the firm). These two intensities were measured by the share of employees using Internet and Intranet respectively in their daily work. The firms were asked to report these shares not by a precise figure but within a range of 20 percentage points (1%–20%, 21%–40%, and so on). Based on these data we constructed two 5-point ordinal variables for the intensity of use of Internet and Intranet respectively. The idea behind these variables is that a measure of the diffusion of a certain technology within a firm would be a more precise proxy for "ICT capital" than the mere incidence of this technology or some kind of simple hardware measure (e.g., number of installed personal computers). In a further step we calculated a composite indicator for ICT by adding together the standardized values of the two above constituent variables for Internet and Intranet (having average 0 and standard deviation 1) (technology variable ICT; see also Arvanitis, 2005b and Arvanitis and Loukis, 2009 for using the same variable construction).

For the reasons explained in section 2.1 we expect in general a positive correlation of this technology variable with the employment share of high-educated employees. Further, we expect a negative correlation between the technology variable and the share of low-educated employees. We have no a priori expectation for the relation between technology variable and the employment share of medium-educated employees.

Organizational input. The measurement of organizational inputs, here focusing on inputs related to the new forms of workplace organization, is an issue still open to discussion, since there is not yet any agreement among applied economists to the exact definition of "organizational capital" (see Lev, 2003; Black and Lynch, 2005; and Squiccisarini and Le Mouel, 2012 for a discussion on this matter).

In order to choose the variables related to changes and/or introduction and use of new organizational practices at the workplace level we draw on the definition offered by Black and Lynch (2001, 2005). They distinguished two main components of organizational capital: "work design" and "employee voice." The first component "work design" includes new practices that involve changing the occupational structure of the workplace, the number of levels of management within the firm, the existence and diffusion of job rotation and teams, and also job share arrangements. The second component of organizational capital, "employee voice," is associated with practices that enhance the role and the voice of firm employees, such as individual job enrichment schemes, employees being consulted in groups, employees having more decision competences, etc. (see, e.g., Gomez *et al*., 2009).

Our data enabled us to construct two composite variables for organization, one for "work design"-oriented organizational practices (ORG1) and a second one for "employee voice"-oriented organizational practices (ORG2) (see also Arvanitis and Loukis, 2009 for using a similar variable construction). The main justification for the use of composite indexes is that in this way (i) the relative importance of the three factors ICT, organization, and trade (identified in the conceptual part as the main drivers of the shift toward high-educated employees) can be demonstrated and (ii) the complementarity between these factors can be investigated. Alternatively to the construction of the composite indexes through standardization (and subsequent addition of the constituent variables), we tested in earlier studies (see Arvanitis, 2005b,c; Arvanitis and Loukis, 2009) the use of principal component factor analysis and obtained similar results. Given this experience, we refrained in this article from testing this second method of constructing the composite variables.

The variable ORG1 was constructed as the sum of the standardized values of the following three variables measuring the intensity of use of the main new work design-oriented organizational practices: intensity of use of teamwork (project groups, quality circles, semiautonomous teams, etc.); intensity of use of job rotation; decrease of the number of management levels. The variable ORG2 was calculated as the sum of the standardized values of the

