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Access to skilled labor, institutions and firm performance in developing countries

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Abstract

Purpose – The purpose of this paper is to examine the role of access to skilled labor in explaining firms' sales growth subject to the controlling influence of a wide range of firm-specific characteristics and country-level economic and non-economic factors.

Design/methodology/approach – The analysis uses a consistent and large firm-level data set from the World Bank's Enterprise Surveys that includes 138 developing countries. An instrumental variables model with a GMM estimator is used for estimating the impact of access to skilled labor on firm performance. In order to obtain more robust estimators, the analysis introduces country-level controls reflecting the influence of economic and institutional factors, such as economic and financial development, institutional governance, education and technological progress.

Findings – The results document a significant and positive association between access to skilled labor and firm performance in the developing world. The explanatory power of access to skilled labor remains broadly robust after controlling for a wide range of firm-specific characteristics: sectoral and geographical influences matter. The results also show that the association between labor skill constraints and firm performance is mitigated by country-level factors but in diverse ways. Development, institutions, education and technological progress exert various mitigating effects on firm-level behavior regarding access to skilled labor.

Originality/value – The paper's novel contribution is threefold: first, it uses joint firm, sector and country-level information to analyze the role of access to skilled labor on firm performance; second, it uses consistently produced information at the firm level from 138 developing countries; and, third, it considers the controlling impact of a wide range of country-level factors that reflect a country's overall development, institutions and evolution.

Keywords Institutions, Survey data, Firm performance, Labour skills

Paper type Research paper

1. Introduction

Access to skilled labor is a key determinant of firm performance. Nickell and Bell (1995), Machin *et al.* (1996) and Leuven *et al.* (2004) argue that intensifying competitive pressures on firm performance have increased the demand for skilled labor, which in turn has revealed a problem of skill shortage. The situation is more aggravated in developing countries where education–occupation mismatches as well as other labor market specificities result in skill shortage fluctuations thereby affecting firm performance. For instance, Bhattacharya and Wolde document that reducing the labor skill shortage from the MENA region average to the world's average could result in a 4 percent increase in per capita GDP annually. Fakih and Ghazalian (2015) document for the same region the importance of various firm-specific characteristics and institutional factors in explaining labor skill shortages. Brixiova *et al.* (2009) show that labor skill shortages affect the pace of convergence of transition economies in Central Europe toward European structures. Tan *et al.* (2016) find that deficiencies in the education and training systems in Tanzania compromise the quality of labor skills, giving rise to skill shortages, thereby constraining

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the operations and growth of formal sector firms in the country. Fajnzylber and Fernandes (2009) show that firms in Brazil and India that engage in international trade and foreign direct investment activities experience more or less severe labor skill constraints depending on their technology diffusion and extent of trade specialization, respectively.

This paper analyzes the relation between labor skill shortages of firms and their performance in developing countries. The analysis of the relation is carried out under different economic, educational and technological conditions. The novel contribution of the paper is threefold: first, it uses firm, sector and country-level information to analyze the role of firms' access to skilled labor on their performance; second, it uses consistently produced information at the firm level from 138 developing countries; and, third, it considers the controlling impact of a wide range of firm-specific characteristics and country-level factors that reflect a country's overall development, educational and technological conditions. To our knowledge, this is the first paper that analyzes in detail this relation in a wide range of developing countries. Our paper contributes to the literature on the impact of labor supply conditions on firm performance in developing countries.

The results document a significant positive relation between access to skilled labor and firm performance in the developing world that remains broadly robust to various firm-level controls comprising a wide range of firm-specific characteristics (age, size, sector of activity, location, export status, ownership, etc.). Importantly, the results also document that the interaction between access to skilled labor and firm performance is mitigated by country-level factors, such as the levels of development, income inequality, education and technological progress. In order to develop a more solid basis for steering labor market reform to improve firm performance in the developing world, policy makers need to understand more adequately the influence of firm-specific factors and the economic and institutional environment conditioning the interaction between labor skill constraints and firm performance.

In what follows, Section 2 reviews the related literature; Section 3 describes the data and the empirical methodology used for the analysis; Section 4 explores the power of labor skill constraints and other firm-specific characteristics in predicting firm performance; Section 5 extends the analysis to include the controlling impact of country-level factors; and Section 6 concludes the paper.

2. Related literature

Labor skills are competencies needed to carry out the tasks and duties of a given job (ILO, 2012, p. 11). These competencies include cognitive (i.e. literacy), non-cognitive (i.e. team work, communication, language, IT use and other soft skills) and job-specific skills. Skill formation is the result of a successive sequence of education, training and labor market participation activities (Banerji *et al.*, 2010). Few developing countries have comprehensive information on these different competencies (World Bank, 2014).

The importance of labor skills for firm performance can be understood by reference to the competitive pressure on firms to survive and grow in the modern globalized world. This requires faster productivity growth and efficient strategy adaptation. Syverson (2011) reviews the evidence on the determinants of firm productivity growth highlighting the pervasive within-sector dispersion in productivity levels across firms. Hsieh and Klenow (2009) show that this dispersion is larger in developing countries. The within-sector dispersion in productivity levels among firms also appears to persist over time. The evidence suggests that firms exhibit heterogeneous internal capabilities that persist over time and respond with different efficiency to uncertain external demand.

Firms appear to offer two different responses to these challenges. The first focuses on the competitive adjustment of their cost structure and output composition to align with the broad shifts in overall demand brought about by the business cycle, trade liberalization

(Pavcnik, 2002) and technological change (Bloom *et al.*, 2015). The second response focuses on adjusting the internal organization and production strategy, by introducing new management practices (Bloom and Van Reenen, 2010), in-service training programs (Dearden *et al.*, 2005) and investing in fixed capital improvements (Bartel *et al.*, 2007), among others. Both responses influence price and non-price factors of output and hence economic performance. These responses are further elucidated below.

According to the first response, the availability and quality of appropriate labor skills affect firm performance through their impact on unit labor cost (productivity effect), which has confirmed evidence. Haskel and Martin (1996), Bennett and McGuinness (2009) and Healy *et al.* (2015) argue that shortages of labor skills can cause a competitiveness loss as a result of inadequate competences and excessive wage increases. Montt (2015) shows that in the OECD countries higher and persisting mismatches in labor skills are associated with lower labor productivity. Rehman (2015) documents that skill shortage is associated with lower productivity growth in the Pakistani software industry. Mahy *et al.* (2015) find a significant positive relationship between specialized training of employees and firm productivity. This relation is stronger when firms belong to a technology-intensive industry, deploy a relatively high share of tasks that require advanced skills, and evolve within an overall discouraging business environment, as is the case in most developing countries.

The dispersion of labor skills too affects firm productivity. Bombardini *et al.* argue that variations in labor skills help adjust mismatches between labor demand and supply, but the adjusting effect varies among sectors of activity. Firms operating in industries with higher complementarity respond more efficiently to labor skill dispersion. Iranzo *et al.* (2008) show that the dispersion of labor skills in Italian firms has a positive effect on firm productivity when it materializes between occupational groups within the same firm, i.e. between productive and non-productive workers. In contrast, it has a negative effect when it materializes across firms. Giesing and Laurentsyeva (2014) show that one standard deviation increase in labor skill shortage results in a 6.1 percent decrease in total factor productivity of the firm in the EU.

Moreover, the impact of labor skills on firm productivity is affected by the specific characteristics of firms. Galindo-Rueda and Haskel (2005) argue that the share and gender composition of full-time workers in the firm affects the impact of labor skill dispersion on firm productivity. In a cross-country setting, Poschke (2014) shows that the variation of firm size affects entrepreneurial activity and thereby the dispersion of average demand for labor skills. Ouimet and Zarutskie (2014) find a positive association between firm age, employee age with new skills and firm growth in new ventures. Shleifer and Vishny (1994) and Prasnikar *et al.* (1994) argue that the firms' ownership structure and especially state ownership have direct effects on worker incentives through political constraints placed on the labor contracting process. Modified labor contracts can in turn affect investment in human capital and hence labor skill acquisition and work effort. Cai *et al.* (2008) argue that the formation and distribution of labor skills during the reform process in China, especially in state-owned enterprises, has been driven rather by government intervention than private sector initiatives. Kaiser (2002, Ch. 5) argues that limited liability firms in the services sector in Germany tend to switch to less desirable financial assets more often than unlimited liability firms, thereby affecting the structure of skills required to manage these assets. Atkin *et al.* show that exporting firms in Egypt realize learning-by-exporting economies that lead to specific skill acquisition that helps improve their technical efficiency.

