International Competition, Returns to Skill, and Labor Market Adjustment

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Abstract

Does increased import competition lead to higher returns to skill within an industry and, therefore, to greater incentives for skill acquisition? Does it also induce skill upgrading by the industry's existing workforce? To answer these questions, this paper follows individual workers across skills/occupations, firms, and industries using a longitudinal matched employer-employee data set covering all workers and firms in Portugal over 1986–2000. To identify the effects of international competition the analysis uses two exogenous measures of changes in international competition at

the industry level. The first is a quasi-natural experiment based on the strong appreciation of the Portuguese currency during 1989–1992 and preexisting differences in trade exposure across industries in a differences-in-differences estimation. The second is source-weighted real exchange rates defined at the industry level. Based on both empirical strategies, and two definitions of skill, the paper shows that international competition increases returns to skill and induces skill/occupation upgrading within industries.

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1 Introduction

In recent decades the increased integration of national product markets has stimulated a large literature aiming to identify and explain its labor market consequences. Among the consequences of particular interest are adjustments in the market returns to different skills/occupations and changes in workers' skill-acquisition decisions. The former were the early focus of this literature, in particular whether trade liberalization was an important driver of the increased wage inequality between skilled and unskilled workers observed in many high-income countries. The general consensus emerging from this literature seems to be that trade liberalization contributed to increase the skill premium, but played a small role relative to skilled biased technological change (Slaughter 2000, Acemoglu 2002, Machin 2003).¹ Other contributions argue that organizational change (Caroli and Van Reenen, 2001; Black and Lynch, 2004; Garicano and Rossi-Hansberg, 2006) and declining unionisation (Machin, 1997; Card, 2001) have also played an important role.²

Work by Guadalupe (2007) reports a previously unnoticed driver of the increase in returns to skill: changes in the degree of product market competition. Theoretically, she shows that if product markets are imperfectly competitive, fiercer competition increases the sensitivity of profits with respect to production costs. Provided that skilled workers are more productive than unskilled workers, this induces a rise in demand for skills, which translates into higher returns. The causal relationship between product market competition and returns to skill is then empirically confirmed by individual panel data for the UK.³

In this paper we note that by increasing returns to skill, fiercer international competition will also raise the incentives for skill acquisition. Indeed, theoretical work by Falvey et al. (2010)

¹An important exception to this consensus is Wood (1998 and forthcoming). For surveys of the literature on globalization and inequality see Greenaway and Nelson (2002), Feenstra and Hanson (2003), Bardhan (2005), Goldberg and Pavcnik (2007 and 2016) and Messina and Silva (2017). Three points should be noted. First, the effects of trade on wage inequality can also occur through its interaction with technology—increasing imports from low-wage can contribute to the adoption of skill-biased technologies. Second, other factors linked to globalization also have contributed to inequality trends, including outsourcing (Acemoglu, Gancia, and Zilibotti 2015; Feenstra and Hanson 1996 and 1997) and exchange rate movements (Verhoogen 2008, and Brambilla, Lederman, and Porto, 2012). Third, while most of the empirical studies find statistically significant but limited (in terms of magnitude) effects of globalization on wage inequality, Autor et al. (2014), Topalova (2010), McCaig (2011), and Dix Carneiro and Kovak (2017) find large effects. The common factor across this set of papers is that they rely on regional variation in trade exposure to identify the causal effect of trade.

²Since the emergence of China in the 2000s, trade has received renewed attention as a driver of wage inequality. Autor, Dorn, and Hanson (2013) and Autor et al. (2014) document a substantial impact of import competition from China on earnings and unemployment of U.S. workers with larger earnings losses for individuals with low initial wages.

³Increased competition may also generate wage differentials between sectors by reducing monopoly rents (Krueger and Summer, 1988) and thereby increase workers' incentives to switch industry.

shows that a production or price shock that increases the relative wages of skilled workers induces significant skill acquisition by the existing workforce.⁴ Understanding the implications of increased competition for skill acquisition is important given the theoretical possibility of poverty traps generated by lack of education and occupational choice (Barham et al. 1995; Banerjee and Newman, 1993), and the role of human capital accumulation in growth. To date, however, this relationship has not been subject to empirical scrutiny.

Our paper makes two contributions. We begin by providing further evidence on the impact of within-industry changes in competition on returns to skill using longitudinal matched employee-employer data for Portugal. The data we use cover virtually all workers and firms in the private sector over the 1986-2000 period, and are supplemented with industry-level information on imports by the country of origin. The worker and firm dimensions of our data are particularly important for our purposes, as they allow us to account for the role of firm characteristics and composition effects.⁵ Our identification strategy involves two exogenous measures of changes in international competition. First, following Cuñat and Guadalupe (2005) and Guadalupe (2007), we exploit a strong appreciation of the Portuguese currency in 1989-1992 (over 25%) and pre-existing differences in cross-industry trade exposure in a differences-in-differences estimation.⁶ Second, following Revenga (1992), Campa and Goldberg (2001) and Bertrand (2004), we make use of industry-specific real exchange rates, for which we have data for a later period (1991-2000). Based on both strategies, and on two different skill definitions, we find strong confirmation for the hypothesis that within-industry increases in international competition are an important determinant of rising wage inequality.

The second, and perhaps most important, contribution of this paper is to investigate whether changes in international competition also cause skill upgrading and industry switching. Using the aforementioned empirical strategies to identify exogenous changes in foreign competition, we estimate transition probabilities between skills and/or industries (controlling for worker, firm and sector characteristics) in a bivariate probit specification. We distinguish between four alternatives: no change; moving industry; skill upgrading; and moving industry and skill upgrading. Our results provide strong support to the view that labor market adjustment to

⁴Modeling worker transitions induced by a trade shock is also the focus of Davidson and Matusz (2000, 2002 and 2004), who consider the consequences of industry specific human capital for the adjustment process, and Long et al. (2007) who consider firm specific human capital.

⁵See Abowd and Kramarz (1999) and Abowd et al (2006) for a detailed discussion of the effects of the exclusion of these effects on earnings regressions.

⁶In a related literature, Frias, Kaplan and Verhoogen (2009) (for Mexico); Araujo and Paz (2014) (for Brazil); and Macis and Schivardi (2016) investigate the relationship between exports and wage premia exploiting sudden and large exchange rate devaluation episodes as a source of exogenous variation in the firms' incentive to export.

globalization involves significant worker movements across sectors and skills. Specifically, we find that increased international competition induces skill acquisition, decreases skill downgrading, and induces workers to move industry.

