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Michele Raitano, Francesco Vona

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Michele Raitano

Sapienza University of Rome, Department of Economics and Law

Francesco Vona

OFCE Sciences-Po and SKEMA Business School

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Michele Raitano
Sapienza University of Rome, Department of Economics and Law

Francesco Vona
OFCE Sciences-Po and SKEMA Business School

Abstract

The authors investigate the impact of exogenous product market competition shocks on returns to skills in Italy using a new longitudinal dataset on individual working histories. This impact is identified using three exogenous shocks affecting competition: the unforeseen devaluation of the Lira in 1992, its return to a fixed exchange regime in 1996 and the market liberalisation in the utility and transport sectors in the late 1990s-early 2000s. This paper extends the analysis of Guadalupe (2007) by investigating how firm heterogeneity and shocks of different types and signs affect the impact of competition on skill premia. The authors find that opposite shocks have opposite effects: an increase (resp. decrease) in international competition increases (resp. decreases) returns to skills. Moreover, international shocks have greater effects on medium-sized firms, while domestic liberalisation shocks have greater effects on large incumbents previously sheltered from any entry threat.

Keywords: skill premia; competition; currency shocks; product market regulation; firm size.
JEL classification: J31; L11; D41

1. Introduction

Empirical research on the effect of product market competition on innovation and various measures of firm and sector performance has grown rapidly in recent decades[1]. Less established is the literature analysing the labour market impacts of pro-competitive reforms, such as trade and product market deregulation. While seminal studies show that both reforms can have a substantial impact in terms of wages and employment, evidence remains scant concerning the effect of competition on more qualitative outcomes, such as workforce composition and returns to skills[2]. Because both product market competition and returns to skills increased substantially in recent decades and competition spurred the adoption of new, arguably skill-biased, technologies, it is likely that competition has had a considerable indirect impact on inequality and skill premia. In addition to this indirect impact through innovation, greater competition could directly affect the demand for skilled workers by increasing the sensitivity of profits to costs and the quality of the workforce, on which costs crucially depend.

The aim of this paper is to shed light on this direct mechanism by assessing the impact of exogenous competition shocks on returns to the skills of Italian men. We use a novel panel dataset that spans a sufficiently long period (1987-2007) to allow us to study the effect of different types of competitive shocks. This is a considerable advantage over previous research (Guadalupe 2007), as we can use an homogeneous dataset to study two international shocks, i.e., the Lira devaluation of 1992 and the pre-euro revaluation at the end of 1996, and a domestic one, i.e., the liberalisation of the utility, transport and communication sectors in the late 1990s and early 2000s. Our paper is closely related to that by Guadalupe (2007), who examines the impact of competition on returns to skills in a quasi-experimental difference-in-difference (DID) framework. In particular, she exploits the effect of two exogenous competition shocks, i.e., the adoption of the single market programme and the revaluation of the British Pound, and demonstrates that a considerable fraction of the increase in the returns to skills experienced by British men is

[1] For good surveys, see Nicoletti and Scarpetta (2003), Aghion et al. (2005), Aghion et al. (2009), Griffith et al. (2010), Bassanini and Brunello (2011), Alesina et al. (2011), Buccirossi et al. (2013) and Schiantarelli (2005), among others.

[2] A seminal strand of the literature examines the impact of deregulation reforms and international competition on wages and employment in Anglo-Saxon countries (e.g., Revenga 1992, Abowd and Lemieux 1993, Borjas and Ramey 1995, Card 1986, Van Reenen 1996). For cross-country evidence on the association between product market deregulation, wages and employment, see Nicoletti and Scarpetta (2003), Kugler and Pica (2004) and Jean and Nicoletti (2004). Few recent papers examine the effect of international competition on skill upgrading (Neary 2002, Falvey et al. 2010, Lu and Ng 2013, Consoli et al. 2014). Only Guadalupe (2007) and Falvey et al. (2008) analyse the impact of competition on returns to skills in two developed countries.

explained by an increase in market competition[3]. Building on the seminal analysis of Guadalupe (2007), the primary contribution of this paper is to investigate how firm heterogeneity and shocks of different types and signs affect the relationship between competition and returns to skills.

The effect of international competition on wages crucially depends on firm characteristics, as suggested by new trade theory (Melitz 2003). Sector-level measures of exposure to competition can hardly capture differences in firm productivity that translate into differences in hiring strategies and wage policies. On the one hand, the market size of highly productive firms increases following a competition shock, as do the wage premia of workers employed there (Yeaple 2005, Davidson et al. 2008, Helpman et al. 2010). In the presence of assortative matching between firms' productivity levels and workers' abilities, the increase in returns to skills should be concentrated in high-productivity firms. On the other hand, however, high-productivity firms are more likely to export abroad and naturally exposed to international competition; therefore, they may require less adjustment in their workforce composition compared to firms that were not exposed to foreign competitors before the shock. Accordingly, increases in the demand for skilled workers and returns to skills should be particularly concentrated in low-productivity firms. In Italy, there was a greater scope for a post-euro restructuring because in the early 1990s, small and medium firms relied on continuous devaluations and opted to compete on price rather than quality (Basile 2001, Bugamelli et al. 2010). In this paper, we assess the relevance of these two mechanisms by comparing the magnitude of competition shocks for firms of different sizes, under the standard assumption that size is a good proxy for firm productivity (see, e.g., Frias et al. 2012).