According to the second response, labor skills affect firm performance through their impact on the range and composition of capabilities required to make efficient strategic decisions (strategic management effect). These capabilities refer to a firm's capacity to deploy suitable resources and develop and disseminate task-specific information through

its human capital. Capabilities are intangible assets often developed in key functional areas (e.g. production engineering, brand management in marketing) by combining physical, human and technological skills. Teece (2017) argues that the capabilities view of the firm looks beyond factors of production to recognize the importance of managerial choices in enhancing labor productivity and better meeting consumer demand. Technology adoption and expertise result from search, R&D and investment. Value generation depends on the firms' response to competition, the extent to which they appropriate and refine capabilities and the acquisition of suitable industrial knowledge over time. Teece *et al.* (1997) further argue that improvements in internal coordination, adjustment of labor skills to evolving production requirements, such as tacit knowledge and asset complementarity, and the realization of increasing returns provide firms with a competitive advantage thereby increasing productivity. The latter may be enhanced or eroded depending on the stability of the business cycle, the ease of internal skill adjustment and the extent of competitive replication of strategy. The strategic emphasis shifts from merely having the right pool of human resources to internally generating new human capital. Ahmad and Schroeder (2003) stress that success of some business decisions (e.g. international mergers and acquisitions) necessitates recognition and reconciliation of the differences among human resource management practices in different countries and industries. Snow and Snell (2011) note that human capital improvements aid strategy formulation by allowing novel approaches to the organization of production. Barney and Wright (1998), Ployhart (2006) and Irvin and Michaels (1989) argue that, to the extent that they are difficult to be imitated by competitors and to be substituted by other resources, new capabilities enhance long-term competitive advantage. Amit and Schoemaker argue that organizations must decide both on the selection of suitable labor skills and capabilities and on the best way to make skilled labor an integral part of organizational improvement. Ahmed *et al.* (2014) provide evidence that suitable operational capabilities of workforce make the firms' performance more resilient to shocks. Galunic and Riordan (1998) argue that heterogeneity in labor skills provides firms with a higher ability of comprehensive problem solving and creative conflict resolution. The cognitive diversity resulting from interaction among people with different perspectives and capabilities facilitates the identification and formulation of better organization strategies.

The studies surveyed above rely mostly on aggregate data and therefore do not adequately consider the individual firms' perspective on the role of labor skill constraints for their performance, especially in the developing countries. Further, they rarely consider the role of a wide range of firm-specific characteristics. Moreover, the empirical association between access to skilled labor and firm performance is mostly analyzed within individual country settings and rarely on a comparative cross-country basis. Finally, the analysis of economic and institutional factors across countries is rarely considered explicitly on a cross-country setting. Based on a new and rich data set, this paper aims to fill the void to some extent by examining in more detail the relation between access to skilled labor and firm performance in developing countries. It tests for the impact of skilled labor constraints experienced by firms on their performance in developing countries, subject to the influence of a wide range of firm-specific characteristics and country-level institutional factors. The large size of the data allows the analysis of the sectoral and geographical dimensions of the association. The paper takes a behavioral perspective by considering firms' own perceptions of labor constraints rather than relying on aggregated reporting information, which may be either inadequate or not credible in many developing countries. The results provide new evidence that contributes to the elucidation of certain aspects of the two types of responses firms offer. The results have useful implications for labor market policy aiming at enhancing labor supply conditions and firm performance in developing countries.

3. Data and research methodology

The analysis utilizes data from the World Bank's Enterprise Surveys (ES hereafter). The basic data include 131,908 non-financial firms from 138 developing countries, covered by the ES between 2006 and 2016 over several surveys of firms from the manufacturing and other non-financial sectors of economic activity. Survey rounds are essentially independent cross-sections with only a limited number of firms appearing consistently throughout survey rounds. However, the data set has the advantage of consistent identification of firms' responses throughout many survey years and across a wide range of developing countries. This allows the focusing on the variation in average firm-level responses within each country and dynamically over time. The ES data reflect the individual firms' experience and perception of the environment in which they operate. The ES facilitate the linking of firm performance with other firm characteristics and the business environment. The ES use updated and complete sampling frames for each country and strive to eliminate alien elements from the frame prior to the sample selection. An important strength of the data is that it focuses on small and medium enterprises, which are the bloodline of economic activity in most developing countries. The ES stratifies firm size into small (5–19 employees), medium (20–99) and large (100 and more) firms. A shortcoming of ES data stems from the doubts often expressed regarding the representativeness of firms' true constraints. While the responses of firms are private unaudited information, these concerns could only be addressed by using firm census data, which are not available for most developing countries. Instead, micro-survey data provide more valuable information, at least in the developing countries.

The outcome variable for measuring firm performance is the real annual growth of sales, GSALES. Based on the ES explanation, GSALES represents the real annual growth of sales reported during the current fiscal year from a previous period. The variable captures a dynamic aspect of firm performance. For most countries in the ES, the difference between the two fiscal periods is two years. However, for some countries the interval is three years. Hence, an annualized measure is used. All values for GSALES are converted to USD using the exchange rate that corresponds to the fiscal year of the survey. GSALES is then deflated to 2009 using the USD deflator.

The main independent variable is SKILLS. The latter is an ES categorical variable that reflects the extent to which firms identify the current level of labor skills as a major constraint for their performance. It is the answer of firms to the question: "How problematic is the level of labor skills for the operation and growth of your business?" It takes the value of 1 if the answer is "very problematic or moderately problematic" and 0 otherwise. It is possible that the firms' answer does not capture all reality, as some firms may report labor skill constraints while they are not actually constrained by them but rather facing temporary skill shortages instead. Therefore, one must be cautious of this behavioral bias and interpret the results carefully. Nevertheless, the measure is consistently applied across firms and countries for the sample period. Table I reports the average value of SKILLS per country; the average sample value is 21.3 percent and the standard deviation is 41.2 percent. The data show a large divergence among countries. Most firms operating in Suriname consider labor skills as the biggest obstacle to their operations (66.4 percent), while few firms operating in Eritrea consider labor skills as an important obstacle (1.7 percent). Interestingly, Table I shows that labor skills tend to be a serious obstacle to some of the biggest developing economies, such as Brazil (57.3 percent), Argentina (49.5 percent) and Syria (59.6 percent).

Control variables include a range of firm-specific characteristics and country-level factors that account for the impact of national economic and non-economic conditions. These latter control variables capture unobservable differences among countries and account for any spurious relationships. They provide an improved measure of the impact of

Country (num. of firms)	Mean	Country (num. of firms)	Mean	Country (num. of firms)	Mean
Afghanistan (945)	32.3	Georgia (959)	17.2	Paraguay (974)	41.4
Albania (960)	17.5	Germany (1,196)	6.9	Peru (1,632)	33.4
Algeria (600)	36.8	Ghana (1,214)	9.4	Philippines (1,326)	6.0
Angola (785)	23.2	Greece (546)	8.6	Poland (1,960)	19.2
Antigua and Barbuda (151)	31.1	Grenada (153)	39.1	Portugal (505)	12.4
Argentina (2,117)	49.5	Guatemala (1,112)	31.3	Romania (1,721)	31.5
Armenia (1,128)	11.8	Guinea (223)	12.6	Russia (5,953)	27.7
Azerbaijan (1,196)	5.1	Guinea-Bissau (159)	13.2	Rwanda (453)	19.6
Bahamas (150)	33.3	Guyana (165)	48.8	Samoa (109)	27.8
Bangladesh (2,946)	16.8	Honduras (796)	23.6	Senegal (1,107)	9.1
Barbados (150)	28.9	Hungary (1,218)	10.5	Serbia (1,102)	13.2
Belarus (1,034)	23.6	India (13,515)	11.2	Sierra Leone (150)	17.4
Belize (150)	40.7	Indonesia (1,444)	6.1	Slovak Rep. (748)	20.4
Benin (150)	27.9	Iraq (756)	25.8	Slovenia (804)	8.7
Bhutan (503)	13.8	Ireland (501)	15.6	South Africa (937)	9.0
Bolivia (975)	32.9	Israel (483)	12.5	South Korea (598)	6.8
Bosnia and Herzegovina (999)	12.4	Jamaica (376)	21.5	South Sudan (738)	20.5
Botswana (610)	27.6	Jordan (1,076)	18.7	Spain (606)	13.8
Brazil (3,444)	57.3	Kazakhstan (1,768)	24.7	Sri Lanka (610)	19.3
Bulgaria (2,500)	25.6	Kenya (1,438)	16.3	St Kitts and Nevis (150)	45.0
Burkina Faso (533)	30.3	Kosovo (472)	17.8	St Lucia (150)	24.7
Burundi (427)	12.7	Kyrgyz Rep. (877)	22.6	St Vincent and Gren (154)	32.0
Cabo Verde (254)	39.7	Lao PDR (630)	21.5	Sudan (662)	15.5
Cambodia (974)	22.6	Latvia (836)	29.5	Suriname (152)	66.4
Cameroon (535)	26.8	Lebanon (943)	28.2	Swaziland (307)	13.4
Central African Rep. (150)	24.7	Lesotho (151)	17.3	Sweden (600)	23.2
Chad (150)	58.5	Liberia (150)	13.5	Syria (508)	59.6
Chile (2,050)	34.5	Lithuania (1,057)	29.9	Tajikistan (1,099)	18.9
China (2,700)	2.9	Madagascar (977)	12.7	Tanzania (1,232)	30.4
Colombia (1,942)	31.4	Malawi (673)	17.5	Thailand (1,043)	38.5
Congo (151)	48.8	Malaysia (1,115)	20.2	Timor-Leste (150)	18.0
Congo, Dem. Rep. (1,228)	33.7	Mali (850)	9.3	Togo (155)	18.4
Costa Rica (881)	24.7	Mauritania (387)	28.8	Tonga (150)	50.8
Côte d'Ivoire (526)	34.3	Mauritius (398)	46.9	Trinidad and Tobago (370)	40.7
Croatia (1,284)	14.9	Mexico (2,960)	24.7	Tunisia (592)	31.7
Czech rep. (846)	18.1	Micronesia (68)	44.1	Turkey (4,559)	21.4
Djibouti (266)	18.2	Moldova (1,238)	27.0	Uganda (1,325)	16.4
Dominica (150)	13.3	Mongolia (722)	18.7	Ukraine (2,556)	23.2
Dominican Rep. (360)	36.1	Montenegro (266)	6.0	Uruguay (1,228)	29.1
Ecuador (1,024)	33.1	Morocco (1,066)	30.5	Uzbekistan (1,251)	12.4
Egypt (5,766)	27.1	Mozambique (479)	18.0	Vanuatu (128)	29.4
El Salvador (1,053)	27.0	Myanmar (632)	16.0	Venezuela (820)	29.7
Eritrea (179)	1.7	Namibia (909)	13.7	Vietnam (1,053)	8.4
Estonia (804)	16.6	Nepal (850)	9.7	West Bank and Gaza (835)	15.4
Ethiopia (1,976)	9.6	Nicaragua (814)	18.6	Yemen (830)	30.9
Fiji (164)	15.3	Niger (275)	30.3	Zambia (1,204)	11.4
FYR Macedonia (982)	10.2	Nigeria (4,567)	8.2	Zimbabwe (599)	5.1
Gabon (179)	42.3	Pakistan (2,182)	15.7		
Gambia (174)	11.5	Panama (969)	14.5		