The remainder of the paper is organized as follows. In Section 2 we outline the empirical methodology. In Section 3 we describe the data and present some descriptive statistics about workers' transitions. Section 4 discusses the empirical estimates, and Section 5 concludes.

2 Empirical Strategy

2.1 Effect of increased international competition on the returns to skill

Our analysis consists of two parts. First, we investigate whether increased import competition leads to higher returns to skill within an industry and, therefore, incentives for skill acquisition. Second, whether it also induces skill-upgrading by the industry's existing workforce.

In order to argue for a causal effect of international competition, we identify two exogenous changes in international competition at the industry level. First, we use a quasi-natural experiment consisting of the strong appreciation of the Portuguese currency in 1989-1992 and pre-existing differences in trade exposure across industries in a differences-in-differences estimation. Second, we make use of source-weighted real exchange rates at the industry level where the weights are given by the import shares of different countries in the base period (1990). Appreciation of the home currency leads to increased international competition for national firms for two reasons: it reduces the prices that foreign competitors can offer in the home country market; and it encourages entry by increasing the number of potential foreign firms that can sell in the home country. As argued by Revenga (1992), Bertrand (2004) and Guadalupe (2007), exchange rate movements are largely unpredicted and exogenous to the behavior of firms and workers within each industry.

The first identification strategy has been employed by Guadalupe (2007) using UK data at the worker-industry level focusing on the effect of international competition on returns to skills. The data used by Guadalupe (2007) are worker-industry level, therefore abstracting from potential effects of firm heterogeneity (e.g. in compensation and retention policies) on workers' earnings and compositional effects that may arise from workers switching across firms. In this paper we exploit the worker-firm-industry level of detail of the Portuguese data to account for these effects by controlling for firm characteristics and including worker-firm fixed effects.

This is important as whereas in individual fixed-effects models the effect is identified out of individuals who stay in the same firm as well as individuals who move after a shock, in firm-worker fixed-effects models the effect is identified out of variation over the time period in which the worker is employed in a given firm, thereby ensuring that unobserved changes to the industry composition of employment are not driving the results.⁷ The richness of our data also allows us to use a more informative definition of skill level. In Guadalupe's study skills evaluation was exclusively based on workers' occupations; our data permit evaluation based on occupations and schooling levels. Given the focus of our analysis on foreign competition induced skill/occupation upgrading and its underlying incentives (returns to skills), it is particularly important to investigate whether results are robust to these different measures.

Figure 1 depicts the evolution of the real effective exchange rate against all currencies weighted by the respective country's relative importance in Portuguese imports. As this figure makes clear, the escudo appreciated sharply in 1989-1992, preceded and followed by a period of relative stability.

Figure 1: Real effective exchange rate, Portuguese escudo (1985=100)

Source: Bank of Portugal.

In Figure 2 we plot the difference in mean log wages between skilled and unskilled workers of

⁷See Abowd and Kramarz (1999) and Abowd et al (2006).

the manufacturing sector over our sample period. Whether we identify skill by schooling only or using the ILO's skill definition, between 1989 and 1992 this difference increased sharply.

Figure 2: High to low skill wage differentials of the manufacturing sector

Source: Author calculations from *Quadros de Pessoal*.

We use the pre- and post-appreciation period (1986-1988 and 1989-1992 respectively) and pre-appreciation differences between sectors in trade openness to identify exogenous changes in international competition in a difference in differences specification. The advantage of this is that it controls for pre-existing differences across industries and changes common to all industries. The hypothesis is that the appreciation represents a higher increase in the degree of product market competition in the sectors that are (ex-ante) more open (treatment group) relative to those fairly closed (control group). More specifically, we estimate:

$$w_{it} = \beta(indop88_k * post89 * skill_{it}) + \theta(indop88_k * post89) + \lambda(post89 * skill_{it}) + \varsigma(indop88_k * skill_{it}) + skill_{it}\phi + X_{it}\alpha + Z_{jt}\delta + \gamma hhi_{kt} + a_{ij} + b_k + c_t + \varepsilon_{it}. \quad (1)$$

where w_{it} is the log of the hourly real wage of worker i in industry k and firm j , at year

t ; $indop88_k$ is the degree of openness to trade of industry k in the base year.⁸ $post89$ is a dummy variable that takes the value zero in the pre-appreciation period (1986-1988) and one during the appreciation (1989-1992); $skill_{it}$ is a vector comprising measures of the skill level of worker i at year t ; X_{it} is a vector of time varying worker characteristics (including age, age squared (proxy for labor market experience) and tenure); Z_{jt} is a vector of characteristics of firm j at year t (including firm size, labor productivity, age, proportion of foreign owned capital, sector, location); a_{ij} , b_k and c_t are, respectively, worker-firm, industry and time fixed effects;⁹ and ε_{it} is conditional-mean-zero error term. Note that since trade openness may vary endogenously with real appreciation, the variable $indop88_k$ is computed as the level of openness for 1988. In this specification λ is the differences-in-differences estimate of returns to skill and captures how these vary with international competition. To get this estimate it is necessary to control for differences in returns to skill before and after the experiment (captured by ς) and differences in returns to skill between sectors with different degrees of openness (captured by ϕ).

The second identification strategy uses a more direct measure of exogenous change in competition: changes in the weighted average of the log real exchange rates of importing countries, where the weights are the shares of each trade partner in the industry's total imports in a base period. This index varies across industries based on the composition of imports by country of origin. To avoid potential endogeneity issues, the weights should be prior to the period under analysis. Given that the first years for which bilateral data on imports by industry are available are 1990 and 1991, the period under analysis is restricted to 1991-2000. This strategy was established in the literature by Revenga (1992) to investigate the effect of international competition on industry wages and employment in US manufacturing, and has been adopted by Campa and Goldberg (2001), Bertrand (2004) and Cuñat and Guadalupe (2006) to examine the effect of competition on, respectively, industry wages and employment, the sensitivity of wages to the unemployment rate, and the provision of incentives to top managers inside the firm. Using this identification strategy we estimate the following equation:

$$w_{it} = \beta(IC_{kt} * skill_{it}) + \theta IC_{kt} + \lambda skill_{it} + X_{it}\alpha + Z_{jt}\delta + \gamma hhi_{kt} + a_{ij} + b_k + c_t + \varepsilon_{it}. \quad (2)$$

where IC_{kt} is the source-weighted real exchange rate of industry k at year t and the other variables are as above.¹⁰ The main parameter of interest is β , which reflects how returns to

⁸Defined as the ratio of total industry trade (imports plus exports) to domestic demand (industry sales plus net imports).