Table 3. Definition of model variables

Variable	Definition and measurement
Dependent variables	
H_EDUC	Employment share of employees with tertiary-level education
M_EDUC	Employment share of employees with a formal degree in vocational education
L_EDUC	Employment share of employees without any formal vocational education or with some vocational education but without a formal degree (for Swiss firms)
Independent variables	
ICT	Sum of the standardized values of the two variables INTERNET and INTRANET
INTERNET	Six-level ordinal variable for the intensity of *Internet use*: share of employees using Internet in daily work: 0: 0%; 1: 1–20%; 2: 21–40%; 3: 41–60%; 4: 61–80%; 5: 81–100%
INTRANET	Six-level ordinal variable for the intensity of *Intranet use*: share of employees using intranet in daily work: 0: 0%; 1: 1–20%; 2: 21–40%; 3: 41–60%; 4: 61–80%; 5: 81–100%
ORG1	Sum of the standardized values of the three variables TWORK, JROT and LEVEL
TWORK	Ordinal variable measuring how widespread is *teamwork* inside a firm on a 5-point Likert scale (1: "very weakly widespread"; 5: "very strongly widespread"); teamwork: project groups, quality circles, semi-autonomous teams, etc.
JROT	Ordinal variable measuring how widespread is *job rotation* inside a firm on a 5-point Likert scale (1: "very weakly widespread"; 5: "very strongly widespread"
LEVEL	Three-level ordinal variable for the change of the number of *managerial levels* in the period 2000–2005: 1: increase; 2: no change; 3: decrease
ORG2	Sum of the standardized values of the eight variables COMP_OVERALL, COMP_WORKPACE, COMP_WORKSEQ, COMP_WORKASSIGN, CONP_WORKWAY, COMP_PRODUCTION, COMP_CUSTOMER_CONTACT, and COMP_CUSTOMER
COMP_OVERALL	Three-level ordinal variable measuring the *change* of the distribution of decision competences between managers and employees inside a firm in the period 2000–2005: 1: shift towards managers; 2: no shift; 3: shift towards employees
COMP_WORKPACE	Ordinal variable measuring the distribution of decision competences to determine work *pace* (1: "primarily managers"; 5: "primarily employees")
COMP_WORKSEQ	Ordinal variable measuring the distribution of decision competences to determine the *sequence* of the tasks to be performed (1: "primarily managers"; 5: "primarily employees")
COMP_WORKASSIGN	Ordinal variable measuring the distribution of decision *competences to assign tasks* to the employees (1: "primarily managers"; 5: "primarily employees")
COMP_WORKWAY	Ordinal variable measuring the distribution of decision competences to determine the *way* of performing tasks (1: "primarily managers"; 5: "primarily employees")
COMP_PRODUCTION	Ordinal variable measuring the distribution of decision competences to solve emerging *production problems* (1: "primarily managers"; 5: "primarily employees")
COMP_CUSTOMER-CONTACT	Ordinal variable measuring the distribution of decision competences to*contact customers* (1: "primarily managers"; 5: "primarily employees")
COMP_CUSTOMER	Ordinal variable measuring the distribution of decision competences to solve emerging *problems with customers* (1: "primarily managers"; 5: "primarily employees")
EXPQ	Exports of goods and services as a percentage of sales
ICT*ORG1	Interaction term of the variables ICT and ORG1
ICT*ORG2	Interaction term of the variables ICT and ORG2
EXPQ*ICT	Interaction term of the variables EXPQ and ICT
EXPQ*ORG1	Interaction term of the variables EXPQ and ORG1
EXPQ*ORG2	Interaction term of the variables EXPQ and ORG2
PART_TIME	Ordinal variable measuring how important is *part-time work* inside a firm on a 5-point Likert scale (1: "not important"; 5: "very important")

(continued)

Table 3. Continued

Variable	Definition and measurement
TEAM_COMP	Ordinal variable measuring how important is *compensation by group or team* inside a firm on a 5-point Likert scale (1: "not important"; 5: "very important")
IPC	Ordinal variable measuring the intensity of *price competition* at a firm's main market on a 5-point Likert scale (1: "very weak"; 5: "very strong")
INPC	Ordinal variable measuring the intensity of *non-price competition* (competition with respect to quality, customer services, etc.) at a firm's main market on a 5-point Likert scale (1: "very weak"; 5: "very strong")
Medium-sized firms	50–249 employees
Large firms	250 employees and more
Instruments	
INNOV_IND	Percentage of innovating firms in a two-digit industry
COMP_CUSTOMER- CONTACT_IND	Percentage of firms reporting high competence on the part of employees to contact customers in a two-digit industry

following eight variables measuring the extent of various aspects of decentralization of decisions/delegation of competences: overall shift of decision competences from managers to employees; decentralization from managers to employees of the competence: to determine the work pace; the sequence of performing tasks; the way of performing tasks; to assign tasks; to solve emerging production problems; to contact customers; to solve problems emerging with customers.

For the reasons explained in section 2.2 we expect an overall positive effect of the above organizational variables on the share of high-educated employees and a negative effect on the share of low-educated employees. We have no a priori expectations with respect to the medium-educated employees.

The use of these composite variables (ICT, ORG1, and ORG2) as overall measures of technology and new forms of organization adoption enabled us not only to assess the relative importance of these factors with respect to employee education but also to test the postulated interrelationships between technology and organization.

Export activities. The trade effect was measured in our specification by the export intensity (value of exports as a percentage of total sales value; variable EXPQ), a variable that has been used by several other empirical studies as a measure of export activity.

Other model variables. We also included two more variables which are related to workplace organization but are not components of organizational capital per se. The first one (TEAM_COMP) is referring to incentive-based compensation and measures how important is employee compensation according to team-performance in the firm. A further variable (PART_TIME) measures labor flexibility (ordinal variable for the intensive use of part-time work). Both variables serve as controls for relevant characteristics of the working conditions of different categories of labor. According to the "High-Performance Work Systems" (HPWS) concept (see, e.g., Ichniowski *et al*., 1997; Appelbaum *et al*., 2000; especially Ch. 7 and Ch. 10) the modus of compensation of work and the work time schedule are, besides technology, organization, and human capital, important constituents of HPWS. With respect to the compensation variable the sign of the correlation to the dependent variable is not a priori clear for medium- and low-educated employees; we expect that team compensation is considered as more suitable and/or is more often used for higher- than lower-qualified employees. The sign of the correlation between part-time work and education level of the employees is in the empirical literature not clear and depends on the overall conditions of the labor market as well as its institutional framework.