Source: Enterprise Surveys, World Bank. The figures report the percent of firms reporting labor skill as an important constraint to do business

Table I.
Labor skills as a constraint to firms' business operations (mean percent)

firm-specific variables beyond the effects of others. Each individual firm is not large enough to affect country-level measures of those development indicators. Thus, the regression estimates represent within-country over time variation in the relationship between access to skilled labor and firm performance. Table AI describes the variables used in the paper.

Table II shows summary statistics. The growth of sales varies considerably among countries, whereby there is an average of 4.73 percent variation with a standard deviation of 27.8 percent. The firms in the sample are on average young medium-size firms, operating mainly in the manufacturing sector in big cities. They are on average moderate exporters with a minority foreign ownership stake. On average, about a third of their labor force consists of unskilled workers, which are employed mainly as permanent production workers.

The estimation analysis must deal with a number of potential econometric problems. First, there is a possibility that the skilled labor constraints of firms may be endogenously influenced by the growth of sales, giving rise to a problem of reverse causation. This, in turn, might cause regressors to be correlated with the error term. However, the large cross-section of firms and countries limits the possibility of reverse causation. Second, time-invariant country characteristics, such as institutions, may exert considerable unobservable cross-country effects on individual firm behavior and therefore be correlated with the regressors. In order to deal with this potential problem more effectively, we add firm-level characteristics as first-level controls and country-level factors as second-level controls, corrected for collinearity and capturing nonlinearities (log values) and we apply an instrumental variables analysis. The OLS estimator may result in upwards biased estimates, whilst the use of a within-group estimator may result in downwards biased estimates (Nickell, 1981).

Endogeneity concerns are dealt with the use of instrumental variables estimation. However, finding proper external instruments across countries and over time is a formidable task and thus the ordinary instrumental variables estimator does not adequately

Variable	Obs.	Mean	SD	Min	0.25%	Median	0.75%	Max
GSALES	85,191	4.73	27.75	−100	−7.87	3.89	16.19	100
SKILLS	147,468	0.21	0.41	0	0	0	0	1
AGE	143,689	2.54	0.82	0	2.08	2.56	3.09	5.37
SIZE	151,274	0.81	0.4	0	1	1	1	1
SECTR	151,707	0.59	0.61	0	0	1	1	3
LEGAL	145,892	0.48	0.5	0	0	0	1	1
LOCAT	115,165	0.53	0.5	0	0	1	1	1
EXPR	149,208	15.5	36.19	0	0	0	0	100
OWNF	148,620	10.61	30.8	0	0	0	0	100
OWNG	151,707	0.03	0.16	0	0	0	0	1
OWND	151,707	0.87	0.33	0	1	1	1	1
RSKILL	73,262	33.36	32.22	0	0	25	58.33	100
RPROD	63,444	2.14	17.03	0	0.15	0.42	1.33	31
RPERM	120,954	0.23	1.06	0	0	0	0.15	80
GDPCP	151,707	3.48	0.49	2.2	3.11	3.5	3.85	4.77
GINI	139,923	39.49	8.36	16.64	33.6	38.47	45.3	65
HDI	149,741	0.66	0.13	0.3	0.59	0.68	0.75	0.91
CREDIT	151,063	1.51	0.32	0.31	1.29	1.54	1.71	2.2
VOICC	150,859	−0.21	0.79	−2.16	−0.88	−0.18	0.41	1.67
POLSTB	150,859	−0.57	0.88	−2.69	−1.19	−0.62	0.07	1.33
GVEFF	150,859	−0.24	0.66	−1.73	−0.68	−0.27	0.12	1.89
RGQLT	150,859	−0.18	0.69	−2.26	−0.64	−0.28	0.27	1.89
RLLW	150,859	−0.35	0.68	−1.95	−0.82	−0.46	−0.03	1.95
CNTCR	150,859	−0.4	0.67	−1.64	−0.9	−0.56	−0.12	2.29
FRCTHN	149,892	0.45	0.23	0	0.25	0.42	0.63	0.93
FRCLNG	150,819	0.41	0.31	0	0.13	0.37	0.72	0.92
FRCRLG	150,969	0.41	0.22	0	0.21	0.38	0.61	0.86

Sources: World Development Indicators; World Bank Enterprise Surveys

Table II.
Descriptive statistics of variables

address endogeneity bias. Arellano and Bover (1995) and Blundell and Bond (1998) argue that lagged values of the endogenous variable may by themselves be poor instruments in large data sets and they propose the system GMM estimator. The latter can account for endogeneity bias by producing valid internal instruments under the assumption that current-period shocks in the error term do not affect past values of the regressors and the past values of the regressors do not directly affect current values of the outcome variable. In other words, instruments include both lagged levels and lagged differences of the variables. However, this causes a potential problem of instrument proliferation. Roodman (2009) discusses the problem of too many instruments. He argues that the system GMM estimator assumes no contemporaneous correlation among cross-sectional error terms, so period dummies can be used to control for it. It also requires that there is first-order serial correlation but no second-order serial correlation in the error term. But, as the time dimension increases, the number of instruments can be too large compared to the sample size making some asymptotic results and specification tests invalid. Too many instruments can overfit endogenous variables and fail to expunge their endogenous components, resulting in biased estimates. He moreover shows that in large-T data samples, a shock to the country's fixed effect would decline with time and hence the correlation of the lagged outcome variable with the error term would be insignificant. The system GMM estimator produces efficiency gains when the number of time series observations is small relatively to cross-section observations. It also reduces the adverse effect of information gaps in the unbalance panel data. The validity of the instruments collectively can be tested by using the Hansen's J statistic of over identifying restrictions. However, the potential instrument proliferation problem may also lead to the overfitting of the endogenous variables and thereby weaken the validity of the J test. A return to the Sargan test might be contemplated as it is less vulnerable to instrument proliferation, but this test requires homoscedastic errors for consistency, which is a difficult assumption to make. As a rule of thumb, the number of instruments should be less than the number of countries. On the other hand, Bond *et al.* (2001) argue that in small samples the asymptotic standard errors may be downwards biased. Windmeijer (2005) provides a finite-sample correction procedure for the variance of the linear efficient two-step system GMM estimator. In our analysis, the existence of a very large N makes the potential instrument proliferation problem less likely to occur. Thus, given the small T per country and the large N of countries in our weakly balanced sample, we use an instrumental variables model with a two-step GMM estimator for cross-section analysis and correct for finite-sample bias. Only observations with non-missing values are considered. Standard errors are corrected for heteroskedasticity and clustered at the country level. In general, the estimated model assumes that the following equation describes the firm's underlying response:

$$Y_{ij} = \alpha_j + \text{SKILLS}_{ij}\beta_1 + X_2'\beta_2 + X_3'\beta_3 + \mu_{ij}, \quad (1)$$

where $Y_{i,j}$ (GSALES) is the annual growth rate of sales reported by firm i in country j; SKILLS is the binary variable that reflects the perception of labor skills as significant or insignificant constraints for performance of firm i in country j; X_2' is the vector of firm-specific characteristics; X_3' is the vector of country-level control variables. The term μ_{ij} is the two-way error term component that comprises the sum of η_i, λ_t and $e_{i,t}$, where η_i accounts for unobservable country-specific effects, λ_t, accounts for time-specific effects and the $\varepsilon_{i,t}$ is a disturbance parameter that is assumed to vary across countries and years. An additional variable is deployed as external instrument in the endogeneity analysis. This variable is the extent to which labor regulations affect firms' business operations (LABREG), obtained from the ES. It exhibits a significant correlation with SKILLS (31.8 percent) and no correlation with GSALES (0.083 percent). Hansen's J statistic will be

used for checking the validity of instruments and the model's specification. Given that our analysis contains several regressors, we are also mindful of Roodman's (2009) concerns that too many instruments tend to weaken the power of the Hansen *J* test. Finally, we are well aware of the difficulty in interpreting the observed correlations as causal effects. Our results are therefore interpreted as strength of association rather than causation, and the use of the words "predict" or "impact" or "effect" is only made to simplify exposition. Table III presents the pairwise correlations between the independent variable and the firm-specific control variables. The results show small pairwise correlations (considerably lower than 0.5) and therefore do not document severe collinearity problems between the firm-specific variables. Therefore, all these variables can be included in regression analysis.