In addition, differences in the nature of competition shocks can be a source of heterogeneity. While an increase in international competition may have greater consequences for less productive firms, an increase in domestic competition, such as the liberalisation of utilities, is likely to induce substantial restructuring, especially for state-owned monopolies that were previously sheltered from the threat of new entrants. By considering domestic shocks, our analysis extends Guadalupe (2007) to all economic activities other than the manufacturing sector.

Finally, our study assesses the symmetry of the effects of two opposite shocks, i.e., an increase and a decrease in international competition. This issue is of interest because asymmetric currency shocks may not entail opposite effects on skill premia. Unlike the Lira revaluation of 1996 that has been unambiguously interpreted as an increase in competition (e.g., Bugamelli et al. 2010), a

[3] Falvay et al. (2008) use a matched employer-employee dataset on Portugal and, exploiting the strong appreciation of the Portuguese currency during the period 1989-1992 and pre-existing differences in trade exposure across industries in a DID framework, also find that competition increases returns to skills.

currency devaluation has two contrasting effects on competition. First, it reduces the costs of both exporting and quality upgrading. For Mexico, Verhoogen (2008) finds that quality upgrading in response to a devaluation shock is more likely to occur in large firms and this will increase skill premia due to the complementarity between product quality and workforce skills. However, returns to skills should decline according to the main direct effect considered in our study, i.e., lower competition decreases the sensitivity of firms to costs and hence reduces the demand for skilled workers.

Three main findings of our analysis are noteworthy: i) opposite shocks have opposite effects: an increase (resp. decrease) in international competition increases (resp. decreases) returns to skills; ii) international shocks have a more substantial effect on medium-sized firms, while domestic liberalisation has greater effects on large incumbents that were previously sheltered from any entry threat; and iii) the short-term effects are generally greater than long-term ones, as gradual adjustments to skill composition tend to mitigate the increase in skill premia (Lopez and Namini 2013).

Our paper is closely related to three papers that consider the effects of similar shocks for Italy, although focusing on different outcomes. Bugamelli et al. (2010) find that the adoption of the Euro had a positive impact on productivity growth, especially in sectors and firms with low skill and technology levels. Macis and Schivardi (2013) examine the effect of the unforeseen 1992 devaluation shock on the export wage premium in a matched employer-employee dataset. They demonstrate that the export wage premia increased following the devaluation, but the skill quality of the workforce remained constant. The latter finding resonates with evidence indicating that exports and TFP (a variable highly correlated with skills) are weakly correlated for Italian firms (Crinò and Epifani 2012) and firms benefiting the most from the 1992 devaluation are not the most productive (e.g., Basile 2001). Finally, Bassanini and Brunello (2011) demonstrate that the liberalisation of the utility, transport and communication sectors in the 1990s increased firms' training investments, which is an essential component of human capital.

Our paper is also related to the active literature on the effects of trade liberalisation on wages and skill premia, which is primarily limited to developing countries[4]. However, our results are only comparable with the few papers that also consider a currency devaluation shock and demonstrate its positive consequence for quality upgrading and returns to skills among large firms (e.g.,

[4] See, e.g., Verhoogen (2008), Krishna et al. (2012), Amiti and Cameron (2012), Helpman et al. (2012), Frias et al. (2012), and Lopez and Namini (2013).

Verhoogen 2008, Frias et al. 2012). In contrast to these works, our findings for the 1992 devaluation reveal that the quality-upgrading effect seems more than compensated by the effect of reduced competition on the demand for skilled labour.

The remainder of the paper is organised as follows. In Section 2, we present a simple theoretical mechanism that highlights the role of firm heterogeneity in mediating the effect of a shock. Section 3 describes the dataset used in this paper and gathers preliminary evidence on the trend in the skill premium in Italy, while Section 4 details our empirical strategy. Section 5 presents and discusses the results for the three shocks, while Section 6 concludes.

2. Theoretical discussion on competition and returns to skills

To more formally present our central argument on the importance of firm heterogeneity in mediating the effect of a shock, we propose a simple extension of the model in Boone (2000) as developed by Guadalupe (2007). This model can be regarded as a useful way to simplify competition models with firm heterogeneity to derive straightforward predictions of the effects of competition on returns to skills. The common feature of this class of models is that greater competition increases the profits of a firm relative to the least efficient one.

Consider a standard setting in which heterogeneous firms are involved in monopolistic competition (example 4 in Boone 2000). The profit ratio $\tilde{\pi}_i/\tilde{\pi}_j$ between firms *i* and *j* can be written as

$$(1) \qquad \frac{\tilde{\pi}_i(c_i,\theta)}{\tilde{\pi}_j(c_j,\theta)} = \left(\frac{c_j}{c_i}\right)^{\frac{\theta}{1-\theta}},$$

where c_i are unitary costs with $c_i < c_j$ and $\theta\epsilon(0,1)$ is the elasticity of substitution between the products of the two firms. The effect of an increase in competition, a greater θ, is then:

$$(2) \qquad \frac{d(\tilde{\pi}_i/\tilde{\pi}_j)}{d\theta} = \frac{\log(c_j/c_i)}{(1-\theta^2)}\left(c_j/c_i\right)^{\frac{\theta}{1-\theta}} > 0.$$