Further, we included two variables measuring the intensity of price competition (IPC) as well as non-price competition (INPC). Gersbach and Schmutzler (2012) postulated and derived theoretically, among other things, two statements about the market conditions under which industry-specific training is likely to occur: (i) concentration is high or competitive intensity is low, and (ii) product differentiation is sufficiently strong. We considered the IPC as measured in this study as a proxy for "competitive intensity" in the above theoretical context and the INPC as measured in this study as a proxy for "product differentiation." Thus, according to the above hypothesis (i) intensive price competition would

exercise a *negative* influence on training propensity. On the contrary, according to the above hypothesis (ii) intensive non-price competition would have a *positive* effect on training propensity. Given that a firm's training propensity is generally positively correlated to the demand for high-qualified employees we conclude that the above-mentioned hypotheses could be directly used as theoretical background for the two competition variables in our model.

In order to test for the complementarity hypotheses we inserted in the model also five interaction terms for possible joint effects of ICT, ORG1, ORG2, and EXPQ.

Since we did not dispose of data on capital use costs and wage data for each education category, we relied on controls for firm size and industry affiliation to seize the influence of these variables.[6]

5.3 Methodical issues

5.3.1 Multicollinearity

Initially we calculated the correlations between the model independent variables in the Greek and the Swiss sample, which are shown in Tables A3 and A4 respectively. We can see that most of them are low and only for two values might raise some suspicion of possible multicollinearity: first, the correlations between ICT and ORG2 in both countries (Greece: $r = 0.375$; Switzerland: $r = 0.288$), and second, the correlation between IPC and INPC in the Greek data ($r = 0.360$). Additional model estimations not presented here, in which only one of the variables is kept in the equation to be estimated, have shown that there is no bias due to multicollinearity. Further, estimates without interaction terms not presented here showed no multicollinearity of the interaction terms with the other model variables.

5.3.2 Use of centered variables

We estimated all models with centered variables that have been constructed by subtracting from each variable its sample average. This way, the interpretation of the direct effects and the effects of the interaction terms becomes easier. Further, we estimated our models without the nonsignificant interaction terms and we obtained the same results with respect to signs and statistical significance.

5.3.3 Endogeneity

Since our results were only cross-section estimates, it was not possible to test strictly the existence of causal relations between the independent variables and the dependent variable. Nevertheless, some robust regularities came out, which if interpreted in view of our hypotheses 1–4 (see section 2) could possibly indicate the direction of causal links. We refrained from testing the exogeneity of right-hand variables in the econometric sense of the word because the variables for ICT and workplace organization were to a considerable extent predetermined being measured as structural characteristics of the last 3 years and not for a concrete point of time (see, e.g., the Swiss questionnaire, which is available in German, French, and Italian under www.kof.ethz.ch), while the dependent variables are measured for 2004. This was not the case for the export variable EXPQ, which was measured also for 2004. As a consequence, the exogeneity of this variable had to be tested by the methodology developed by Rivers and Vuong (1988). In a first step we estimated instrument equations for EXPQ for the three workforce composition equations. As instruments we used for the Swiss estimates the percentage of innovating firms in two-digit industries (INNOV_IND) and the percentage of firms that reported high competence on the part of employees to contact customers (COMP_CUSTOMER_CONTACT_IND; see Table 3). Both instruments passed all three tests for validity: significant correlation to the instrumented variables, insignificant correlation to the dependent variables, and insignificant correlation to the error term of the workforce equations. We inserted the residuals (predicted instrumented variable minus original variable) of the instrument equations in the equations forH_EDUC, M_EDUC, and L_EDUC, respectively, as additional right-hand variables. Bootstrapping was used in order to correct the standard errors of the estimated parameters. If the coefficient of the residuals was statistically significant (at the 10%-test level), we assumed that endogeneity was a problem and consequently we based our inference on instrumented variables; also in this case standard errors were estimated by bootstrapping. That was the case only in the Swiss equation for H_EDUC. In cases in which the coefficient of the residual was not statistically significant, the estimates were based on the original

6 Capital use costs do not vary much among industries. In case of wage data and their use as factor prices a further problem is their endogeneity which could cause serious econometric problems; some authors even proposed to omit altogether wage data in one-equation frameworks (see, e.g., Machin and Van Reenen, 1998).