4. Analysis of results

The regression results report the estimated impact of access to skilled labor on firm performance depending on the firms' own characteristics. In order to obtain a better understanding of the relevant impact, the total sample of developing countries is divided between high-income and low-income ones based on the sample mean level of GDP per capita. Table IV reports the results of the baseline analysis. Several regression models are sequentially estimated and the results are shown in columns A1–A11. In all models access to skilled labor is positively and significantly associated with the growth of firms' sales in developing countries. Better access to skilled labor increases the growth of sales. The magnitude of the effect is on average small (1.9 percent) but strongly significant. The Hansen *J* statistic is low and therefore the null hypothesis, that the models' over-identification restrictions are valid, is not rejected. This implies that the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. The predictive power of access to skilled labor remains robust after the successive addition of firm-specific characteristics in the analysis. The latter are significant determinants of sales growth. The younger the firm, the higher its sales growth. This confirms the product life-cycle hypothesis. The larger the firm, the more buoyant its sales growth. Large firms can realize better organization, economies of scale and scope and establish more expanded sales networks and marketing policies. Sales growth is faster as we move from manufacturing to services and commerce. The latter find it easier to expand sales as they face lower costs of production and distribution of products and services. Export-oriented firms realize higher sales growth as they have access to wider markets and benefit from the challenges of open competition. Sales growth is also stronger in public joint-stock companies and in those companies located in the capital city or other major cities in a country. Further, high ownership stakes by private domestic and foreign owners as well as by the state tend to retard sales growth. On the other hand, the higher the stakes of dominant shareholders, the stronger the growth of sales in the firm. It appears that dominant shareholders take a more proactive stance in boosting sales growth performance of their firms. The inclusion of firm-specific characteristics affects the magnitude but not the direction of the labor skill effect. However, more pronounced differences emerge when the sample is split between high- and low-income developing countries. While access to skilled labor remains robust, the magnitude of its effect is twice as large in low-income countries as compared to that in high-income countries. It appears that labor skill improvement has a stronger effect in less-developed countries and therefore presents a more powerful case for public intervention. Further, the role of the sector of activity and export status of firms is stronger in high-income developing countries, whilst that of the legal status, location of operation and ownership structure is stronger in low-income countries. This new cross-country evidence highlights the important role of labor skills for sales growth as well as of the role of firm-specific characteristics in explaining firm performance across different

Table III. Correlation among firm-specific variables

	Pairwise correlation	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	GSALES	1													
2	SKILLS	0.041*	1												
3	AGE	−0.082*	0.041*	1											
4	SIZE	−0.028*	−0.038*	−0.205*	1										
5	SECTR	−0.033*	0.045*	0.123*	−0.131*	1									
6	LEGAL	0.078*	0.112*	0.113*	−0.192*	0.059*	1								
7	LOCAT	0.045*	0.024*	0.026*	−0.042*	0.030*	−0.022*	1							
8	EXPR	0.018*	0.028*	0.111*	−0.296*	0.189*	0.147*	−0.020*	1						
9	OWNF	0.035*	0.013*	−0.022*	−0.181*	0.007*	0.118*	0.042*	0.195*	1					
10	OWNG	0.021*	0.027*	0.038*	−0.058*	−0.012*	0.036*	0.024*	−0.002	−0.005	1				
11	OWND	0.007	−0.019*	−0.101*	0.121*	−0.034*	−0.143*	−0.013*	−0.081*	−0.025*	0.038*	1			
12	RSKILL	0.029*	0.051*	0.041*	−0.087*	0.046*	0.104*	0.068*	0.048*	0.026*	−0.010*	−0.046*	1		
13	RPROD	0.014*	0.011*	0.039*	−0.154*	−0.001	0.046*	0.007	0.054*	0.055*	0.046*	−0.011*	0.015*	1	
14	RPERM	0.0041	0.006*	−0.031*	0.018*	−0.009*	−0.027*	−0.002	0.002	−0.002	−0.008*	−0.005	−0.018*	−0.013*	1

Notes: Pairwise correlation coefficients of firms-specific characteristics with GSALES. Correlation rates are in all cases considerably lower than 0.50. *Significant at the 5 percent level

Table IV.
Labor skills, firm-specific characteristics and firm performance

GSALES	A.1	A.2	A.3	A.4	A.5	A.6	A.7	A.8	A.9	A.10	A.11
					All countries					High-income	Low-income
SKILLS	0.019***	0.021***	0.017***	0.018***	0.019***	0.018***	0.019***	0.020***	0.018***	0.011***	0.021***
	(8.41)	(9.24)	(7.69)	(8.13)	(8.32)	(7.98)	(7.14)	(8.53)	(6.68)	(3.04)	(5.42)
AGE		−2.238***							−3.230***	−3.323***	−3.263***
		(−12.85)							(−15.61)	(−9.81)	(−12.57)
SIZE			1.467***						1.964***	2.115***	1.967***
			(12.82)						(12.98)	(9.62)	(9.70)
SECTR				0.339***					0.290***	0.651***	0.003
				(4.86)					(2.66)	(3.64)	(0.02)
EXPRT					0.027***				0.009*	0.020**	0.002
					(6.54)				(1.81)	(2.51)	(0.29)
LEGAL						−0.499***			−0.599***	−0.172	−0.654***
						(−6.19)			(−6.13)	(−1.18)	(−5.04)
LOCAT							−0.398***		−0.361***	0.362***	−0.895***
							(−5.03)		(−4.46)	(3.21)	(−7.95)
OWNP								−0.057***	−0.058***	−0.003	−0.074***
								(−4.47)	(−4.39)	(−0.18)	(−4.52)
OWNF								−0.037***	−0.050***	0.013	−0.069***
								(−2.79)	(−3.56)	(0.67)	(−3.96)
OWNG								−0.044**	−0.034	0.009	−0.040
								(−2.32)	(−1.62)	(0.38)	(−1.25)
OWND								0.001	0.007*	−0.017***	0.022***
								(0.32)	(1.81)	(−2.80)	(4.03)
adj. R^2	0.0017	0.0090	0.0023	0.0028	0.0067	0.0036	0.0020	0.0028	0.021	0.017	0.022
Hansen's J	0.011	0.438	0.438	0.002	0.009	0.002	0.274	0.051	0.016	3.992	3.824
p(J)	0.918	0.508	0.508	0.994	0.925	0.964	0.601	0.821	0.900	0.045	0.051
n	93,849	93,043	93,849	93,588	93,273	93,848	76,757	89,807	72,075	24,704	47,371

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. *t* values in parentheses. *,**,***Significant at 10, 5 and 1 percent level, respectively

microeconomic conditions in developing countries. The results tend to confirm those found in the productivity-enhancement approach (Haskel and Martin, 1996; Bennett and McGuinness, 2009; Healy *et al.*, 2015), even though the latter are drawn from individual countries and different data.

An important question is whether the impact of skilled labor constraints depends on labor structures internal to the firm. In order to study this question, Equation (1) is re-estimated to include separately the impact of labor structure information at the firm level that is available in the ES. These include the ratio of unskilled over skilled permanent production workers in the firm (RSKILL), the ratio of non-production over production permanent workers in the firm (RPROD) and the ratio of temporary over permanent full-time workers in the firm (RPERM). Table V reports the results of the estimation (models B.1–B.6). Access to skilled labor remains a robust positive predictor of sales growth. The magnitude of the effect is small but significant. It also varies considerably between high- and low-income developing countries. However, the predictive power of the internal labor structure indicators is weak. The ratios of non-production over production permanent workers in the firm and of temporary over permanent full-time workers in the firm do not appear to affect sales growth. The ratio of temporary over permanent workers in the firm is significant only in high-income countries. It appears that temporary employment rises relative to permanent one along with the level of a country's economic development. On the other hand, the ratio of unskilled over skilled permanent production workers in the firm is a significant positive predictor of sales growth. Surprisingly, the higher the percentage of unskilled labor in the firms' labor force, the higher the growth of firms' sales. This is so in both high- and low-income countries. This finding may be explained by the informal labor conditions and depressed labor costs due to abundant and cheap labor in most developing countries. It may also be explained by lax labor regulations. Further, the low-tech, low-manufacturing structure of production in developing countries may also justify the importance of unskilled labor. An ILO (2010) study highlights how different incentive-based labor structures within the firm affect its productivity and long-term performance. This is new evidence on developing countries, which deserves further analysis based on proper accounting of the determinants of internal labor structures.