This result has an important implication for the returns to skills. From (2), the incentives to pursue cost reductions increase when competitive pressure rises. As a result, firms will compete more fiercely to hire skilled workers, who are the drivers of productivity improvements and innovations (e.g., Nelson and Phelps 1966). In perfectly competitive labour markets and under the assumption of a fixed skill supply, skilled workers can obtain the entire surplus they generate if firms are all

identical with the exception of their draw of a worker with a different skill s[5]. In our simplified setting, this implies that heterogeneity in firm costs only depends on workers' skills. That is: $c_i = c(s_i)$, where s_i is the skill level of the worker employed by firm *i*, with $s \epsilon (\underline{s}, \overline{s})$. Profits net of wages are defined as:

$$(3) \qquad \pi_i(c(s_i), \theta) = \big(p_i(\theta) - c(s_i)\big)y_i(\theta) - w(c(s_i), \theta) = \tilde{\pi}_i(s, \theta) - w(s, \theta).$$

Because all firms are assumed to be identical, profits are equal across firms: $\pi_i(c(s_i), \theta) = \pi_j\big(c\big(s_j\big), \theta\big)$ and each worker with skill *s* obtains the additional profits she generates with respect to the marginal worker $\underline{s}$:

$$(4) \qquad w(s, \theta) = \tilde{\pi}(s, \theta) - \tilde{\pi}\big(\underline{s}, \theta\big) + w\big(\underline{s}\big).$$

Overall, the surplus obtained by skilled workers increases with competition, as does with the relative gap in performance between high- and low-productivity firms. This result is more general than it appears in this ad-hoc theoretical construct[6]. Under a standard complementarity assumption, i.e., more productive firms use skilled workers more intensively than less productive ones (Kurokawa 2011), it holds in all models, such as trade models with heterogeneous firms (Melitz and Ottaviano 2008), where an increase in competition generates a reallocation in favour of more productive firms. Further recall that the direct effect of competition on skill premia is likely to be reinforced by the effect of competition on three related factors affecting returns to skills: union bargaining power, innovation and their interaction[7].

Within this simplified framework, we allow the scope for skill upgrading in response to an increase in competition to depend on the initial conditions of the firms and sectors involved (Bugamelli et al. 2010). At the firm level, initial conditions can be made to depend on heterogeneity in productivity or on the initial skill composition. Our central assumption is that firms beginning with

[5] Note that this result can be easily generalised to Nash Bargaining settings provided that the share of the surplus obtained by the worker exceeds the outside option. In this case, firms also obtain a fraction of the surplus because they have to be compensated for the periods where they are idle. See Davidson et al. (2008) and Helpman et al. (2010) for extensions of the standard Melitz (2003) model of heterogeneous firms with frictions.

[6] Bassanini and Brunello (2008) construct a model of the effect of competition on training based on the notion that competition increases the sensitivity of prices to costs and induces firms to make additional cost-reducing investments such as training.

[7] In protected sectors, unions share a fraction of the additional rents with entrepreneurs and, simultaneously, compress wage differences across workers. Skilled workers accept lower premia with respect to unskilled workers being more than compensated by a higher average wage. When competition increases, rents decline, and for skilled workers, the benefits of wage compression decline. In addition, competition is likely to spur innovation from both entrants and incumbents, which have to defend their market shares (Aghion et al. 2005). If new technologies are skill-biased, reducing barriers to entry will increase the skill premia. Third, if enhanced competition among firms favours the adoption of advanced skill-intensive technologies, the coalition between skilled and unskilled workers will dissolve, hence increasing skill premia (Acemoglu et al. 2001). See Guadalupe (2007) for a detailed discussion.

different initial levels of skill intensity will adjust their demand for skills differently and the increase in the skill premium required to ensure this adjustment will also be heterogeneous. This issue can be illustrated more formally by exploiting the dependence of c(.) on s and computing the cross-derivative of $\tilde{\pi}_i/\tilde{\pi}_j$ with respect to both the degree of competition and the initial skill level. We obtain:

$$(5) \qquad \frac{d^2(\tilde{\pi}_i/\tilde{\pi}_j)}{d\theta ds} = \frac{\varphi'_{ij}(s)}{(1-\theta^2)}\left(1 + \frac{\theta}{1-\theta}\log\left(\varphi_{ij}(s)\right)\right),$$

where $\varphi_{ij} = c(s_j)/c(s_i)$ and $\varphi'(s) = \frac{d\varphi}{ds}$. Note that the sign of the cross derivative in (5) exclusively depends on $\varphi'(s)$. It is clear that $\varphi'(s) < 0$ if the proportional cost reduction, and hence the implicit increase in the demand for skills, is greater in initially less productive firms:

$$(6) \qquad \frac{|c'_j(s)|}{c_j(s)} > \frac{|c'_i(s)|}{c_i(s)}$$

A negative sign of the cross-derivative in (5) implies that firms with a lower initial skill intensity value an increase in the demand for skilled workers proportionally more than firms with a higher initial skill intensity. Under quite reasonable assumptions regarding the shape of the function $c(s)$, i.e., $c' < 0, c'' > 0$, the incentives to upgrade are greater the larger the distance between *s* and the maximum skill level $\bar{s}$. Firms closer to $\bar{s}$ can primarily adjust their skill levels upward by increasing $\bar{s}$, for instance by innovating. However, for a technologically laggard country such as Italy, an upward shift in $\bar{s}$ constitutes a second-order effect with respect to the effect of pure skill upgrading.