Table 4. OLS and Tobit estimates; Greece

	H_EDUC OLS	M_EDUC OLS	L_EDUC Tobit
ICT	6.160*** (0.870)	−2.000** (0.961)	−6.336*** (1.011)
ORG1	−0.061 (0.571)	1.325* (0.769)	−1.703** (0.842)
ORG2	0.542* (0.286)	−0.125 (0.374)	−0.333 (0.390)
EXPQ	−0.036 (0.050)	0.018 (0.059)	0.031 (0.081)
ICT*ORG1	0.564 (0.399)	−0.631 (0.492)	−0.196 (0.481)
ICT*ORG2	−0.014 (0.224)	−0.287 (0.277)	0.407** (0.187)
EXPQ*ICT	0.020 (0.038)	−0.010 (0.046)	0.026 (0.056)
EXPQ*ORG1	0.021 (0.015)	−0.046 (0.031)	0.035 (0.040)
EXPQ*ORG2	−0.005 (0.008)	−0.003 (0.015)	0.011 (0.022)
PART_TIME	1.140 (1.503)	−2.517 (1.929)	1.065 (2.318)
TEAM_COMP	−0.612 (1.113)	1.212 (1.423)	−1.448 (1.634)
IPC	−1.486 (1.299)	−1.012 (1.544)	3.701** (1.890)
INPC	2.831*** (1.105)	−0.162 (1.477)	−3.732*** (1.768)
Medium-sizedfirms	2.688 (3.003)	−5.741 (3.909)	7.997* (4.635)
Large firms	−3.096 (3.122)	1.771 (3.965)	8.332* (4.546)
Const.	19.709*** (6.741)	60.091*** (8.238)	14.162*** (9.135)
N	266	266	266
N (left-censored)			86
R^2	0.356	0.090	
Pseudo-R^2			0.044
F-test	8.8***	1.5*	7.0***
RMSE	19.633	24.767	

Note: Heteroskedasticity-robust standard errors are in brackets below the coefficients; ***, **, and * denote statistical significance at the 1%, 5%, and 10% test-level, respectively. All equations include control for services/manufacturing (reference sector: construction).

variable. The detailed test results are available upon request. We refrained from testing exogeneity of EXPQ for the Greek estimates because the parameters in this case were throughout not statistical significant and the search for an appropriate instrument turned to be difficult.

We applied Ordinary Least Squares (OLS) for the separate estimation of the equations for the high-educated and the medium-educated employees and Tobit for the equation of the low-educated employees because in this case the dependent variable contained many zero values in both countries.

6. Results

6.1 Technological factors

From Table 4 we can see that for Greece the coefficient of the ICT variable is positive and statistically significant for the high-educated employees and negative and statistically significant for the medium-educated employees as well as for the low-educated employees. For Switzerland the estimates for the ICT variable coefficient in Table 5 show clearly that the technological factors correlate positively with the share of high-educated employees and negatively with the share of low-educated employees. No significant effect could be found for the medium-educated employees. This Swiss result differs from the negative effect found for medium-educated employees in Michaels *et al.* (2013) at industry level (see section 2.1). In sum, we find for both countries a positive effect of ICT on the shares of the high-educated and a negative effect on the share of low-educated employees. Thus, hypothesis 1a of "skill-biased technological change" receives strong support for both countries. This is the most important common finding for both countries.

However, at the same time we observe a notable difference between the two countries concerning the effect of ICT on the medium-educated employees. In Greece the use of ICT results in a decrease of the share of the medium-educated employees, while in Switzerland this effect is positive but statistically insignificant. This can be probably

Table 5. OLS and Tobit estimates; Switzerland

	H_EDUC OLS	M_EDUC OLS	L_EDUC Tobit
ICT	2.624*** (0.385)	0.474 (0.3091)	−4.496*** (0.495)
ORG1	0.416 (0.247)	−0.847*** (0.308)	0.518 (0.390)
ORG2	0.267*** (0.101)	0.165 (0.120)	−0.603*** (0.159)
EXPQ	0.074*** (0.014)	−0.081*** (0.016)	0.012 (0.020)
ICT*ORG1	0.329** (0.143)	−0.358*** (0.142)	0.006 (0.166)
ICT*ORG2	−0.043 (0.058)	−0.141** (0.059)	0.251*** (0.072)
EXPQ*ICT	0.017** (0.008)	−0.016** (0.008)	−0.001 (0.010)
EXPQ*ORG1	−0.006 (0.006)	0.015** (0.007)	−0.013 (0.008)
EXPQ*ORG2	−0.001 (0.003)	0.003 (0.003)	−0.002 (0.003)
PART_TIME	−0.946*** (0.359)	−0.437 (0.447)	2.047*** (0.593)
TEAM_COMP	0.343 (0.330)	−0.047 (0.391)	−0.246 (0.513)
IPC	−0.731* (0.389)	0.391 (0.484)	0.436 (0.627)
INPC	0.339 (0.376)	−0.134 (0.463)	−0.242 (0.619)
Medium-sizedfirms	−1.829** (0.855)	−1.043 (1.085)	6.014*** (1.390)
Large firms	−2.423** (1.216)	−2.524* (1.347)	9.509*** (1.734)
Const.	18.684*** (2.841)	53.041**** (2.052)	28.357*** (4.613)
N	1688	1688	1688
N (left-censored)			198
R^2	0.395	0.214	
Pseudo-R^2			0.051
F-test	18.00***	13.3***	27.3***
RMSE	14.742	17.409	