⁹Note that the model does not have a variable measuring openness on its own, nor a before and after dummy on its own because they are swept out by the industry and time dummies.

¹⁰See Appendix A for a detailed description of how the variables are constructed.

skill vary with international competition and we expect it to be positive.

We consider two different specifications of equations (1) and (2). In the first, the worker's level of skill is based on schooling, defined as the number of completed years of education (equation (2.1)). In the second, skill is computed using the International labor Office's (ILO) correspondence table between major groups of occupations in the 1988 International Standard Classification of Occupations (ISCO-88) and skill level (equation (2.2)). The ISCO-88 "is based on the nature of the skills required to carry out the tasks and duties of the job not the way these skills are acquired" (Hoffmann 2000, pp. 2), considering formal education, training and experience. Table 1 presents the correspondence Table and description of requirements associated with each skill level provided by Elias et al (1999).¹¹ In the econometric analysis we aggregate skill groups 1 and 2 as low skilled workers, which is then used as the base category in the estimation of returns to skill.

Table 1: Definition of skill groups – ISCO 1988

Skill level	ISCO-88 major groups	Description
4th	1. Legislators, senior officials and managers 2. Professionals	Normally requires a degree or an equivalent period of relevant work experience.
3rd	3. Technicians and associated professionals	Requires a body pf knowledge associated with a period of post-compulsory education but not to degree level.
2nd	4. Clerks 5. Service workers and shop and market sales workers 6. Skilled agriculture and fishery workers 7. Craft and related trades workers 8. Plant and machine operators and assemblers	Requires knowledge as for first skill level, but in addition typically have a longer period of worker-related training or work experience.
1st	9. Elementary occupations	Competence associated with general education usually acquired by completion of compulsory education.

Sources: International labor Office (1990, pp. 2-3) and Elias et al. (1999) as in Upward and Wright (2007).

¹¹Using information for each worker's schooling and tenure we have also checked the consistency of the described educational requirements with those in our data for each skill group and our results are in line with the Elias et al. (1999) description.

2.2 Effects of increased international competition on skill acquisition and industry relocation

Krueger and Summer (1988) show that by decreasing monopoly rents, and therefore the ability of firms to pay higher wages, international competition may also generate wage differentials between sectors. Increased competition can therefore increase returns to skill (tested in this paper) and generate wage differentials between sectors for workers with the same skill. While higher returns increase the incentives for skill acquisition, inter-sectoral wage differentials increase the incentive to switch industry. To disentangle the effects of increased international competition on skill acquisition from that of industry relocation we estimate a bivariate probit model. The underlying assumptions are that moving skill and moving industry are two alternative but related routes for adjusting to increased competition.

We adopt the following baseline two-equation system:

$$\begin{cases} moveind_{it}^* = X_{it}\alpha_0 + \theta_0\Delta IC_{kt} + Z_{jt}v_0 + \gamma hhi_{kt} + \tau_k + \mu_t + \Psi_{it} \\ skillup_{it}^* = X_{it}\alpha_1 + \theta_1\Delta IC_{kt} + Z_{jt}v_1 + \gamma hhi_{kt} + \tau_k + \mu_t + \Lambda_{it} \end{cases} \quad (3)$$

where $moveind_{it}$ and $skillup_{it}$ are two observed binary indicator variables driven by the two-equation system of latent propensities to move industry ($moveind_{it}^*$) and skill upgrading ($skillup_{it}^*$). ΔIC_{kt} is the percentage change in competition in industry k . Ψ_{it} and Λ_{it} are exogenous disturbances (assumed to be correlated). The other variables are as before. The observability criteria for the two sets of observed binary outcomes are

$$\begin{cases} moveind_{it} = 1(moveind_{it}^* > 0) \\ skillup_{it} = 1(skillup_{it}^* > 0) \end{cases}$$

$moveind_{it}$ is equal to one if individual i in the subsequent observation is employed in a different industry and $skillup_{it}$ is equal to one if individual i in the subsequent observation has a higher level of skill. The main parameters of interest are θ_0 and θ_1 which reflect how the propensities to move industry and skill vary with competition and we expect them to be positive.

3 Data Description and Descriptive Statistics

3.1 The data set

Our data are from a longitudinal matched employer-employee data set, “Quadros de Pessoal” [QP], collected by the Portuguese Ministry of Employment, which covers virtually all workers and firms in the Portuguese private sector, around 200,000 firms and more than 2 million workers each year over the 1986-2000 period. It provides comprehensive information on workers’ demographic characteristics (age, gender, schooling), job characteristics (occupational group, professional category, wage, hours worked and plant tenure), along with employing firm identifier codes. Firm-level characteristics include sales, number of employees, equity, percentage of foreign capital, geographical location and date of creation, along with industry code. This code allows us to merge this data set with trade data, disaggregated at the industry level with imports by country of origin, collected by the Portuguese National Statistics Office (INE). Trade data are only available for manufacturing for the period 1988-2000. As the Portuguese classification of industries has been revised in 1994 to match the NACE-Rev 2, a concordance was needed and the analysis considers 74 manufacturing industries.¹²

There are two important characteristics that guarantee this data set’s coverage and reliability. First, data are collected from a compulsory administrative census that the Ministry of Employment runs annually to check the firm’s compliance with labor law. Second, and unique to this data base, firms are required by law to make the information provided to the Ministry available to every worker in a public place of the establishment. Another important advantage is its longitudinal nature that results from the fact that a unique identification number is attributed to each worker the first time he enters the data set. This is based on the worker’s social security number, which does not change over time.

To control for any coding errors, we have performed extensive checks to guarantee the accuracy of the worker data using information on gender, date of birth and maximum schooling level achieved, as described in Appendix B. After these checks, we kept for analysis full-time wage earners, aged between 16 and 65, earning at least the national minimum wage, working in firms operating in mainland Portugal. The final panel used in the analysis contains information on 2,998,727 workers, 467,269 firms, imports and exports from 74 manufacturing industries over the period 1986-2000, yielding a total of 15,613,149 worker-year observations.

¹²The concordance used can be found at www.ine.pt/Proderv/nomenclaturas/CAE.html. Note that 56 industries have direct equivalents in the old and new classifications and are, therefore, defined at the 2-digit level of the NACE-Rev. 2. The remaining 46 categories of NACE-Rev. 2 do not have direct equivalents in the old classification and are aggregated into 18 sectors.