In essence, the effects of competition on the demand for skilled labour may not merely depend on the exposure to competition, but it is likely to be mediated by initial differences in firm characteristics. The interaction of the two exposure margins (competition and initial skill/technological level) suggests heterogeneous responses by firms of different sizes. Larger firms are, in principle, more exposed to an increase in competition that challenges their quasi-monopolistic rents, thus they should increase their demand for skilled workers considerably more than smaller firms. However, most large firms are already exposed to foreign competition and benchmark their strategies based on those of global players, thus the increase in the demand for skills in response to an increase in competition is likely to be limited. Medium-sized firms have the most uncertain response to the competition shock: some contract and eventually exit the market, while some expand and enter foreign markets, improving product quality and increasing wages to

attract talented workers. Particularly in the case of currency shocks and under the usual working assumption that firm size is a sufficient statistics for productivity, medium-sized firms are more subject to selection effects, as they are near the Melitz productivity threshold, above which they export. We hence expect that an international shock will have a greater impact on returns to skills in medium-sized firms, which adjust their hiring plans to compete internationally. Small firms will in principle react similarly to medium-sized ones but with significantly lower likelihoods of succeeding in attracting skilled workers. Some rational entrepreneurs will anticipate this and opt for a different strategy to survive, i.e., price rather than quality competition.

Finally, an important issue not addressed in Guadalupe (2007) regards the timing of the effect of competition on the returns to skills that, for a simple demand and supply argument, crucially depends on the adjustment of the skill supply. Lopez and Namini (2013) develop a theoretical model to highlight the difference in the short- and long-run responses of skill premia to trade liberalisation. Their empirical analysis using Chilean data reveals that the returns to skills overshoot in the short-run and then adjust downward in the long-run because the supply of educated workers expands. We hence expect that, if the direct effect of competition on skill premia is so important, the short-term effect will be lower than the long-term one.

To recapitulate, we can derive four testable implications from this theoretical discussion:

1. An increase in competition is expected to have a direct, positive effect on returns to skills, but the effect of a decrease in competition can be either positive or negative.
2. The effect of competition on returns to skills is expected to be crucially mediated by both the exposure to competition and the initial productivity level.
3. The short-term effects of competition on returns to skills are greater than long-term ones.

3. Dataset and descriptive evidence

In this paper, we use the AD-SILC panel dataset, recently constructed by merging the Italian sample of the 2005 cross-section of the European Union Survey on Income and Living Conditions (EU-SILC; the Italian sample is called IT-SILC)[8] with administrative data on individual working histories, collected by the Italian National Social Security Institute (INPS). The INPS administrative archives offer a comprehensive picture of the working episodes of the Italian labour force, as they contain detailed information for both public and private employees and the self-employed from

[8] EU-SILC is a cross-sectional and longitudinal survey coordinated by EUROSTAT (the Italian version is managed by ISTAT) and performed annually in EU Member states since 2004 according to a homogenous methodology.

their entry into the labour market to the present. Through this merge, the 2005 cross-sectional IT-SILC has been enriched with detailed longitudinal information on the entire working histories of the individuals interviewed in IT-SILC. In each year, for each working spell, INPS data record the number of weeks worked and gross earnings including personal income taxes and social insurance contributions. For working spells as private employees, we obtain our dependent variable by dividing total gross earnings, converted to 2010 constant prices using the consumer price index, by the number of weeks.

For private employees, INPS data also record the contractual arrangement (full-time versus part-time), the occupation (manager, white-collar, blue-collar, apprentice), periods spent receiving unemployment benefits and the region of employment. Furthermore, since 1987, they also contain firm characteristics, namely the type (single firm, leader or belonging to a holding company), size (the number of employees for both the local unit and holding company) and productive sector (coded at the 3-digit NACE level). Note that information on a firm's size and sectoral characteristics is crucial to implement and extend the analysis of Guadalupe (2007), assessing the influence of within-sector firm heterogeneity on returns to skills.

In pursuing the aim of this paper, AD-SILC has four additional advantages: i) it is a very long panel that follows individuals throughout their entire working lives and is hence ideal for longitudinal analyses; ii) the long time span covered by the dataset allows us to investigate the effects of three competition shocks on skill premia and to distinguish short- and long-term effects; iii) it allows us to precisely reconstruct the year of labour force entry and the workers' effective experience, which is a crucial determinant of individual earnings[9]; and iv) it records several time-varying individual characteristics, thereby reducing the influence of unobservables at the individual level, e.g., the contractual arrangement, the receipt of unemployment benefits and the amount of earnings from sources other than private employment (e.g., self-employment).

The matching of INPS with IT-SILC allows us to add time-invariant information on workers' educational attainments. However, in our main specification, we consider occupational attainment as the skill proxy, and assess the robustness of our results to a different skill measure constructed using both educational and occupational attainment in the appendix. We prefer occupation as our skill measure for the following reasons: i) occupational tasks have been considered the best proxy

[9] Before the construction of the AD-SILC, a sample of the INPS archives was delivered to researchers, but it only covered the period 1985-2003 (without providing information on the workers' prior experience) and did not include all types of workers (public employees and professionals were excluded), thereby preventing the computation of workers' effective experience. Note that, as firm codes have been available since 1975, we can also reconstruct a worker's tenure in a given firm.

for workplace skills in the recent literature (Acemoglu and Autor 2011, Goos and Manning 2007, Guadalupe 2007); ii) in contrast to education, in our dataset, occupation is a time-varying variable; and iii) education is a poor proxy for job tasks in Italy due to the substantial over-education of the few tertiary graduates and a diffuse under-education of the large share of those having attained at most a lower secondary degree (Franzini and Raitano 2012). Unfortunately, AD-SILC does not provide detailed occupational information. Therefore, we use a dummy collecting, in one group, apprentices and blue-collar workers (henceforth blue-collars) and, in the other, white-collar workers and managers (henceforth white-collars). We do not consider a more disaggregated skill classification because apprenticeship is a contractual arrangement that only concerns those aged under 24 and the share of managers in our dataset is relatively small, i.e., approximately 2.5% of the labour force.