Note: Heteroskedasticity-robust standard errors are in brackets below the coefficients; ***, **, and * denote statistical significance at the 1%, 5%, and 10% test-level respectively. All equations include controls for 28 two-digit industries (reference industry: food industry).

attributed to differences between the educational systems of the two countries. In Switzerland there has been traditionally a well-developed and effective system for the medium-level vocational education ("Berufslehre"), which produces sufficiently skilled personnel that can use the highly demanding new technologies, such as the ICT, efficiently and react flexibly to the large changes in workplace organization partly caused by ICT. On the contrary, in Greece the medium-level vocational education is not equally well-developed, and the provided education does not enable employees to become efficient users of advanced technologies, such as ICT, thus leading to their partial replacement by high-educated personnel. In view of these findings, the polarization hypothesis (hypothesis 1b; see section 2) receives some support only for Greece, and only partly, i.e., only with respect to medium-educated employees.

6.2 Organizational factors

From Table 4 we see that the organizational variables appear to have different effects on the composition of the workforce in Swiss and Greek firms. We found only a positive effect of ORG2 (employee voice) for high-educated employees, a positive effect of ORG1 (work design) for medium-educated employees, and a negative one for low-educated employees. From Table 5 we can see that for Swiss firms, organizational practices associated to the new forms of "work design" (variable ORG1) show no effect for high-educated and low-educated and a negative effect for the medium-educated employees. Thus, for Swiss firms, practices such as teamwork, job rotation, and flattening of the overall firm organization do not show the expected effects on the shares of high-educated employees and low-educated employees.

For the variable ORG2 measuring various dimensions of "employee voice" we found a positive effect of this variable on the shares of the high-educated employees and a negative one for the low-educated employees.

In sum, by comparing the two countries, organizational factors seem to be much less important for Greek firms as determinants of workforce composition than for Swiss firms. This indicates that Greek firms have not yet sufficiently learnt to adapt their personnel composition to new forms of workplace organization, in comparison with Swiss firms.

However, we remark that the decentralization of decision making, as it is measured by ORG2, shows a positive effect on the share of high-educated employees for both countries. This is the second common finding that provides some empirical evidence for the validity of hypothesis 2 of "skill-biased organizational change." On the whole, the results for the organizational variable ORG2 are in accordance with hypothesis 2; this is not the case for the variable ORG1.

6.3 Export activities

Hypothesis 3 is of no relevance for the Greek firms: the export intensity does not show a statistically significant effect on any of the three education-related employment shares (Table 4).[7] On the contrary, the trade effect seems to be quite important for Swiss firms (Table 5) due to their much stronger exposure to international competition than Greek firms, mainly in highly sophisticated sectors with a high content of high-skilled labor, such as pharmaceuticals, electronics/instruments, financial, and other business services. The positive effect of export activities on the share of high-educated employees is in accordance with expectations. No effect could be found for the low-educated employees, for which a negative effect was expected. Further, a negative effect showed for the medium-educated employees. A possible explanation for these findings might be found in the fact that among internationally competitive firms are also enterprises, which make a wide use of production techniques based on automation that can be operated by workers with low skills. It should be noted that automation of production is not the same as the use of ICT as defined in this study: use of personal computers, Internet, intranet, etc. (see Table 3). Thus, an increasing degree of such production automation due to export activity can keep the employment share of low-educated employees unchanged at the cost of medium-educated employees that are typically involved in more traditional production techniques.[8]

The above results provide some evidence in favor of the trade effect (export activities)—hypothesis 3—only for the Swiss firms. The difference between the two countries as to the effect of export intensity on workforce composition can be attributed to differences in the extent and nature of their export activities. Greek firms have much lower levels of export activity than Switzerland. Greek exports are focused mainly on less sophisticated products without high content of high-skilled labor, so that exporting firms feel much less pressure than Swiss firms to hire personnel of higher educational level for supporting their export activities.