3.2 Worker Transitions: Variable Creation

An industry (skill) switcher is an individual that in the subsequent observation is employed in a different industry (has a different skill). The set of worker transitions contains five alternatives: the worker changes industry retaining the same skill; moves up the skill ladder while remaining in the same industry; moves down the skill ladder while remaining in the same industry; moves up the skill ladder and moves industry; moves down the skill ladder and moves industry. Skill classification follows the ILO’s skill definition described in Section 2.1 and industry classification follows the NACE-Rev.2 at the 2-digit level.

3.3 Descriptive Statistics

Moving industry and/or skill appear to be important forms of labor reallocation. Around 17 percent of all worker-year observations are of some kind of switching. Figure 3 provides some detail on (average) rates of switching (expressed as a percentage of total number of observations). Switching by changing both industry and skill is least common, on average around 3 percent of all worker-year observations are of this type. Switching in one dimension alone (either skill or industry) is more common. The rate of industry switching conditional on retaining the same skill is similar to that of changing skill conditional on staying in the same industry, on average around 7 percent of all worker-year observations are of each of these types. Considering each of these forms of reallocation independently the (unconditional) switching rate increases to around 10 percent (either for industry or skill).

As Figure 3 makes clear, moving up the skill ladder is more common than moving down, but both movements are important – the share of all workers who are upgraders and downgraders is 9 and 3.8 percent, respectively. The difference is driven by differences in the fraction that moves skill while staying in the same industry. Whereas the unconditional rate of industry switching and its components are similar in both cases, the average rate of skill upgrading, conditional on staying in the same industry, is almost twice as high as that of skill downgrading conditional on staying in the same industry.¹³

¹³Detailed tables of transition patterns across industries are available from the authors on request.

Figure 3: Rates of switching, 1991-2000

4 Estimation Results

4.1 Summary Statistics

Table 2 reports summary statistics for the main variables of interest over the 1986-2000¹⁴ period. As can be seen, there is considerable variability of actual wage across industries. Moreover, worker transitions between skills and occupations are an important feature of the Portuguese labor market. In manufacturing the annual average share of workers moving industry is 10 percent and skill-upgrading 6 percent. Also significant is the change in the real exchange rate (the annual average change is 3 percent) and level of openness (the annual average level is 37 percent). Three other characteristics of the Portuguese labor market are worth noting: high female participation, low level of education and low share of population in very skilled occupations.

¹⁴Note that 1986 is the first year for which the QP data set is available and the appreciation finishes in 1992. Baldwin (1988) and Dixit (1989) argue that the appreciation may permanently reshape the competitive structure of the product market and therefore the analysis should be restricted to the end of the episode. Moreover, there was a recession in the Portuguese economy in 1993 that might contaminate the differences in differences estimate. The second strategy requires industry bilateral trade data prior to the period under analysis. This is only available from 1990.

Table 2: Summary Statistics, 1986-2000

Variable	Mean	Standard Deviation
Actual Wage (ln)	11.57	0.44
Move ind	0.1	0.3
Move skill	0.1	0.3
Move skill-up	0.06	0.24
Move skill-down	0.01	0.11
Stayer	0.83	0.38
Real exchange rate	1.37	0.66
% change real exchange rate	0.03	0.67
Openness to trade in 88	0.37	0.27
Age	35.69	10.83
Age-square	1391.04	829.7
Tenure	9.97	8.8
Male	0.59	0.49
Schooling	5.52	3.01
Skilled (Schooling $\geq$ 12)	0.02	0.14
1st Skill level	0.17	0.37
2nd Skill level	0.75	0.43
3rd Skill level	0.06	0.24
4th Skill level	0.02	0.15
Herfindal Index	840.27	1425.81
Firm size (ln)	4.88	1.64
Firm Average labor productivity	8.83	1.18
Firm Age	24.24	21.15
Fraction of Foreign Capital	0.11	0.3
Number of observations	5,561,687	

4.2 International competition and the returns to skill

Table 3 presents the estimated results of equation (1) using the 1989-1992 appreciation as the exogenous change in international competition. Columns 1-4 present estimates for skill defined as the number of completed years of education, columns 5-8 report estimates for skill using the ILO's skill definition. For each, we start by estimating the difference results (columns 1-2 and 5-6) and proceed by estimating difference in differences results (columns 3-4 and 7-8). The dependent variable in each column is the log real hourly wage. Each regression includes regional and year dummies to control for disparities in the returns to skill across regions and macro-shocks, respectively. To control for unobservable industry characteristics we include a full set of 74 industry fixed-effects. Additionally, we run each specification with worker fixed effects (where the effect is identified out of the within sector variation in competition) and proceed by estimating the models with spell (work-firm) fixed effects. Whereas in the first case identification comes from the within sector variation in competition, in the second it comes from within spell variation, that is, from variation over the period in which the worker is employed in a given firm. This procedure is important as we are interested in estimating the effect of within industry changes in international competition on relative wages.

The coefficient on the interaction of skill variables with is always positive and highly significant in all specifications. In addition, one can see that the coefficients associated with the two-way interaction of the skill variables, *inter alia*, are statistically significant. This confirms the importance of accounting for the fact that more open sectors may systematically pay a lower skill premium to start with and that during 1989-1992 returns to skill increased throughout the economy. Controlling for these, the results in columns 1-4 show that, relative to the control group, the appreciation had a positive and significant effect on the skill premium of the treatment group, compared to industries that are relatively shielded. In particular, the estimated coefficients in column 4 indicate that for an industry with average trade openness (0.37), the pre- appreciation return to skill was 4 percent and the post-appreciation return, 15.4 percent. The full effect of the appreciation is only captured by the estimated coefficient on the interaction between the skill and the experiment variable (0.024 on column 4), which indicates that for an industry with average exposure to trade in 1988, the effect of the appreciation was to increase the differential (in returns to skill) by 0.88 percent (relative to an industry with no trade prior to 1988).

Table 3 also presents in columns 5-8 estimated results of equation (2) identifying exogenous changes as source-weighted industry real exchange rate movements. Columns 5-6 present the estimates for skill defined as the number of completed years of education, columns 7-8 report estimates using the ILO's skill definition. Columns 5 and 7 present the worker fixed effects estimates and columns 6 and 8 the spell (worker-firm) fixed effects estimates. A full set of industry, year and regional dummies is included in all specifications. The coefficient on the interaction of skill variables with the exchange rate index is positive and highly significant in all specifications, confirming that when the exchange rate index increases the impact of skill acquisition on actual wage is higher. Note that, as pointed out by Bertrand (2004), this methodology, by simultaneously including individual fixed effects and industry dummies, estimates the relationship between changes (not absolute values) in international competition and returns to skill within industries.