In order to see the sectoral distribution of the impact of labor skill constraints, Equation (1) is re-estimated separately for six sectors of activity: manufacturing, services, retail and wholesale commerce, construction and the rest of the economy. Table VI presents the results of the baseline sectoral model separately for the firm-specific characteristics (Panel A) and the internal labor structures (Panel B). The results in Panel A show a significant positive association between access to skilled labor and sales growth for the manufacturing and

GSALES	B.1	B.2	B.3	B.4	B.5	B.6
	All countries				High-income	Low-income
SKILLS	0.020*** (8.50)	0.019*** (6.29)	0.019*** (6.02)	0.018*** (5.69)	0.011** (2.38)	0.021*** (4.72)
RPERM	0.090 (0.91)			0.064 (0.41)	−0.924* (−1.82)	0.186 (1.16)
RPROD		0.137 (1.48)		0.106 (1.17)	0.176 (1.25)	0.066 (0.66)
RSKILL			0.114*** (3.14)	0.112*** (2.99)	0.135*** (2.69)	0.095* (1.79)
adj. R^2	0.0025	0.0018	0.0018	0.0025	0.0054	0.0013
Hansen's J	0.002	0.209	0.157	0.293	4.460	4.809
p(J)	0.965	0.648	0.692	0.588	0.035	0.028
n	89,664	49,658	46,315	44,437	14,668	29,769

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. t values in parentheses. *,**,***Significant at 10, 5 and 1 percent level, respectively

Table V.
Labor skills, internal labor structure and firm performance

Table VI.
Labor skills and firm performance by sector of activity

GSALES	Manufacturing	Services	Wholesale	Retail	Construction	Other
Panel A. firm-specific characteristics						
SKILLS	0.022*** (6.17)	0.013** (2.38)	0.010 (1.39)	−0.012 (−0.43)	0.056 (1.48)	0.013 (0.77)
AGE	−3.505*** (−13.85)	−2.959*** (−6.46)	−1.355** (−2.17)	−9.368*** (−4.45)	−5.212** (−2.06)	−4.338*** (−3.05)
SIZE	1.622*** (8.45)	2.450*** (7.77)	2.560*** (5.56)	3.426** (2.22)	3.190* (1.92)	0.002 (0.00)
EXPRT	0.004 (0.67)	0.034*** (2.64)	0.092** (2.16)	−0.013 (−0.25)	−0.196 (−0.39)	−0.013 (−0.25)
LEGAL	−0.309** (−2.52)	−0.973*** (−4.76)	−1.239*** (−4.15)	−2.935*** (−3.61)	0.698 (0.78)	0.261 (0.33)
LOCAT	−0.203* (−1.90)	−0.690*** (−4.30)	−0.761*** (−3.72)	2.200*** (2.70)	2.693* (1.87)	0.530 (0.82)
OWNP	−0.044** (−2.34)	−0.078*** (−3.17)	−0.089*** (−2.79)	−0.042 (−0.59)	0.348 (1.08)	0.069* (1.95)
OWNF	−0.031 (−1.58)	−0.079*** (−3.05)	−0.086** (−2.44)	0.090 (0.88)	0.485 (1.34)	0.073* (1.85)
OWNG	−0.021 (−0.75)	−0.099** (−2.33)	0.080 (1.43)	−0.353 (−1.51)	0.303 (0.92)	−0.090 (−0.47)
OWND	−0.004 (−0.85)	0.020** (2.32)	0.039*** (3.42)	−0.131*** (−3.48)	0.114*** (2.91)	0.018 (0.73)
adj. R^2	0.0134	0.0115	0.0161	0.0112	0.0625	0.0197
Hansen's J	1.363	0.017	2.485	5.483	0.827	3.171
p(J)	0.243	0.897	0.115	0.019	0.363	0.075
n	40,935	18,576	9,830	1,254	814	666
Panel B. internal labor structures						
SKILLS	0.017*** (5.17)	−0.026 (−0.26)	−0.026 (−0.26)	−0.026 (−0.26)	−0.026 (−0.26)	0.009 (0.69)
RPERM	0.052 (0.33)	24.951 (1.31)	24.951 (1.31)	24.951 (1.31)	24.951 (1.31)	0.168 (0.12)
RPROD	0.097 (1.09)	1.930 (1.52)	1.930 (1.52)	1.930 (1.52)	1.930 (1.52)	1.613* (1.91)
RSKILL	0.107*** (2.76)	−0.768 (−0.59)	−0.768 (−0.59)	−0.768 (−0.59)	−0.768 (−0.59)	0.164* (1.66)
adj. R^2	0.0101	0.0103	0.0132	0.0107	0.0581	0.0173
Hansen's J	0.902	0.608	0.608	0.608	0.608	6.147
p(J)	0.342	0.436	0.436	0.436	0.436	0.013
n	42,786	82	82	82	82	1,324

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. t values in parentheses. *,**,***Significant at the 10, 5 and 1 percent level, respectively

services sectors only. On the other hand, access to labor skills does not predict sales growth in the commercial, construction and other sectors of the economy. These latter sectors appear to be adequately served by low-skill local workforce that is widely abundant in developing countries. This is reasonable to expect, as sales growth in most non-manufacturing sectors depends mainly on distribution and other non-production channels, which in turn do not greatly depend on high-level skills. For example, a recent report on the commercial sector in Europe documents considerable differences in the dynamics of the manufacturing, services and commerce sectors with significant implications for labor requirements. Moreover, the role of firm-specific characteristics differs among sectors of activity as regards both their significance and direction of influence. Firm age, size and location of operation seem to be robust predictors of sales growth across sectors. The results in Panel B show that, when the internal labor structures are accounted for, access to skilled labor predicts sales growth only in the manufacturing sector. Moreover, the unskilled vs skilled workers ratio is the only significant factor and this is true only in manufacturing. Overall, the results document that the relation between access to skilled labor and firms' sales growth differs across sectors of activity in the developing countries and it is relatively more robust in the manufacturing sector. If the association is to be better understood, additional sectoral factors, such as regulation, competition and concentration of firms across sectors, should be accounted for.

An interesting question is the geographical manifestation of the relation between access to labor skills and sales growth. The determinants of labor skills and firm performance vary across countries throughout the world for various factors governing the availability of skills, the structure of production and sales practices. In order to investigate the geographical impact of access to skilled labor on sales growth, Equation (1) is re-estimated for each of the main UN-classified regions: Africa, East Asia and the Pacific, Central and East Asia, Europe, Middle-East and North Africa and South-East Asia. Table VII presents the results for each region. Considerable differences emerge across geographical regions. Access to skilled labor appears to be a significant predictor of sales growth in firms operating only in Africa, East and Central Asia and Europe. Where significant, access to labor skills improves sales growth. However, the magnitude of the effect differs considerably from 3.4 percent in Africa to 1.8 percent in Europe. Further, the role of firm-specific characteristics differs too across regions. Firm age, size and location of operation seem to be robust predictors across regions. Similarly, when the firms' internal labor structures are accounted for, access to skilled labor is a significant predictor of sales growth in firms operating only in Africa and East Asia and the Pacific. Further, only the ratio of unskilled over skilled labor is significant. These regional differences may also be explained by the considerable labor skill mismatch around the world observed with respect to not only job seekers vs employment opportunities, but also to the different methods of measuring and assessing labor skill constraints (ILO, 2014). These differences may also be the result of choice of invalid instruments for some models, which are associated with high values of the J statistic. Nevertheless, this new evidence shows a strong geographical dimension in the analysis of access to skilled labor and sales growth that deserves further analysis, taking into consideration trade and investment flows, the technological characteristics of infrastructure and the social and environmental conditions on a global scale.

5. Country-level factors and robustness checks

There may be concerns that the empirical results obtained above depend on the nature of labor skill constraints within the firm. Macroeconomic and institutional conditions have a role to play too. They affect domestic patterns of consumption, the organization of production and the effectiveness of infrastructure and technological progress among