6.4 Complementarity (interrelationship) effects

We could not find any statistical significant interrelationships among the technological and the organizational factors and the export share for the Greek firms), with the only exception of a positive and statistically significant coefficient of the interaction term ICT*ORG2 in the equation of the low-educated employees (Table 4). On the contrary, there are several significant interrelationships for the Swiss firms, as indicated by the seven statistically significant interaction terms in the respective model estimates, but only four of them are positive, thus indicating a complementarity relationship (Table 5). In particular, the coefficient of the interaction term ICT*ORG1 is positive (and statistically significant) in the equation for the high-educated employees, significantly negative for the medium-educated employees, and insignificant for the low-educated employees. For the high-educated employees, organizational practices such as teamwork, job rotation, and flattening of the overall firm organization show a positive effect only in combination with the use of ICT. Thus, the result for ICT*ORG1 can be interpreted as a hint for the existence of mutual strengthening effects of ICT and new "work design" forms of workplace organization. This means that an indirect positive effect exists that can be traced back to the joint impact of these two factors on the employment shares.[9] This provides support for hypothesis 4a. For ICT*ORG2 we found for the Swiss firms no effect for the high-educated employees, a negative effect for the medium-educated employees, and, rather unexpectedly, a positive effect for the

7 We suppose that the complementary hypothesis for the role of import substitution would be much more relevant for Greek firms that suffered much under the fierce international competition in the sectors they are mostly present, e.g., clothing, textiles, metals, food. Unfortunately, import data were not available at an adequately low level of aggregation.

8 Salvane and Forre (2003) even find a positive effect on net job creation of low-educated workers in Norwegian firms.

9 As an anonymous referee mentioned, this kind of interrelationship is not the type of complementarity in the sense of Milgrom and Roberts (1995). This issue was shortly discussed in section 2.5. The same referee offered the alternative interpretation of the results as hints about possible coevolutions of ICT, organization, and human capital.

low-educated employees. A possible explanation for this effect, which is found also for Greek firms, could be that even if ICT and ORG2 show negative or no direct effects on demand for low-educated personnel, these two factors lead in combination to an increase of low-educated personnel via the enhancement of firm performance that generates additional demand for empowered low-educated employees.[10] The positive effect of ICT*ORG2 with respect to low-educated employees is contrary to hypothesis 4a. On the whole, hypothesis 4a receives only partial support from these results.

Further, there was a positive effect of the variable EXPQ*ICT for the high-educated employees and a negative effect for medium-educated employees. This result can be interpreted as an indication that increasing internationalization of economic activities (as measured by the export share) and increasing use of ICT contribute not only directly but also through their mutual strengthening to a shift of employment in favor of high-educated employees. Finally, a positive effect was found for EXPQ*ORG1 for the medium-educated employees. On the whole, there is only little evidence in favor of hypothesis 4b.

Again the differences we identified between Greece and Switzerland as to the complementarities reflect the lower knowledge and capabilities of Greek firms to adjust their personnel composition to these new technologies and new forms of workplace organization, and also to the different nature of the export activities of Greek firms in comparison with the Swiss ones.

6.5 Other factors

Part-time work and team compensation are of no relevance for the Greek firms (Table 4). Part-time work and schemes of team compensation are not widespread in the Greek economy. For Swiss firms (Table 5), the variable for part-time work correlates negatively with the share of high-educated employees, positively with the share of low-educated employees, and shows no significant correlation to the share of medium-sized employees. These results reflect the relative importance of various dimensions of quantitative labor flexibility for different employee categories (see also Arvanitis, 2005c). Seemingly, part-time work is considered suitable primarily for low-educated employees. Further, compensation according to team-performance is not relevant for any of the three employee categories in Swiss firms.

The Greek results with respect to the two dimensions of competition, namely a positive effect of the intensity of non-price education (INPC) on the high-educated and a negative effect of the same variable on the low-educated employees are in accordance with theoretical expectation (hypotheses (a) and (b) in Gersbach and Schmutzler 2012). For the Swiss firms the competition effects are of considerably smaller importance for workforce composition; we could find only a negative effect of IPC on the share of high-educated employees, which is also in accordance to the above theoretical prediction.

This stronger influence of competition on the workforce composition of the Greek firms in comparison to the Swiss ones, can be probably attributed (at least to some extent) to the intensification of the competition that Greek firms faced, due to the full membership of Greece in the European Economic and Monetary Union and the globalization of the economy. On the contrary, Swiss firms that are mostly suppliers of specialized high-tech products (pharmaceuticals, electronic instruments, medical technology) are operating in niche markets, in which the main competition parameters are innovation and quality and not the price.