Our results are therefore very much in line with Guadalupe (2007). This is particularly reassuring given that firm characteristics and work-firm fixed effects are highly statistically significant. Based on two different identification strategies and skill definitions, we find strong confirmation of the hypothesis that increased international competition is an important determinant of rising wage inequality between skilled and unskilled workers.

Table 3: Effects of international competition on returns to skill

	Depend Variable: Log real hourly wage							
	1989-92 appreciation				Exchange rate changes			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
indop88*post89	-0.083 (31.5)***	-0.085 (31.8)***	-0.073 (55.6)***	-0.072 (52.4)***				
indop88*schooling	-0.004 (2.9)***	-0.007 (4.9)***						
post89*schooling	0.012 (52.8)***	0.01 (45.9)***						
indop88*post89*schooling	0.002 (4.5)***	0.003 (5.6)***						
indop88*mskill			-0.029 (4.1)***	-0.033 (4.7)***				
indop88*hskill			0.01 (0.6)	-0.023 (1.4)				
post89*mskill			0.067 (23.3)***	0.06 (20.6)***				
post89*hkill			0.118 (19.4)***	0.105 (17.5)***				
indop88*post89*medskill			0.041 (6.6)***	0.036 (5.6)***				
indop88*post89*highskill			0.022 (1.7)*	0.024 (1.9)*				
IC					-0.119 (59.31)***	-0.11 (54.38)***	-0.089 (55.60)***	-0.077 (46.59)***
IC*schooling					0.006 (24.6)***	0.007 (28.29)***		
IC*medskill						0.018 (10.86)***	0.017 (10.42)***	
IC*highskill						0.039 (12.03)***	0.038 (12.02)***	
Number of observations	2,300,567	2,300,567	2,300,567	2,300,567	3,868,747	3,868,747	3,868,747	3,868,747
R-square	0.215	0.164	0.187	0.147	0.226	0.005	0.001	0.003
Year+Industry+Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Worker-firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The period of analysis is 1986-1992 in columns 1-4 and 1991-2000 in columns 5-8. Absolute value of t-statistic in parentheses, based on robust standard errors clustered by individual. All specifications include the variables age, age square, tenure, Herfindahl index, firm size, labor productivity, firm age, and percentage of foreign capital. In addition, the specifications in columns 1-2 also include the variables schooling, indop88 and post89, the specifications in columns 3-4 include the variables mskill, hskill, indop88 and post89, the specification in columns 5-6 include the variable schooling, and the specifications in columns 7-8 include the variables mskill and hskill. The variables age, tenure are divided by 10, and age-square and Herfindahl index by 1000. Dependent variable: log real hourly wage.

4.3 International competition and skill upgrading

Using bivariate probit models, Table 4 reports the results for the two equation system (3) representing each of the different forms of relocation that may be induced by increased competition. The marginal effects on the probability of each potential outcome (when all variables are held at their mean) are presented.¹⁵ All regressions include industry fixed effects, year and regional dummies and standard errors are clustered by individuals (to account for the fact that the individual error term may be autocorrelated). Columns 1-5 present estimates for the latent propensities of moving industry (*moveind**) and moving skill (*moveskill**), columns 6-10 report the estimates for the latent propensities of moving industry (*moveind**) and skill-upgrading (*skillup**). Columns 1-3 present each of the different forms of reaction to increased competition against the probability of no change in skill or industry, $Pr(\text{moveind}_{it} = 0, \text{moveskill}_{it} = 0 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt})$, that is:

$$Pr(\text{moveind}_{it} = 1, \text{moveskill}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}),$$

$$Pr(\text{moveind}_{it} = 1, \text{moveskill}_{it} = 0 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}),$$

$$Pr(\text{moveind}_{it} = 0, \text{moveskill}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}), \text{ respectively.}$$

In addition, columns 4-5 present bivariate probit estimates of the marginal effects of each of the covariates on the following unconditional probabilities:

$$Pr(\text{moveind}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}), Pr(\text{moveskill}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}).$$

Similarly, columns 6-8 present each of the different forms of reaction to increased competition against the probability of no skill-upgrading or switching industry,

$$Pr(\text{moveind}_{it} = 0, \text{skillup}_{it} = 0 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}), \text{ that is:}$$

$$Pr(\text{moveind}_{it} = 1, \text{skillup}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}),$$

$$Pr(\text{moveind}_{it} = 1, \text{skillup}_{it} = 0 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}),$$

$$Pr(\text{moveind}_{it} = 0, \text{skillup}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}), \text{ respectively.}$$

Finally, columns 6-10 present bivariate probit estimates of the marginal effects of each of the covariates on the following unconditional probabilities:

$$Pr(\text{moveind}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}), Pr(\text{skillup}_{it} = 1 | X_{it}, \Delta IC_{kt}, Z_{jt}, hhi_{kt}).$$

The marginal effect of interest on the variable *indop88 * apprec* is always positive and highly significant. These results therefore indicate that the propensity to switch (industry and/or skill) in response to the appreciation is higher in sectors more open to trade. In addition, results in columns 1-6 show that the effect of increased competition on skill acquisition and

¹⁵Regression results can be found in Appendix C.

industry relocation is similar (columns 5 and 6). However, the effect on the probability of changing in one dimension only is stronger than the effect on the probability of changing both skill and industry (coefficients in columns 2-3 are higher than in 1). Furthermore, results from the second specification (columns 6-10), show that increased international competition in the 1989-1992 appreciation also increases significantly the propensity to skill-upgrade, whether remaining in the same industry or changing industry, though the effect on the latter is weaker. In particular, the estimated coefficients on trade exposure, the post-appreciation dummy and their interaction (column 9) indicate that for an industry with average trade exposure in 1988 (0.37), appreciation increased the propensity to move industry by 0.23 percent, and this effect was 0.05 percent higher than in an industry with 10 percentage points lower trade exposure in 1988. Similarly, column 10 indicates that for an industry with average trade exposure in 1988 (0.37), appreciation increased the propensity to skill-upgrade by 0.1 percent and, this effect was 0.03 percent stronger than in an industry with 10 percentage point lower trade exposure in 1988.

All signs on the coefficients of the control variables are as expected. Worker covariates indicate that moving between skills and industries is significantly less frequent in older workers but the effect of an additional year of age is higher in younger than older workers. High tenured workers also switch industry and/or skill less frequently. Skilled workers tend to be more mobile than unskilled workers. Male workers move more frequently than female workers. Moreover, industry covariates show that a high degree of industry concentration is associated with higher switching rates. Finally, firm covariates indicate that elevated firm size, labor productivity and participation of foreign capital predict lower switching rates, whereas firm's age increases this rate.