To study the effect of competition on wage inequality, we supplement AD-SILC with information on sectoral proxies for competition. Data on sectoral variables are obtained from the STAN database of the OECD and are available for 49 sectors, which were matched to the AD-SILC dataset by converting the 3-digit NACE classification available in INPS archives to the ISIC classification of STAN[10]. In particular, we add two sectoral variables that are generally considered the standard proxies for competition by the literature to AD-SILC (e.g., Guadalupe 2007 and references therein). The first proxy for international competition is the import penetration share, defined as the ratio of imports to GDP adjusted for the difference between exports and imports. The second proxy is the index of product market regulation (henceforth PMR), which is a direct measure of regulation for a sub-set of sectors: professional services (legal, accounting, engineering, and architecture professions), retail distribution and network industries (telecommunication, electricity, gas, post, rail, air passenger transport, and road)[11]. Moreover, to perform robustness checks, we add the sectors' investment intensities (calculated as the ratio of gross fixed capital formation to value added within a specific sector), a structural variable used to proxy for the technological level of the sector, to AD-SILC. As a further control for a sector's technological level, we also computed the average educational attainment at the sectoral level using the AD-SILC dataset.

As firm characteristics and worker occupations are only collected for private employees, we limit our analysis to them, analysing their earnings over the period 1987-2007[12]. To overcome

[10] Details on this conversion are available from the authors upon request.

[11] For details on the construction of the PMR index, see Wolfl et al. (2009).

[12] Years prior to 1987 and periods spent as public employees or self-employed are taken into account to precisely identify the year of labour market entry and actual experience.

difficulties associated with the much more fragmented working careers of females and in line with Guadalupe (2007), we only consider males aged 15-59, excluding non-Italian citizens from the sample because the retrospective AD-SILC sample under-represented immigrants in past years. To reduce the impact of outliers we dropped the top and bottom 1% of the weekly wage distribution in each year. The final sample used in this paper comprises 126,644 longitudinal observations concerning 11,767 male workers that worked as private employees in the period 1987-2007. On average, individuals are followed for 15 years, 26% of them are followed as private employees for the entire 21-year period, 50% for at least 16 years and 90% for at least 6 years.

Table 1 presents descriptive statistics for the entire sample and by the three classes of firms that will be distinguished in the empirical analyses: small firms (those with at most 15 employees), medium-sized firms (those with 16 to 199 employees), and large firms (those with at least 200 employees)[13]. For the entire observation period, 36%, 33% and 31% of observations refer to small, medium-sized and large firms, respectively, and these shares remain constant over the period. With respect to worker characteristics, it is important to note that wages, age, experience and tenure are positively associated with firm size. Similarly, the share of white-collars – amounting to 28.6% in the full sample (and slightly increasing from 27% to 31% in the observation period) – is remarkably higher in large firms (46.5%) than in medium-sized and small firms (25.4% and 16.3%, respectively). Large firms are also concentrated in sectors characterised by higher import penetration and investment intensity. As expected because large firms are prevalent in the utility, transport and communication sectors, the value of mean PMR increases in firm size. Overall, this descriptive evidence suggests that both the exposure to competition and the quality of the workforce, in terms of skills and experience, are higher in larger firms.

Figure 1 shows that, on average, the real weekly wages of blue-collars have been stable since 1992, when Italy was affected by a sudden and severe recession. Conversely, the series of white-collars' weekly wages does not exhibit any evident break and has risen since 1997, although at a slower pace than that in the 1980s. As a consequence, the skill premium (i.e., the ratio between the mean gross weekly wage of white-collars and blue-collars) increased throughout the observation period, except for the period 1993-1996 (see Figure 1, right axis). Furthermore, we find that the increase in wage inequality between white-collars and blue-collars observed since 1997 cannot be attributed to growing wage gaps between sectors but is primarily explained by a within-sector increase in skill premia. Consistent with evidence on other countries (Lemieux 2006),

[13] In case of a firm that belongs to a holding company, we consider the total size of the holding company.

Figure 2 shows that – decomposing the trend of the Theil index by sector –in Italy, the largest fraction of the increase in wage inequality is explained by the within sector component, which has steeply increased since 1997.

4. Empirical Strategy

The identification of the effect of product market competition on returns to skills can be highly problematic because the two variables are clearly affected by common, unobservable factors not captured by fixed individual effects. Technology is an obvious example of these factors that affect both competition and returns to skills[14]. The availability of a longitudinal dataset that allows us to control for a rich set of time-varying and –invariant, unobservable workers' characteristics only represents a necessary condition to reduce this omitted variable bias. We therefore exploit exogenous variations in the degree of competition to correctly identify our effect of interest. In addition, the replication of three quasi-experiments within the same dataset ensures that our results are not driven by a particular historical episode but represent a structural feature of the economy under consideration. Our dataset fulfils the requirements for a correct identification, as the long period covered allows us to consider three exogenous variations in the degree of competition: two international shocks (the Lira devaluation and revaluation) and a domestic shock (the liberalisation of the utility and transport sectors).