7. Summary and conclusions

In sum, comparing the three examined factors, which have been proposed by the literature for explaining the shift of labor demand in favor of high-skilled labor, the technology (ICT) has been found to have a strong and robust effect on the demand for employees' skills. For both countries, we found a positive effect on the demand for high-qualified personnel and a negative effect on the demand for low-qualified personnel. Further, for Greece the results showed in accordance to (part of) the polarization hypothesis a negative effect for the medium-educated employees, while no effect could be found for this employee category in the Swiss data.

The new forms of workplace organization in Switzerland seem to have discernible effects on the demand for employees' skills. The pattern of effects differs between new work design and employee voice practices. The former showed no effect on the demand for high-qualified and low-qualified personnel and a negative effect on the demand

10 We thank an anonymous referee for pointing to this issue.

for medium-educated employees. For the latter a positive effect was found for the high-qualified and a negative effect for the low-qualified employees. For Greece only a positive effect of employee voice practices on high-educated personnel, a positive effect of new work design on medium-educated employees, and a negative one for the low-educated employees could be found. This indicates that in the Greek context firms have not sufficiently learnt to adapt their personnel composition to new forms of workplace organization that are generally considered to foster firm performance. This lack of flexibility may also be due to "rigidities" in labor legislation, that make it costly to make personnel adaptations by firing some existing personnel and hiring new ones.

Similarly, the export intensity in Switzerland, focused mainly on sophisticated products with high content of high-skilled labor, has a strong effect on the composition of firms' personnel. It correlates positively with the share of high-educated, negatively with the share of medium-educated personnel, and shows no effect on the share of low-educated employees. However, in Greece the export intensity does not correlate with the composition of firms' personnel. This may be due to the fact that Greece is a country with much lower export activity (therefore with much lower exposure to international competition) than Switzerland, and its exports are focused mainly on less sophisticated products without high content of high-skilled labor.

By comparing the results from the two countries, both similarities and differences in the above aspects can be identified. In Greek firms the main effects with respect to high-qualified employees come from the use of ICT and the decentralization of certain competences (and also the INPC); furthermore, the use of ICT shows negative effects on the shares of medium-qualified and low-qualified personnel. On the contrary, in Swiss firms there is a wider spectrum of factors that correlate positively with the share of high-qualified employees: use of ICT, decentralization of certain competences, export activity, and also the interaction between ICT and new work design practices, as well as the interaction between ICT and export. Swiss firms seem to be able to take a maximum out of the potential of technology and decentralization through the combination of them with appropriate human skills.

The results of this study might have significant implications for research and government policy. With respect to government policy makers, our recommendation would be to pay special attention to the conditions favoring the formation and growth of required human capital in the economy. In this sense, it is necessary to take into account the results of this study, which indicate that many of the examined factors (with few exceptions) have a negative effect (or at the best no effect) on the demand for medium-educated and low-educated personnel, which can result in increasing unemployment for these groups and therefore complex and multidimensional social problems. Therefore they should design appropriate policies for addressing this issue. In order to offer more employment perspectives to medium-educated persons, government should promote and develop not only tertiary education, but also education institutions that produce this middle-skilled personnel. For instance, in Switzerland, the system of the "normal" vocational education ("Berufslehre"), which is one of the two pillars of the Swiss "dual education system" that produces medium-educated personnel, has to be (further) upgraded, especially with respect to the content of education. Further training or life-long training could also be a way to enhance the skills of medium-educated persons that are too specialized and thus more prone to obsolescence of their skills.

A more difficult problem is to offer more employment perspectives to low-educated persons, especially in case that many of them might be immigrants with a different cultural background as that of the host country. Additional education and/or vocational training is one way of trying to tackle this problem, but it is not a way accessible and feasible for all involved persons, particularly not for older ones; for such cases social partners and policy makers have to coordinate efforts for specific solutions aiming at the social integration of this category of employees.

Finally, it should be noted that for designing policies solutions from other countries cannot be just "copied." It is necessary to exploit the relevant knowledge of other countries, but in combination with a sound knowledge of the particular characteristics and specificities of country's own national context.

Also, the results of this study might have significant implications for the future research on the observed shift of labor demand toward high-skilled personnel (which is expected to become more intensive in the near future): this research should become more "multifactor" than in the past (when it focused on one or two factors-independent variables), taking into account (i) a multitude of independent variables (associated with different types of ICT, new forms of workplace organization, export activities, competition, etc.) and their possible complementarities, and also (ii) various characteristics of the national context, which might affect the relationship of the demand for employees' (vocational) education and skills with the above independent variables.

There are of course drawbacks in the study in its current form. The use of alternative methods to capture in more detail the inter-linkages between ICT, organization exports, and workforce qualification would probably yield useful

additional insights. As already mentioned, a further critical point is the cross-sectional character of our data. We hope that in the near future data for more than one cross-section will become available, thus enabling us to apply a dynamic approach.