Table 5 presents bivariate probit estimates using source-weighted industry real exchange rate fluctuations to identify changes in competition.¹⁶ Results are in line with those previously obtained and confirm the association between increased international competition and additional skill acquisition and industry relocation. For a worker who is average on all characteristics, employed in a firm that is average in all characteristics that belongs to an industry that has the average level of the Herfindahl-Hirschman index, a 1 percentage point increase in the exchange rate index is associated with a probability to move industry 0.03 percentage point higher and probability to skill-upgrading 0.02 percentage point higher. The effect on skill upgrading while remaining in the same industry is more than twice as large as the effect on skill upgrading and moving industry simultaneously.

¹⁶Regression results can be found in Appendix C.

Table 4: Marginal effects of international competition on the probability of skill-upgrading and/or moving industry: 1989-1992 appreciation

	Move industry (ind.) and/or move skill									
	Move industry (ind.)					and/or move skill-up				
	ind.&skill (1)	Propensity to move ind.-only (2)	Propensity to move skill only (3)	Propensity to move ind. (4)	Propensity to move skill (5)	ind.&skill- up (6)	Propensity to move ind. only (7)	skill-up only (8)	Propensity to move ind. (9)	Propensity to skill-up (10)
Predicted Propensity	2.63%	5.95%	6.71%	8.58%	9.35%	1.15%	7.43%	4.23%	8.58%	5.38%
Variables										
age	-0.036 (83.5)***	0.007 (7.36)***	-0.111 (106.66)***	-0.029 (23.51)***	-0.146 (111.49)***	-0.024 (101.24)***	-0.003 (2.82)***	-0.096 (131.61)***	-0.027 (21.98)***	-0.120 (136.2)***
age-square	0.032 (57.95)***	-0.027 (21.97)***	0.124 (90.19)***	0.005 (2.98)***	0.156 (90.07)***	0.023 (78.55)***	-0.021 (14.34)***	0.107 (113.19)***	0.002 (1.5)	0.130 (113.97)***
tenure	-0.014 (106.36)***	-0.023 (88.18)***	-0.014 (42.74)***	-0.036 (107.3)***	-0.027 (66.65)***	-0.008 (112.25)***	-0.028 (93.45)***	-0.016 (69.67)***	-0.037 (107.06)***	-0.024 (86.25)***
skilled	0.032 (32.15)***	0.011 (8.54)***	0.065 (30.26)***	0.043 (21.51)***	0.097 (35.2)***	0.019 (31.56)***	0.023 (14.39)***	0.049 (31.68)***	0.042 (20.99)***	0.068 (34.66)***
indop88*post89	0.002 (4.6)***	0.003 (3.16)***	0.003 (2.25)**	0.005 (3.96)***	0.005 (3.23)***	0.001 (4.57)***	0.004 (3.59)***	0.002 (2.33)**	0.005 (4.01)***	0.003 (2.99)***
indop88	0.002 (1.35)	0.004 (1.25)	0.002 (0.53)	0.006 (1.36)	0.004 (0.89)	0.001 (1.37)	0.004 (1.16)	0.002 (0.69)	0.005 (1.25)	0.003 (0.91)
post89	-0.003 (10.64)***	-0.001 (1.36)	-0.007 (11.31)***	-0.004 (4.66)***	-0.010 (12.24)***	-0.003 (17.21)***	-0.001 (1.48)	-0.010 (18.79)***	-0.004 (4.52)***	-0.012 (19.38)***
male	0.007 (39.63)***	0.009 (26.08)***	0.009 (21.04)***	0.016 (33.91)***	0.015 (28.49)***	0.003 (41)***	0.012 (29.93)***	0.007 (24.25)***	0.016 (34)***	0.011 (29.59)***
hhi	0.006 (11.8)***	0.006 (5.52)***	0.010 (8.42)***	0.012 (8.17)***	0.016 (10.4)***	0.003 (9.39)***	0.010 (7.72)***	0.005 (4.63)***	0.013 (8.62)***	0.007 (5.96)***
firmsize	-0.002 (43.46)***	-0.005 (39.99)***	-0.002 (12.61)***	-0.007 (45.81)***	-0.004 (23.4)***	-0.001 (31.14)***	-0.006 (45.06)***	0.000 (0.28)	-0.007 (45.72)***	-0.001 (7.24)***
firmlabprod	-0.002 (31.5)***	-0.005 (41.26)***	0.000 (2.07)**	-0.007 (42.46)***	-0.001 (8.22)***	-0.001 (22.53)***	-0.006 (43.87)***	0.001 (6.93)***	-0.007 (43.43)***	0.000 (0.52)
firimage	0.001 (13.92)***	0.002 (21.12)***	0.000 (3.07)***	0.002 (21.14)***	0.000 (1.8)*	0.000 (10.11)***	0.002 (22.2)***	0.000 (5.73)***	0.002 (21.59)***	0.000 (2.31)**
%foreignK	-0.006 (20.17)***	-0.023 (36.4)***	0.009 (12.91)***	-0.029 (34.55)***	0.003 (3.63)***	-0.002 (13.67)***	-0.027 (36.65)***	0.008 (15.95)***	-0.029 (34.92)***	0.006 (9.69)***
Observations			2,300,567							
rho			0.475					2,300,567		
%Correctly predicted			0.999					0.299		
McFadden's pseudo R2			0.052					0.999		
								0.066		

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The period of analysis is 1986-1992. Absolute value of t-statistic in parentheses, based on robust standard errors clustered by individual. All specifications include a full set of industry dummies (74 industry fixed-effects), year and regional dummies. Marginal effects are computed at the mean of each variable. The variables age, tenure are divided by 10, and age-square and hhi by 1000.