The first international shock concerns the sudden devaluation of the Lira in September 1992 and Italy's exit from the European Monetary System (EMS) that followed strong speculative attacks on the currency[15]. The second international shock concerns Italy's return to the EMS at the end of 1996 in line with the process of adopting the Euro[16]. Figures 3 and 4 depict the trends of, respectively, the Lira/ECU exchange rate and the index of import penetration, i.e., our competition measure. A discontinuity in the exchange rate is evident in 1992, while the decline in import penetration occurs after only one year, which is in line with the well-known J-effect. For the second shock, the two figures indicate that the increase in import penetration anticipates the stabilisation of the Lira-ECU exchange rate in 1996, most likely reflecting the slow deterioration of

[14] Other firm-level characteristics can also affect both competition measures and returns to skills. The degree of unionisation within a firm is clearly correlated with both the skill premia and the quasi-rents above the market wage, which are both correlated with the degree of market competition. Data restrictions do not allow us to distinguish the direct effect of competition from the indirect one on union bargaining power.

[15] EMS allowed a limited, 6% fluctuation of the Lira/ECU exchange rate. After the exit from the EMS, Italy entered a flexible exchange rate regime.

[16] The Lira returned to the EMS on 25 November 1996; on 1 January 1999, an irrevocable exchange rate between the Lira and the Euro was fixed and the Euro began to circulate on 1 January 2002.

Italian competitiveness. However, the bulk of the increase in import penetration clearly occurred after the adoption of the Euro. In summary, the two currency shocks seem to have clear effects on our sectoral measure of international competition: while the 1992 Lira devaluation was associated with a decrease in competition (i.e., less import penetration), the return of the Lira to the EMS was associated with an increase in competition.

Assessing the effects of two opposite currency shocks that occurred in close proximity has advantages and disadvantages for our identification strategy. The pro is that the persistency in the unobservable factors affecting the policy under consideration is excluded because the two opposite shocks occurred within a relatively brief period (see Betrand et al. 2004 for a discussion of this problem). The disadvantage is that hysteresis in export behaviour (Baldwin and Krugman 1989) and lagged adjustments in skill supply (Lopez and Namini 2013) may delay the response to the shock, for instance because marginal firms may continue exporting even after the revaluation of 1997[17]. We distinguish between the short- and long-term effects of the shock to mitigate these potential sources of bias.

The domestic shock concerns the process of deregulation of the energy, communication and transport sectors during the period 1999-2001 (see Bassanini and Brunello 2011). As shown in Figure 5, the PMR index that we use to measure market regulation decreases substantially from the end of the 1990s until 2004. However, the gradual decline in the index that occurs after 2001 suggests that it is difficult to identify a clear structural break in this case. We hence exclude the years from 1999 to 2001 altogether. Moreover, in analyses available upon request, we confirm that our results are not affected by small changes in the period considered.

For the practical assessment of the hypotheses presented in Section 2, we follow Guadalupe (2007) and use these exogenous policy changes in a reduced-form DID specification. As is common in a DID framework, we define two periods, before and after the experiment, as captured by the dummy variable *post*, which equals one, after 1992 or 1996 for the two external shocks and after 2001 for the domestic shock[18]. The logarithm of the real gross weekly wage of individual *i* with skill *k* in sector *j* in time *t* is modelled as a function of a vector of individual and sectoral controls:

[17] In addition, if the decrease in skill premia following the 1992 devaluation reduces the long-run supply of skills, the estimated increase in returns to skills following the Euro shock could be upward biased, as it would also reflect the reaction of skill premia to this change in the fundamentals.

[18] Specifically, we consider three sub-periods: 1987-1996 for the devaluation shock, 1993-2005 for the revaluation shock and 1993-2007 for the PMR shock, excluding the years between 1999 and 2001 when the main liberalisation process occurred.

$$(7) \quad log(w_{ijkt}) = \alpha + X'_{ijkt}\gamma + (post_t * exp^j_{pre} * S^k_{it})'\theta + \lambda(post_t * exp^j_{pre}) + \lambda_0(post_t) + \lambda_1(exp^j_{pre}) + \lambda_2(exp^j_{pre} * S^k_{it}) + \lambda_3(post_t * S^k_{it}) + \rho S^k_{it} + d_t + d_k + d_i + \varepsilon_{ijkt}$$

where exp^j_{pre} indicates how sensitive a given sector *j* was to competition prior to the experiment – i.e., the value of the continuous import penetration and PMR indexes before the shock – S^k_{it} is the proxy for a worker's skill and our key variable is the triple interaction $post_t * exp^j_{pre} * S^k_{it}$, the estimated coefficient of which θ captures the relative change in the skill premium triggered by the shock.

As is common in a reduced-form DID specification, the identification of this effect is ensured by including all possible sources of heterogeneity that are likely to be correlated with the effect of interest. First, year, sector, and individual fixed effects (d_t, d_k and d_i, respectively) are added to eliminate unobservable heterogeneity affecting our estimates. Second, we saturate the model with respect to the three variables in the triple interaction to isolate the effect of interest from the following: a pre-existing trend in returns to skills in more exposed sectors ($exp^j_{pre} * S^k_{it}$), the direct effect of the shock on the skill premia ($post_t * S^k_{it}$) and the overall effect of the competition shock on wages ($post_t * exp^j_{pre}$). Third, as suggested by Bertrand et al. (2004), in all the analyses of this paper standard errors have been computed using sectors as cluster units to reduce the over-acceptance of H1 typical of DID estimators. Finally, our rich dataset allows us to control for very detailed time-varying proxies for a worker's carrier, such as unemployment spells and earnings from self-employment, and further proxies for workers' abilities and skills, such as tenure and effective individual experience.