Table VII.
Labor skills and firm performance by geographical region

GSALES	Africa	East-Asia and Pacific	East and Central Asia	Europe	Latin America	Middle-East and North Africa	South-East Asia
Panel A. firm-specific characteristics							
SKILLS	0.034*** (3.87)	−0.003 (−0.35)	0.023*** (3.83)	0.018* (1.94)	−0.006 (−1.44)	−0.004 (−0.47)	0.004 (0.57)
AGE	−1.105* (−1.82)	−3.583*** (−6.78)	−6.966*** (−10.65)	−7.231*** (−6.88)	−4.681*** (−11.15)	−0.160 (−0.28)	−3.132*** (−8.95)
SIZE	1.397*** (2.67)	1.418*** (3.95)	2.284*** (5.93)	2.324*** (4.30)	2.123*** (6.81)	3.822*** (8.66)	1.444*** (5.30)
SECTR	0.353* ((1.65)	−0.160 (−0.56)	0.239 (0.80)	−0.368 (−0.73)	0.073 (0.24)	0.689** (2.12)	0.174 (0.64)
EXPRT	0.011 (0.51)	−0.002 (−0.14)	0.030** (2.38)	0.059*** (3.66)	−0.038*** (−3.24)	0.039*** (3.24)	0.011 (1.13)
LEGAL	−1.227*** (−4.01)	0.722*** (3.11)	0.547* (1.76)	0.365 (0.94)	0.010 (0.05)	0.485* (1.77)	−0.339* (−1.65)
LOCAT	−4.069*** (−11.87)	0.282 (1.05)	−0.647*** ((−3.32)	−0.258 (−0.98)	−0.372*** (−2.79)	0.734*** (3.77)	−0.003 (−0.02)
OWNP	−0.093*** (−4.60)	0.029 (1.12)	−0.083** (−2.55)	0.007 (0.24)	0.014 (0.47)	−0.019 (−0.47)	−0.102* (−1.86)
OWNF	−0.070*** (−3.20)	0.003 (0.11)	−0.075** (−2.14)	−0.004 (−0.11)	0.004 (0.14)	0.022 (0.51)	−0.012 (−0.20)
OWNG	−0.010 (−0.14)	0.026 (0.83)	−0.054 (−1.30)	−0.055 (−0.91)	0.145 (1.46)	−0.018 (−0.31)	−0.068 (−0.68)
OWND	0.037** (2.50)	−0.002 (−0.24)	0.008 (0.77)	−0.016 (−1.12)	0.006 (0.77)	−0.073*** (−6.73)	0.018** (2.27)
adj. R^2	0.0154	0.0137	0.0271	0.0179	0.0692	0.0127	0.0154
Hansen's J	0.713	14.758	0.537	0.003	8.654	3.446	1.331
p(J)	0.398	0.001	0.464	0.955	0.003	0.063	0.249
n	14,822	12,155	11,158	4,044	11,650	6,201	12,045
Panel B. internal labor structures							
SKILLS	0.032*** (2.97)	0.034*** (2.67)	0.014 (1.58)	0.014 (1.02)	−0.002 (−0.33)	0.016 (1.39)	0.007 (1.02)
RPERM	−0.268 (−0.68)	0.382 (1.27)	1.246 (1.03)	7.141*** (3.67)	0.339 (1.05)	−1.442 (−1.57)	0.019 (0.04)
RPROD	−0.198 (−1.11)	1.029** (2.33)	0.039 (0.13)	−0.784 (−1.09)	0.219* (1.76)	0.630 (1.02)	0.357 (0.95)
RSKILL	0.297*** (2.82)	0.184*** (2.64)	0.056 (0.35)	0.151 (0.94)	−0.018 (−0.36)	0.217* (1.87)	−0.148** (−2.19)
adj. R^2	0.0017	0.0045	0.0053	0.0024	0.0228	0.0016	0.0017
Hansen's J	0.020	9.430	1.018	1.140	6.034	5.362	1.123
p(J)	0.887	0.002	0.313	0.286	0.014	0.021	0.289
n	8,012	7,816	4,763	1,486	10,187	3,208	8,965

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. t values in parentheses. *,**,***Significant at 10, 5 and 1 percent level, respectively

countries, all of which affect labor market outcomes. Therefore, it is possible that, by accounting for the impact of economic and institutional country-level factors, the association between access to skilled labor and firm performance is affected. In order to test for these conjectures, a series of additional robustness tests in groups are applied. Based on the literature suggestions, Equation (1) is expanded to include separately the impact of a country's: level of economic, financial and human development as well as its openness; access to and quality of education and aspects of technological progress. The variables corresponding to each of the above groups of factors are described in Table AI. Correlation checks preceded the choice of variables in each group to minimize collinearity problems. Interaction effects are included to capture the dynamic influences.

5.1 Impact of the development, finance and openness conditions

Economic development and growth dynamics in open economies affect the size and composition of labor skills demanded by firms. Development is associated with the rise and decline of industrial sectors, the introduction of new technology and structural transformation in the production and distribution of goods and services. The ILO (2010) argues that economic growth in the future will depend more heavily than today on the productivity of the workforce, complemented by longer labor force participation rates, especially among women and older workers. Shierholz (2014) notes that, by determining the overall level of aggregate demand, economic growth rather than structural changes affect the demand for labor skills. Murphy *et al.* (1991) show that important recent financial innovations led to the development of new markets and high incomes, which changed the demand for skills in the financial sector, which has become an attractive destination of highly talented individuals. Finally, Tybout notes that a country's economic openness tends to enhance labor productivity. In order to test for some of these conjectures, Equation (1) is expanded to include regressors capturing the impact of economic, financial and human development and an open environment of the sample countries. Table VIII presents the results of the baseline model after controlling sequentially for economic growth (GDPG), economic development (GDPCAP), financial development (CREDIT), income inequality (GINI), human development (HDI), the extent of globalization (GLOBAL) and the openness of capital account (FINOPEN) (models C.1–C.10). The results show that, when the individual effects are taken into consideration, access to labor skills is a significant predictor of sales growth in few models. The rate of economic growth and economic and human development in a country do not appear to affect the association between labor skills and sales growth in developing countries. In contrast, financial development turns out to be significant with a strong positive interaction effect that points to accelerating influence. It seems that access to finance and financial development mitigate strongly the effect of access to skilled labor on sales growth and it may be an important policy factor in the labor market of developing countries. Further, the openness of the capital account does not appear to mitigate the impact of access to skilled labor, but higher globalization does so. However, the latter is associated with a negative coefficient for both access to skilled labor and itself. The luck of significance may also be attributed to instrumental variables misspecification as the large value of the *J* statistic shows for some models. It is important to note that while the *J* stat may reject the null hypothesis, it does not provide guidance on the likely sources of the model's misspecification. This leads to the inclusion of all firm-specific characteristics and controls as regressors. In this case, access to labor skills turns significant and positive for both high- and low-income developing countries. The *J* statistic does not reject the null hypothesis and therefore the models do not suffer serious misspecification bias. The impact of GDP growth is significant but with a positive sign for low-income countries and a negative one for high-income countries. Economic development is also significant but with inverse signs for low- and high-income countries. Both the Gini and human development

Table VIII.
Impact of economic development, finance and globalization

GSALES	C.1	C.2	C.3	C.4	C.5	C.6	C.7	C.8	C.9	C10
		All countries			High-income				Low-income	
SKILLS	0.015	−6.352	0.103	0.784	−1.259***	−2.470	−4.608***	0.017***	0.021***	0.004**
	(0.26)	(−1.32)	(0.48)	(0.53)	(−4.37)	(−1.57)	(−3.09)	(3.84)	(3.21)	(2.13)
GDPG	−0.080							−0.376	−2.259***	4.855***
	(−0.04)							(−1.52)	(−8.88)	(10.81)
SKILLS × GDPG	−0.549									
	(−0.13)									
GDPCAP		−14.103						−8.608***	0.675	−8.234***
		(−1.27)						(−14.91)	(0.47)	(−6.67)
SKILLS × GDPCAP		70.020								
		(1.32)								
GINI			0.171					0.051**	0.004	0.028
			(1.50)					(2.13)	(0.12)	(0.45)
SKILLS × GINI			−0.236							
			(−0.45)							
HDI				34.409				0.662	−2.282	26.447***
				(0.74)				(0.19)	(−0.58)	(3.93)
SKILLS × HDI				−14.79						
				(−0.52)						
CREDIT					1.805**			4.563***	7.712***	3.515***
					(−2.18)			(14.37)	(13.99)	(4.57)
SKILLS × CREDIT					34.81***					
					(4.42)					
FINOPEN						19.188		−0.005	−1.370***	−0.852
						(1.16)		(−0.02)	(−3.08)	(−1.61)
SKILLS × FINOPEN						−75.68				
						(−1.13)				
GLOBAL							−1.481***	0.626***	0.569***	0.492***
							(−2.62)	(18.34)	(11.59)	(6.48)
SKILLS × GLOBAL							7.805***			
							(3.10)			
RPERM	0.182	0.470	0.162	0.161	0.362	1.475	0.385	0.320	1.397**	0.406*
	(0.80)	(1.55)	(0.72)	(0.53)	(1.54)	(1.30)	(1.49)	(1.59)	(2.36)	(1.86)

(continued)

Table VIII.