Table 5: Marginal effect of international competition on the probability of skill-upgrading and/or moving industry: exchange rate fluctuations

	Move industry (ind.) and/or move skill					Move industry (ind.) and/or move skill-up						
	ind.&skill (1)	Propensity to move ind. only (2)	skill only (3)	Propensity to stay (4)	Propensity to move ind. (5)	Propensity to move skill (6)	ind.&skill- up (7)	Propensity to move ind. only (8)	skill-up only (9)	Propensity to stay (10)	Propensity to move ind. (11)	Propensity to skill-up (12)
Predicted Propensity	2.10%	6.18%	6.47%	85.24%	8.29%	8.58%	0.95%	7.35%	3.9%	87.80%	8.30%	4.85%
Variables												
age	-0.032 (115.61)***	-0.010 (13.6)***	-0.100 (127.1)***	0.142 (121.14)***	-0.042 (46.35)***	-0.132 (135.92)***	-0.020 (130.33)***	-0.021 (24.94)***	-0.081 (157.86)***	0.122 (119.04)***	-0.041 (44.97)***	-0.101 (165.53)***
age2	0.032 (89.19)***	-0.001 (0.56)	0.112 (106.18)***	-0.144 (92.39)***	0.032 (26.4)***	0.144 (110.99)***	0.021 (107.02)***	0.009 (8.31)***	0.091 (133.44)***	-0.121 (89.32)***	0.030 (25.03)***	0.112 (137.66)***
tenure	-0.009 (110.1)***	-0.016 (82.4)***	-0.013 (55.19)***	0.039 (113.34)***	-0.025 (102.07)***	-0.022 (74.29)***	-0.005 (118.02)***	-0.020 (88.69)***	-0.013 (80.47)***	0.039 (131.76)***	-0.025 (102.08)***	-0.019 (94.39)***
skilled	0.018 (40.42)***	0.007 (8.38)***	0.048 (39.71)***	-0.072 (46.99)***	0.024 (22.41)***	0.065 (44.2)***	0.008 (34.78)***	0.016 (16.64)***	0.023 (31.52)***	-0.047 (37.15)***	0.024 (21.84)***	0.031 (34.56)***
exchrate	0.008 (4.8)***	0.019 (4.53)***	0.006 (1.38)	-0.033 (4.76)***	0.027 (5.01)***	0.014 (2.47)***	0.007 (7.21)***	0.021 (4.41)***	0.018 (5.01)***	-0.046 (7.15)***	0.028 (5.21)***	0.024 (5.66)***
male	0.003 (29.78)***	0.010 (33.9)***	0.001 (3.98)***	-0.014 (29.23)***	0.013 (36.2)***	0.005 (11.15)***	0.002 (32.87)***	0.011 (34.85)***	0.002 (10.68)***	-0.015 (37.1)***	0.013 (36.57)***	0.004 (16.13)***
hhi	0.000 (19.82)***	0.001 (24.46)***	0.000 (0.03)	-0.001 (19.54)***	0.001 (25.34)***	0.000 (5.58)***	0.000 (17.6)***	0.001 (24.32)***	0.000 (1.71)*	-0.001 (22.13)***	0.001 (24.94)***	0.000 (5.12)***
firmsize	0.000 (8.28)***	0.000 (1.6)	-0.001 (11.04)***	0.001 (8.44)***	0.000 (1.23)	-0.002 (11.12)***	0.000 (1.6)	0.000 (1.84)*	0.000 (0.36)	0.000 (1.86)*	0.000 (1.92)*	0.000 (0.65)
firmlabprod	-0.001 (19.21)***	-0.004 (33.86)***	0.001 (9.35)***	0.004 (18.64)***	-0.005 (32.74)***	0.000 (2.22)***	0.000 (14.91)***	-0.005 (34.88)***	0.001 (9.91)***	0.004 (23.65)***	-0.005 (33.98)***	0.001 (5.06)***
firmage	0.000 (0.9)	0.000 (2.49)**	0.000 (1.14)	0.000 (0.85)	0.000 (2.28)**	0.000 (1.7)*	0.000 (1.7)*	0.000 (2.97)***	0.000 (0.36)	0.000 (2.34)**	0.000 (2.96)***	0.000 (0.07)
%foreignK	-0.002 (11.07)***	-0.006 (13.9)***	0.000 (0.09)	0.008 (10.88)***	-0.008 (14.4)***	-0.002 (2.98)***	-0.001 (6.27)***	-0.008 (14.97)***	0.002 (5.13)***	0.007 (10.02)***	-0.008 (14.47)***	0.001 (2.87)***
Observations	3,858,747											
rho	0.409											
%Correctly predicted	0.963											
McFadden's pseudo R2	0.053											

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The period of analysis is 1991-2000. Absolute value of t-statistic in parentheses, based on robust standard errors clustered by individual. All specifications include a full set of industry dummies (74 industry fixed-effects), year and regional dummies. Marginal effects are computed at the mean of each variable. The variables age, tenure are divided by 10, and age-square and hhi by 1000.

5 Conclusions

This paper confirms international competition as a source of increased returns to skill. Using a large panel (1986-2000) of matched employer-employee data for the Portuguese manufacturing sector, two different skill definitions, and two different identification strategies of exogenous changes in international competition, we show that returns to skill within an industry increase with competition. Furthermore, we identify increasing international competition as a significant determinant of skill upgrading. This result is valid both when workers stay in the same industry and when they move. It indicates that skill acquisition is an important part of the adjustment process to a policy change or shock (exogenous to the wage setting conditions within the country) that changes relative wages, and suggests that policy attention to the consequences of increased competition for human capital accumulation seems merited.

Appendices

APPENDIX A: Variable description

Wage data is the log deflated monthly earnings actually received including the base wage, tenure-related and other regularly paid components. Wages are deflated using the consumer price index.

Worker covariates: Tenure is defined as the number of years with the same firm, schooling as the number of completed years of education and skilled as having a number of completed years of education higher than 12 (that marks the end of high-school in Portugal).

Sector covariates: The Herfindahl-Hirschman index of industrial concentration in industry K is defined as $hhi_K = \sum_{J \in K} (mshare_J)^2$ where $mshare_J$ is the market share of firm J of industry K in 1988 (*indop88*), defined as the ratio of total industry trade (imports plus exports) to domestic demand (industry sales plus net imports).

Source weighted industry real exchange rate index: is defined as the weighted average of the log real exchange rate of each of the importing countries. The weights are the shares of each foreign country's imports in industry total imports in the base period (1990-1991). Real exchange rates are nominal exchange rates (expressed in foreign currency per escudo) multiplied by the Portuguese consumer price index and divided by the foreign country consumer price index. Nominal exchange rates have been provided by the Bank of Portugal and foreign consumer prices indexes from the International Financial Statistics of the International Monetary Fund.

Firm covariates: The firm size is defined as the number of employees; firm (nominal average) labor productivity as the ratio of firm sales to number of employees; firm age as current year minus year of creation of the firm; and percentage of foreign capital as share of foreign capital in equity.