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Appendix

Table A1. Composition of the data sets by industry and firm size class

	Greece		Switzerland	
	N	Percentage	N	Percentage
Industry				
Food, beverage	25	9.2	77	4.5
Textiles	6	2.2	24	1.4
Clothing, leather	7	2.6	6	0.3
Wood processing	3	1.1	27	1.6
Paper	3	1.1	24	1.4
Printing	12	4.4	52	3.0
Chemicals	12	4.4	66	3.8
Plastics, rubber	6	2.2	38	2.2
Glass, stone, clay	9	3.3	28	1.7
Metal	4	1.5	24	1.4
Metalworking	7	2.6	106	6.2
Machinery	1	0.4	165	9.7
Electricalmachinery	2	0.7	50	2.9
Electronics, instruments	3	1.1	122	7.1
Vehicles	2	0.7	20	1.1
Other manufacturing	5	1.8	30	1.8
Energy	3	1.1	33	1.9
Construction	14	5.2	179	10.5
Wholesale trade	52	19.2	142	8.3
Retail trade	21	7.7	102	6.0
Hotels, catering	27	10.0	56	3.3
Transport, telecommunication	15	5.2	91	5.3
Banks, insurances	5	1.8	73	4.3
Real estate, leasing	2	0.7	11	0.6
Business services	16	5.9	151	8.8
Personal services	10	3.7	11	0.6
Firm size				
20–49 employees	88	32.5	474	27.7
50–249 employees	105	38.7	875	51.2
250 employees and more	78	28.8	361	21.1
Total	281	100.0	1710	100.0

Table A2. Descriptive statistics

Variable	Greece				Switzerland			
	Mean	Standard deviation	Min	Max	Mean	Standard deviation	Min	Max
H_EDUC	26.181	23.690	0	100	20.034	20.306	0	100
M_EDUC	55.863	25.122	0	100	56.730	21.165	0	100
L_EDUC	17.956	23.838	0	97	22.316	24.653	0	100
ICT	−0.006	1.808	−2.573	3.921	−1.47 E−09	1.788	−2.422	3.454
ORG1	−0.003	1.833	−3.810	5.330	0.012	1.867	−4.739	8.330
ORG2	0.020	4.785	−9.455	16.652	−0.010	4.693	−12.932	19.153
EXPQ	11.956	23.457	0	100	22.576	34.076	1	100
PART_TIME	1.764	0.945	1	5	2.639	1.107	1	5
TEAM_COMP	3.417	1.189	1	5	2.716	1.158	1	5
IPC	3.967	1.052	1	5	3.933	1.056	1	5
INPC	3.177	1.141	1	5	3.064	1.003	1	5
Medium-sized firms	0.387	0.488	0	1	0.358	0.479	0	1
Large firms	0.288	0.454	0	1	0.149	0.356	0	1
Number of observations	266				1688			

Table A3. Independent variables: correlation matrix; Greece

	ICT	ORG1	ORG2	EXPQ	PART_TIME	TEAM_COMP	IPC	INPC	Medium firms	Large firms
ICT	1.000									
ORG1	0.068	1.000								
ORG2	0.375	−0.037	1.000							
EXPQ	−0.100	0.023	−0.002	1.000						
PART_TIME	0.007	0.069	0.014	−0.081	1.000					
TEAM_TIME	0.150	0.091	0.042	−0.015	0.037	1.000				
IPC	0.042	0.058	0.132	0.132	0.031	0.125	1.000			
INPC	0.077	0.040	0.095	0.005	0.090	0.073	0.360	1.000		
Medium firms	0.067	0.076	−0.009	0.007	−0.029	0.006	−0.097	−0.022	1.000	
Large firms	0.138	0.040	0.066	0.054	0.201	−0.017	0.039	0.041	−0.501	1.000

Table A4. Independent variables: correlation matrix; Switzerland

	ICT	ORG1	ORG2	EXPQ	PART_TIME	TEAM_COMP	IPC	INPC	Medium firms	Large firms
ICT	1.000									
ORG1	0.147	1.000								
ORG2	0.288	0.121	1.000							
EXPQ	0.125	0.122	0.071	1.000						
PART_TIME	0.074	0.112	0.117	−0.042	1.000					
TEAM_TIME	0.079	0.235	0.040	0.075	−0.012	1.000				
IPC	−0.009	0.043	−0.020	−0.024	0.081	0.074	1.000			
INPC	0.116	0.055	0.117	0.190	0.099	0.067	0.045	1.000		
Medium firms	−0.038	0.020	−0.042	0.066	−0.033	−0.070	−0.022	0.003	1.000	
Large firms	0.210	0.126	0.130	0.100	0.122	0.034	0.033	0.105	−0.511	1.000