GSALES	C.1	C.2	C.3	C.4	C.5	C.6	C.7	C.8	C.9	C10
		All countries			High-income			Low-income		
RPROD	0.335*	0.665**	0.259	0.211	0.439**	0.887	0.532**	0.282	0.278	0.284
	(1.84)	(2.11)	(1.47)	(1.00)	(2.24)	(1.61)	(2.08)	(1.45)	(1.30)	(0.85)
RSKILL	0.021	−0.040	0.011	0.020	−0.054	−0.293	−0.097	−0.073*	−0.013	−0.135***
	(0.49)	(−0.57)	(0.23)	(0.36)	(−1.09)	(−1.26)	(−1.27)	(−1.77)	(−0.21)	(−2.59)
Firm-specific characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.032	0.080	0.024	0.040	0.116	0.038	0.065	0.039	0.032	0.080
Hansen's J	6.251	0.199	10.643	21.053	1.437	7.025	3.411	3.504	2.758	1.043
p(J)	0.012	0.656	0.001	0.000	0.231	0.003	0.066	0.055	0.034	0.594
n	22,184	21,648	22,184	22,184	21,674	21,611	22,142	21,075	7,479	13,596

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. The coefficients of firm-specific characteristics are not reported. t values in parentheses. *,**,***Significant at 10, 5 and 1 percent level, respectively

measures are significant and positive for both low- and high-income developing countries. Financial openness is significant only for high-income countries, whilst the extent of globalization seems to matter for both low- and high-income countries. Internal labor structures appear to be somewhat important in predicting the impact of access to skilled labor on sales growth, except for the ratio of non-production to production workers. Thus, the relative proportion of non-permanent workers appears to affect positively sales growth, whilst the relative proportion of unskilled workers appears to have a negative effect in low-income countries. Overall, the levels of economic and financial development as well as globalization of countries appear to mitigate the association between access to skilled labor and sales growth of firms in developing counties. This impact does however differ between low- and high-income countries. Thus, the role of access to skilled labor in determining firm performance in developing countries can be better understood by taking into consideration the mitigating impact of national economic, financial and human development levels. The results do not contradict the skill-biased technological progress hypothesis and document a significant role of a more globalized environment.

5.2 Impact of the educational environment

The extent of access to education as well as the quantity and quality of provided education affect the demand and supply of labor skills. The ILO (2010) argues that in many parts of the developing world, the growing size of the youth population challenges both existing education and training capacities as more young people enter the world of work. The importance of schooling for raising labor skills has long been documented (see Psacharopoulos, 1994, for a survey). In order to check for some of these conjectures, Equation (1) is expanded to include regressors capturing the impact of a country's various aspects of quantity and quality of education. Table IX presents the results of the baseline regression model after controlling for a country's years of schooling of adult population (SCHLNG), level of adult literacy (LTRCY), quality of education (QLEDUC), extent of having access to advanced education (ACCEDUC), extent of inequality in attaining education (EDINEQ) and the extent of reliance on professional management (PROFMNG) (models D1.–D.9). The results show a mixed impact. When control factors are individually considered, access to skilled labor remains a significant predictor of sales growth only after controlling for years of schooling, reliance on professional management, access to advanced education and inequality in attaining education. Their interaction effect is also high and significant indicating strong dynamic influence. Access to skilled labor appears to be insignificant when the quality of education and the literacy rate are considered. Further, all education control variables appear to be significant, except for the quality of education and the literacy rate. However, even when access to skilled labor is significant, the respective J statistic is for some models too high casting doubt on the validity of the estimates. After including all control variables, surprisingly access to skilled labor ceases to be a significant predictor of firms' sales growth, except for low-income countries. Again, given that the J statistic is too high in these models where access to skilled labor is insignificant, the latter may be due to instrument misspecification. However, the results document an important role for the educational environment in mitigating the association between access to skilled labor and sales growth in low-income countries. Implicitly this tends to confirm the findings of Easterly and Pritchett, who raised caution that education may not have much impact on skills in less-developed countries that lack other supporting factors, such as functioning institutions for markets and legal systems. These results tend to contradict the findings of Hanushek and Woessmann, who argue that initially low-skill levels retard the effectiveness of subsequently higher skill training and education. The evidence on developing countries seems different from that in the developed ones.

Table IX. Impact of education conditions

GSALES	D.1	D.2	D.3	D.4 All countries	D.5	D.6	D.7	D.8 High-income	D.9 Low-income
SKILLS	−0.451** (−2.45)	−1.356 (−1.63)	1.059** (2.44)	−2.396*** (−2.59)	−0.402** (−2.23)	−1.839 (−1.45)	0.002 (0.41)	0.009 (1.40)	0.001* (1.87)
SCHLNG	−1.599** (−2.50)						−0.060 (−0.53)	0.358** (1.98)	−0.330* (−1.70)
SKILLS × SCHLNG	7.647** (2.50)								
QLEDUC		−6.801 (−1.54)					0.485 (1.01)	4.777*** (3.25)	0.064 (0.07)
SKILLS × QLEDUC		35.580* (1.65)							
PROFMNG			6.104*** (2.66)				1.296*** (3.49)	0.260 (0.44)	2.434** (2.40)
SKILLS × PROFMNG			−23.983** (−2.41)						
ACCEDUC−				−0.590** (−2.34)			0.240*** (12.41)	0.124*** (2.84)	0.334*** (10.97)
SKILLS × ACCEDUC				3.283*** (2.60)					
EDINEQ					−44.621*** (−2.76)		−9.299*** (−3.56)	−33.658** (−2.28)	−12.27*** (−2.82)
SKILLS × EDINEQ					178.875** (2.27)				
LTRCY						−0.347 (−1.32)	−0.270*** (−8.08)	−1.921*** (−4.24)	−0.330*** (−7.62)
SKILLS × LTRCY						2.158 (1.46)			
RPERM	0.256 (1.28)	0.366* (1.83)	0.359* (1.70)	0.818** (2.44)	−0.173 (−0.53)	0.165 (0.80)	0.580*** (2.91)	1.137 (1.40)	0.510** (2.54)
RPROD	0.344* (1.87)	0.314* (1.66)	0.256 (1.45)	0.451* (1.75)	0.045 (0.24)	−0.003 (−0.03)	0.065 (0.38)	0.044 (0.27)	0.208 (0.62)
RSKILL	−0.020 (−0.44)	0.052 (0.91)	0.024 (0.50)	−0.158* (−1.76)	0.031 (0.47)	−0.039 (−0.67)	−0.057 (−1.29)	−0.053 (−0.77)	−0.033 (−0.58)
Firm-specific characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.023	0.012	0.020	0.011	0.031	0.056	0.026	0.016	0.068
Hansen's J	0.105	4.621	1.453	2.133	9.366	0.001	7.822	8.820	0.040
p(J)	0.746	0.032	0.228	0.304	0.001	0.523	0.005	0.003	0.841
n	22,184	21,200	21,200	22,076	20,057	34,333	19,181	6,242	12,939

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. The coefficients of firm-specific characteristics are not reported. t values in parentheses. *,**,***Significant at 10, 5 and 1 percent level, respectively

5.3 Impact of technological progress

The pace and diffusion of technological progress affects the quality and composition of labor skills demanded by firms. Acemoglu argues that labor skills and inequality are linked through technology and its impact on the demand for high-skill labor. Although other factors, such as changes in the minimum wage, the extent of unionization and globalization, play a role in affecting skilled labor, technology is the major driving force. This is due to the existence of technology-skill complementarities. Technical change favors more skilled (educated) workers, replaces tasks previously performed by the unskilled ones and increases the demand for skills. Machin and van Reenen (1998) suggest that technological factors alone can account for a third or less of labor skill changes in the USA and UK, but far more elsewhere. They obtain results that broadly support the skill bias hypothesis across countries. In order to check for some of these conjectures, Equation (1) is expanded to include regressors capturing the impact of a country's various aspects of technological progress. Table X presents the results of the baseline regression model after controlling for a country's efficient use of talent (USETLNT), the extent of firm-level technology adoption (TECHABS), the pace of technological innovation (TECHINNV), the extent of technological achievement (TECHACHV) and the level of knowledge economy (KEI) (models E.1–E.8). The results show a significant positive effect of access to skilled labor in almost all models. The magnitude of the effect is quite strong too. The individual effects of the technological progress variables are significant, except for the knowledge economy index. The interaction effects are significant and strong indicating strong dynamic influences. When all technological control variables are included in the regression, access to skilled labor remains positive and significant with a lower quantitative effect. The direct impact of the technology variables changes too. The talent index and the technology absorption index remain significant only in low-income developing countries. This implies that countries at lower stages of development make better use of talent enhancement in boosting competitiveness and performance - an unexpected result. On the other hand, technology absorption appears to act as a constraint on sales growth. Technological achievement is more pronounced in high-income developing countries but not conducive to higher sales growth. Apart from confirming the importance of access to skilled labor, these results show a quite diverse influence of the technological progress variables. As some of the models are associated with high values of the J statistic, this diverse picture may be the result of instrument misspecification. Nevertheless, even in models with very low values of the J statistic, the sign and magnitude of coefficients change among models. It appears that the role of technological progress in affecting firm performance is complex and could be better understood if analyzed along a multidimensional framework of influences and interactions. The data for developing countries appear to suggest that some technological progress indices are complementary with skilled labor changes, whilst others are not. Based on this evidence, it is hard to say whether skill-biased technological change is present in developing countries. The results tend to align with those of Goux and Maurin who do not find robust evidence for France and we share the concerns of Doms *et al.* and Dunne *et al.* (1997) who stress the importance of unobservable influences in driving the interaction of skills and technological change.