APPENDIX B: Consistency checks of the information on the employer-employee data set

We have performed a number of consistency checks on the information provided by “Quadros de Pessoal” to guarantee the accuracy of the data used.

- *Elimination of invalid or duplicated worker identification codes in a given year:* According to the Ministry of Employment valid worker ID codes have 6 to 10 digits. In each year, observations with codes with less than 6 or more than 10 digits were not considered. Observations with duplicated identification codes were also eliminated. These restrictions led to dropping an average 8.93 percent and 4.51 percent of the observations in the original yearly data sets, respectively.
- *Consistency check of data for each worker across years:* We have merged the yearly information and identified inconsistencies when gender, date of birth or year of hiring (for the same firm) were reported changing, or the highest schooling level was reported decreasing (or was missing) over time for the same worker.
 - *Correcting missing values when reported data for the rest of the period was absolutely consistent* by assigning the reported value for the remaining period. This changed 0 percent,¹⁷ 2.25 percent, 0.71 percent and 0.23 percent of the observations in the initial panel for gender, age, schooling and firm tenure, respectively.
 - *Correcting inconsistent data across years* by taking information reported over half of the times as correct.¹⁸ Inconsistent values on gender were replaced by the value reported over half of the cases the worker has been observed, provided that the year of birth in that observation is the same as that reported in more than 50 percent of the cases for that worker. Similar procedures have been implemented for year of birth and schooling. This affected 0.87 percent, 1.77 percent, 6.65 percent and 1.68 percent of the initial panel for gender, year of birth, schooling and firm tenure respectively. The whole information on a worker has been dropped when inconsistencies persisted after this correction. This restriction led to dropping 8.4 percent, 1.08 percent and 6.28 percent of the observations for gender, year of birth or schooling, respectively.
 - *Dropping workers with remaining missing data on gender, age or schooling:* 0 percent, 0.15 percent, 0.99 percent due to missing data on gender, age and schooling, respectively. The checked panel included 22,686,298 worker-year observations and 3,525,485 workers.

¹⁷Two observations.

¹⁸Note that this is a more demanding criterion than simply using the modal value as replacement.

Table B.1: Shares of regions and years

Variable	% of Total
Region	
North Coast	31.88
Central Coast	14.24
Lisbon	44.28
Inland	7.18
Algarve	2.42
Year	
1986	5.06
1987	5.5
1988	5.47
1989	5.19
1991	6.42
1992	6.72
1993	6.74
1994	6.86
1995	7.76
1996	8.21
1997	8.8
1998	8.74
1999	9.3
2000	9.23
Observations	15,613,149

APPENDIX C: Regression results on the effect of international competition on skill acquisition and industry relocation

The estimated results of the two-equation system (3) presented in Section 4.3 are marginal effects. Appendix Table C.1 displays the regression results instead.

Table C.1: Effect of international competition on skill acquisition and industry relocation: regression results

Variables	Stay in the same industry and skill as base				Stay same ind and no skill up as base			
	Propensity to move ind. (1)	Propensity to move skill (2)	Propensity to move ind. (3)	Propensity to move skill (4)	Propensity to move ind. (5)	Propensity to skill-up (6)	Propensity to move ind. (7)	Propensity to skill-up (8)
age	-0.184 (23.58)***	-0.876 (111.2)***	-0.275 (46.36)***	-0.844 (134.36)***	-0.172 (22.04)***	-1.094 (138.04)***	-0.268 (44.98)***	-1.008 (164.66)***
age2	0.031 (2.98)***	0.934 (90.03)***	0.208 (26.41)***	0.921 (110.12)***	0.016 (1.5)	1.193 (115.15)***	0.198 (25.03)***	1.114 (137.06)***
tenure	-0.232 (105.24)***	-0.163 (65.14)***	-0.165 (100.59)***	-0.141 (73.01)***	-0.233 (104.98)***	-0.222 (82.35)***	-0.166 (100.56)***	-0.187 (91.08)***
skilled	0.238 (24.67)***	0.445 (43.59)***	0.145 (24.47)***	0.338 (52.85)***	0.233 (24.02)***	0.446 (45.47)***	0.142 (23.81)***	0.256 (41.27)***
indop88*post89	0.034 (3.96)***	0.028 (3.23)***			0.035 (4.01)***	0.028 (2.99)***		
indop88	0.038 (1.36)	0.022 (0.89)			0.035 (1.25)	0.024 (0.91)		
post89	-0.023 (4.66)***	-0.061 (12.25)***			-0.023 (4.52)***	-0.111 (19.41)***		
exchrate			0.174 (5.01)***	0.087 (2.47)**			0.181 (5.21)***	0.243 (5.66)***
male	0.102 (33.37)***	0.094 (28.09)***	0.085 (35.95)***	0.030 (11.12)***	0.103 (33.44)***	0.098 (29.05)***	0.087 (36.31)***	0.041 (16.05)***
hhi	0.079 (8.17)***	0.098 (10.39)***	0.004 (25.37)***	0.001 (5.58)***	0.084 (8.62)***	0.067 (5.96)***	0.004 (24.97)***	0.001 (5.12)***
firmsize	-0.045 (45.97)***	-0.025 (23.42)***	-0.001 (1.23)	-0.010 (11.12)***	-0.045 (45.87)***	-0.008 (7.24)***	-0.002 (1.92)*	-0.001 (0.65)
firmlabprod	-0.041 (42.39)***	-0.009 (8.22)***	-0.031 (32.75)***	0.002 (2.22)**	-0.042 (43.32)***	0.001 (0.52)	-0.032 (33.98)***	0.006 (5.06)***
firimage	0.014 (21.14)***	0.001 (1.8)*	0.001 (2.28)**	0.000 (0.68)	0.015 (21.59)***	-0.002 (2.31)**	0.002 (2.96)***	0.000 (0.07)
%foreignK	-0.183 (34.47)***	0.019 (3.63)***	-0.055 (14.38)***	-0.012 (2.98)***	-0.186 (34.84)***	0.053 (9.69)***	-0.055 (14.46)***	0.012 (2.87)***
Year+Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		2,300,567	3,858,747	3,858,747	2,300,567		3,858,747	
rho		0.475	0.409	0.409	0.299		0.267	
McFadden's		0.052	0.053	0.053	0.066		0.066	
pseudo R2								

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The period of analysis is 1986-1992 in Column 1-2 and 5-6 and 1992-2000 in Column 3-4 and 7-8. Absolute value of t-statistic in parentheses, based on robust standard errors clustered by individuals. The variables age, tenure are divided by 10, and age-square and hhi by 1000.

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