Specifically, we include the following individual controls in all estimates presented in next section: age, effective experience and their squares; dummies for part-time employment, unemployment or temporary suspension of working activities (i.e., *cassa integrazione*); the number of weeks in a year spent in unemployment or working as a public employee or self-employed and the annual labour income coming from these activities. Fourth, we include controls for firm size (in log) and dummies for the firm's type (single firm, leader or belonging to a holding company) in all models. This rich set of controls allows us to distinguish the effect of competition on wages from that on several variables affecting earnings.

Because individuals may change sectors in response to changes in competition, the total change in the skill premium measured in equation 7 (called the "overall model") is a combination of a price effect (a skill becoming more valuable as competition increases) and job changes (voluntary and

involuntary). As in Guadalupe (2007), we isolate a pure price effect of competition from the compositional changes in the workforce triggered by the shock. We obtain the pure price effect by estimating equation 7 for stayers only, hence treating wage changes due to sector changes as shocks idiosyncratic to the individual rather than to the sector[19]. To shed light on a potential mechanism behind the estimated effects – i.e., skill-biased technical change – we also estimate the "overall" model when including the OECD index of a sector's investment intensity, the mean educational attainment of workers in the sector, the interactions both variables with the skill dummy and the worker's tenure (also squared) as a proxy for specific skills.

We further extend the analysis of Guadalupe (2007) by examining an additional source of technological (or productivity) heterogeneity at the firm level. We assume that greater competition increases the returns to skills, especially in firms that are more distant from the technological frontier. To identify this effect, we exploit cross-firm variation in both initial competition and technology level. In principle, this would imply modifying our exposure variable to account for these two dimensions. However, to maintain clarity in the interpretation of the interaction terms, we perform our analysis by dividing our sample into small, medium-sized and large firms. This procedure allows the estimated effects to completely differ across firms of different sizes. Note, however, that the AD-SILC dataset is not a matched employer-employee dataset and thus does not allow us to estimate the changes in the returns to skills within a particular firm conditional on its initial class. Therefore, the coefficient of the triple interaction variable should be interpreted in this case as the change in the skill premium for the average firm in the class, which is the result of both changes in skill premia within a firm and firms' movements across classes.

5. Results

5.1 Competition and skill premia

Before presenting the results of the three quasi-experiments, we estimate the relationship between the skill premium and the two proxies for competition considered in this paper, i.e., import penetration and PMR indexes. In practice, we estimate equation 7 without including the terms with $post_t$ and considering the current level of the competition indexes instead of the initial level, i.e., the exp_{pre}^{j} variable.

[19] In particular, we include industry-specific individual fixed effects. Thus, if a worker changes sector, he is treated as a different individual and the estimated effect is net of job changes.

Table 2 reports the results of basic least squares and fixed effect regressions, which are estimated for the full sample period 1987-2007. Panel 1 examines the interaction between import penetration and the white-collar dummy (henceforth WC). This interaction captures the extent to which skill premia vary according to the exposure of the worker's sector to international competition. Similarly, Panel 2 presents the interaction between the PMR and the WC dummy, which captures the extent to which skill premia vary according to the degree of product market regulation. These preliminary estimates are intended to verify whether the association between skill premia and the two proxies for competition is statistically significant, and therefore, it is worth studying it to understand the determinants of wage inequality.

Column 2 presents simple pooled OLS estimates, which include year, regional and sectoral dummies plus time-varying individual and sectoral controls. The OLS model indicates that returns to skills increase within sectors as import penetration increases and PMR decreases[20]. A white-collar worker receives an additional premium of 2.4% when employed in a sector with the average level of import penetration, while the higher WC premium in the sectors affected by the product market deregulation process is offset by a lower, but not statistically significant, average wage.

In column 3, the inclusion of individual fixed effects considerably reduces the magnitude of the additional premium received by the white collars in more competitive sectors. For import penetration, the interaction with the WC dummy remains positive but becomes statistically insignificant when we saturate the model by adding the interaction term between the skill and time dummies (Column 4) and when we fully saturate the model by also including the interaction term between the sectoral and time dummies (Column 5). For PMR, in contrast, the interaction with the WC dummy remains statistically significant even in these more demanding specifications (columns 4 and 5).

Table 3 presents the FE model estimated by dividing the sample into three groups defined on firm size: small (at most 15 employees), medium-sized (16-199) and large firm (at least 200). The significant association between the degree of international competition and the skill premium emerges regardless of firm size, but the size of the coefficient is larger in smaller firms. Conversely, a significant association between PMR and the WC dummy only emerges in small and large firms. These results corroborate our contention that the association between competition and returns to skills depends on firm characteristics, which are approximated here by size.

[20] Notice that PMR is expressed as an index of restrictions, while import penetration is an index of trade openness; hence an increase in the skill gaps in more open sectors is expressed by different signs of the estimated coefficients in the two cases.

However, all of these estimates only suggest a correlation between the skill premia and our two measures of competition. Indeed, these variables could be endogenous or correlated with omitted variables, thereby impeding inferences of a pure causal relationship between changes in competition and skill premia. For instance, an increase in import penetration may depend on a loss of technological competitiveness by Italian firms, which decrease productivity and wages, especially those of skilled workers that complement new technologies. In summary, we cannot argue that results concerning the effect of competition on skill premia presented in tables 2 and 3 are causal, but we can only establish a positive association.