6. Conclusions

Access to skilled labor affects the structure and cost of production of firms and provides the capabilities required for productivity growth and efficient strategic decisions thereby affecting their performance. Based on a large and consistent data set from World Bank's Enterprise Surveys, the paper explores the empirical relation between access to skilled labor and firm performance, measured by the annual growth of sales, in 138 developing countries. The results document a significant positive relation between access to skilled labor and

Table X. Impact of technological progress conditions

GSALES SKILLS	E.1	E.2	E.3	E.4	E.5	E.6	E.7	E.8
	All countries						High-income	Low-income
SKILLS	2.120*** (2.80)	0.852** (2.34)	2.014** (2.55)	−2.352*** (−2.86)	−0.435 (−1.24)	0.017*** (4.35)	0.013** (2.32)	0.019*** (3.57)
USETLNT	8.387*** (2.71)					0.889*** (3.39)	0.369 (0.60)	1.320*** (3.52)
SKILLS × USETLNT	−53.61*** (−2.78)							
TECHABS		6.230*** (3.53)				0.149 (0.42)	−0.638 (−0.77)	−0.854* (−1.76)
SKILLS × TECHABS		−18.16** (−2.31)						
TECHINNOV			11.215** (2.54)			−1.404*** (−3.61)	−1.272 (−1.37)	−0.169 (−0.35)
SKILLS × TECHINNV			−60.952** (−2.53)					
TECHACHV				−7.610*** (−2.59)		−8.476*** (−3.64)	−31.79*** (−5.27)	4.378 (1.31)
SKILLS × TECHACHV				32.216*** (2.87)				
KEI					−0.639 (−0.37)	1.359*** (6.34)	2.305*** (6.47)	−0.216 (−0.51)
SKILLS × KEI					9.800 (1.25)			
RPERM	0.377* (1.92)	0.317 (1.52)	0.357* (1.69)	0.881** (2.41)	0.552*** (2.83)	0.087 (0.49)	1.337** (2.39)	0.006 (0.03)
RPROD	0.256 (1.32)	0.224 (1.30)	0.157 (0.86)	0.570* (1.94)	0.269 (1.40)	0.014 (0.17)	0.187 (1.07)	−0.022 (−0.26)
RSKILL	−0.010 (−0.20)	0.023 (0.51)	−0.043 (−0.89)	−0.101 (−1.35)	−0.060 (−1.23)	−0.019 (−0.50)	0.037 (0.66)	−0.063 (−1.20)
Firm-specific characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
adj. R^2	0.034	0.027	0.056	0.032	0.043	0.062	0.057	0.045
Hansen's J	1.497	0.104	0.608	4.305	6.828	1.233	2.448	3.221
p(J)	0.221	0.747	0.436	0.104	0.009	0.267	0.163	0.113
n	21,200	21,200	21,200	22,015	21,651	32,041	10,978	21,063

Notes: Outcome variable is GSALES. The estimation uses a GMM model with instrumental variables. The extent to which labor regulations affect an individual firm's business operations is used as an external instrument. The coefficients of firm-specific characteristics are not reported. *t* values in parentheses. *,**,***Significant at 10, 5 and 1 percent level, respectively

sales growth that remains broadly robust after various controls at both the firm and country levels. The firm-specific characteristics appear to be significant predictors of firms' sales growth. However, their inclusion does not substantially affect the relation between access to skilled labor and sales growth. Sectoral and geographical influences are documented too. Internal labor structures seem to be less important in predicting sales growth, except for the ratio of unskilled over skilled workers, which appears to be relatively robust in predicting sales growth. The impact of access to skilled labor on sales growth remains robust in most models after controlling for the impact of various country-level economic and non-economic factors; however, the magnitude of the effect varies considerably among the different controls as well as between low- and high-income countries. Economic, financial and human development, financial openness and globalization, the extent of access to education and its quality as well as different technological factors appear to exert a varying mitigating effect on the relation between access to skilled labor and sales growth. The evidence shows that institutions and technology matter. They affect the supply of and demand for skilled labor and thereby firm performance across sectors and regions. Once their role is taken into consideration, a more solid basis for understanding labor market phenomena, such as the mismatch between job seekers and employment opportunities and skill-biased technical change, may be obtained for the developing countries. Finally, the analysis would need an extension to include the role of regulation, global trade and investment, as well as the impact of national culture and political conditions that influence the interaction of labor market institutions and firm performance.

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(The Appendix follows overleaf.)

Appendix

Name	Description and source
AGE	Logarithm of the number of years since the year of a firm's establishment, from the World Bank Enterprise Surveys
SIZE	Ordinal variable that takes the value of 1 if the firm is small (5–19 employees), 2 if it is medium (20–99 employees) and 3 if it is large (over 99 employees), from the World Bank Enterprise Surveys
SECTR	Ordinal variable that takes the value of 1 if the firm is in manufacturing, 2 in services, 3 in retail, 4 in wholesale, 5 in construction and 6 in other sectors, from the World Bank Enterprise Surveys
EXPRT	Percent of a firm's total sales that are directly exported, from the World Bank Enterprise Surveys
LEGAL	Ordinal variable that takes the value of 1 if the firm is a traded joint-stock co., 2 if it is a non-traded joint-stock co., 3 if it is a sole proprietorship, 4 if it is partnership, 5 if it is a limited partnership and 6 otherwise, from the World Bank Enterprise Surveys
LOCAT	Ordinal variable that takes the value of 1 if the firm is located in the capital city, 2 in a city of more than 1m, 3 in a city between 1/4 and 1m, 4 in a city between 1/20 and 1/4 of 1m and 5 in a city less than 1/20m, from the World Bank Enterprise Surveys
OWNP	Percent of a firm's equity capital owned by domestic private owners, from the World Bank Enterprise Surveys
OWNF	Percent of a firm's equity capital owned by foreign owners, from the World Bank Enterprise Surveys
OWNG	Percent of a firm's equity capital owned directly by the state, from the World Bank Enterprise Surveys
OWND	Percent of a firm's equity capital owned by the largest owners, from the World Bank Enterprise Surveys
RSKILL	Ratio of unskilled over skilled permanent production workers in the firm, calculated from data in from the World Bank Enterprise Surveys
RPROD	Ratio of non-production over production permanent workers in the firm, calculated from data in from the World Bank Enterprise Surveys
RPERM	Ratio of temporary over permanent full-time workers in the firm, calculated from data in the World Bank Enterprise Surveys
GDPG	Logarithm of the annual GDP growth rate (%), from the World Bank Development Indicators
GDPCAP	Logarithm of GDP per capita (current USD), from the World Bank Development Indicators. It is generally considered a measure of a country's level of economic development
GINI	Gini coefficient, from the World Bank Development Indicators. It is a measure of a country's income distribution and it is generally considered an indicator of income inequality
HDI	Index ranging from 0 to 1, with higher values corresponding to higher human development, form the UNDP. It is a summary measure of average achievement in key dimensions of human development: a long and healthy life, knowledge and decent standard of living
CREDIT	Logarithm of domestic credit to the private SECTR (% GDP), from the World Bank Development Indicators. It is generally considered a measure of a country's level of financial development
GLOBAL	The KOF Index of globalization, ranging from 0 to 100, comprises three dimensions of globalization: economic, social and political. Higher values indicate higher globalization. Published by the ETH Zurich
FINOPEN	The Chinn-Ito index measures a country's degree of capital account openness, from Chinn and Ito (2006) (annually updated). This index takes on negative and positive values; higher values imply that countries are more open to (fewer restrictions on) cross-border capital transactions
SCHLNG	Years of schooling of a country's adult population, from the Global Competitiveness Report

Table AI.
Definitions of variables

(*continued*)

Name	Description and source
LTRCY	Percent of adult literacy, from the World Development Indicators. It reflects the percentage of people ages 15 and above who can both read and write with understanding a short simple statement about their everyday life
QLEDUC	Index of the quality of education, ranging from 0 to 7, from the Global Competitiveness Report. It reflects a country's education achievements based on education results (e.g. PISA tests, etc.)
ACCEDUC	Index of access to advanced education, ranging from 0 to 7, from the Global Competitiveness Report. It reflects a country's extent of advanced education based on the percent of people receiving advanced education
EDINEQ	Index of inequality in attaining education, ranging from 0 to 7, from the Global Competitiveness Report. It reflects a country's extent of inequality in attaining education based on test scores, poverty levels and other issues
PROFMNG	Index of reliance on professional management, ranging from 0 to 7, from the Global Competitiveness Report. It reflects the extent of a country' choice of professional business management based on merit and qualifications
USETLNT	Index of the extent of effective use of talent, ranging from 0 to 100, from the Global Competitiveness Report. It measures the extent to which countries grow, attract and retain talent for boosting their talent competitiveness
TECHABS	Index of the extent of technological absorption at the firm level, ranging from 0 to 7, from the WEF Global Competitiveness Report. It reflects the extent to which business adopt new technology in their business activity
TECHINNV	Index of technological innovation, ranging from 0 to 100, from the WEF Global Competitiveness Report. It reflects the extent of technological innovation based on both the innovation input and output indices, each comprising several factors
TECHACHV	Index of technological achievement, ranging from 0 to 1, from the United Nations Development Program. It reflects the extent of a country's creation and diffusion of technology and building of human skills in order to facilitate technological innovation in the network age
KEI	Index of the level of knowledge economy, ranging from 0 to 10, from the World Development Indicators. It reflects a country's ability to generate, adopt and diffuse knowledge for facilitating economic development
LABREG	Percent of firms identifying labor regulations as a constraint to business operations, from the World Bank Enterprise Surveys

Table AI.

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