To address the concern of endogeneity in our variable of interest, the following three sub-sections analyse the effect of three exogenous competition shocks on returns to skills: i) the Lira depreciation in September 1992; ii) the Lira appreciation at the end of 1996; and iii) the product market deregulation that began in the period 1999-2001. As the measure of skills we use in this paper is admittedly limited, the Appendix replicates our main results for an alternative skill measure constructed by interacting educational and occupational attainments (see Table A1). However, as our results are generally robust, we prefer to employ a simpler and more intuitive skill measure[21].

5.2 The 1992 devaluation

The large and sudden depreciation of the Lira in 1992 is the first quasi-natural experiment in the period considered by this paper. This experiment is the most critical for testing the conceptual framework presented in Section 2. Although a currency devaluation should be interpreted as a decrease in international competition, it can have either a negative or a positive effect on returns to skills, the latter being a consequence of the quality-upgrading effect highlighted by Verhoogen (2008). The composite effect of these two contrasting forces is assessed over a long (1987-1997) and a short (1990-1995) period. In the latter case, we exclude the years 1992 and 1993 from the analysis, as the effective reduction in import penetration only began in late 1993 (see Figure 4). There are two reasons that the distinction between short- and long-term effects is particularly important for this shock. First, as evident from Figure 3, the Lira revaluation began before its official return to the EMS. Second, the quality-upgrading effect is likely to emerge slowly,

[21] The results are also robust to the use of the export share rather than import penetration as proxy for international competition. These additional analyses are available from the authors upon request.

especially because, in the pre-shock context, price competition was the dominant strategy among Italian firms (Basile 2001).

In Table 4, we present the main results for this shock. Recall that the coefficient of interest is that on the triple interaction among import penetration, the WC dummy and the post 1992 dummy. The baseline "overall" model (column 2) indicates that a decrease in competition significantly reduces the white-collar wage premium. The increase in the WC premium observed after 1992 – confirmed by the sign of the interaction between the WC and post-1992 dummies – is significantly mitigated in sectors relatively more exposed to foreign competition. If, as in Guadalupe (2007), we express the effect of competition as a weighted fraction of the overall change in the skill premium, we find that the increase in the skill premium would have been approximately 20% higher without the decrease in competition[22].

In column 3, we estimate the regression for a shorter period and the effect of competition increases by 1/3. Because the revaluation of the Lira begins before the return to the EMS, as part of the process of adopting the Euro, it is possible to attribute this difference between the short- and long-term effects to deep adjustments in fundamentals (i.e., changes in the supply of skills, quality-upgrading) or a slow reversion in the competitive pressure. This partial overlapping of the two currency shocks makes it difficult to fully disentangle these two forces and evaluate the role of quality upgrading in response to the devaluation.

In column 4, the effect of competition is considerably reduced up to becoming nearly significant if we exclusively consider “stayers”. This result suggests that part of the estimated effect depends on changes in workforce composition across sectors. As would be expected, the composition and price effects operate in the same direction; thus the decrease in the skill premium is amplified in the “overall” model, in which we account for the sorting of skilled workers into lower quality jobs.

In column 4, we consider the overall effect net of the indirect effect of competition on technical change, as proxied by further time-varying sectoral variables (investment intensity and the mean educational attainment in the sector, both also interacted with the WC dummy)[23]. Interestingly, reducing competition decreases returns to skills relatively more if we control for innovation.

[22] The period 1987-1996 was characterised by an increase in skill gaps between white-collars and blue-collars, amounting to approximately 0.030 log points, while, at the average level of import penetration before the shock, the effect of the 1992 Lira depreciation yielded a 0.007 reduction in the skill premium. Notice that for both the 1992 and 1996 shocks, the magnitude of the effect is computed by the ratio between the estimated coefficient computed at the mean import penetration level before the shock and the change (in log points) in the skill premium in the observed period

[23] The results are robust to the use of other sectoral variables, such as R&D or TFP. We select these two proxies to minimise the number of missing observations.

Observe here that the innovation proxies capture the indirect effect of competition on skill premia and the triple interaction captures the true direct effect. This result is hence consistent with Verhoogen (2008): the direct effect of competition on returns to skills would have been larger if the 1992 devaluation had not reduced the cost of upgrading the quality of (or innovating) exported products.

Table 5 allows the effect of the 1992 shock to vary according to firm size. As mentioned above, it is unclear whether the quality upgrading effect is able to offset the direct effect of reduced competition, especially for large firms. To address this issue, we estimate the baseline "overall model" but divide the sample according to the three firm-size classes. The main finding is that a significant decrease in returns to skills in response to a decrease in competition only emerges among medium-sized firms. Note also that the effect is considerably larger in small firms compared to large ones. This result implies that the quality-upgrading effect, if any, was modest among large firms. In turn, the large effect of competition on medium-sized and, to a lesser extent, small firms indicates that the 1992 devaluation may have reduced the role of technological competitiveness, and hence of skilled workers, a key requirement to enter foreign markets (Basile 2001).

5.3 The Lira returns to the EMS and the adoption of the Euro

The second shock considered in this study is the Lira revaluation associated with the process of adopting the Euro. Observe that a revaluation has a less complicated interpretation than devaluation. In this case, there are no theoretical reasons that the revaluation of the Lira should have an ambiguous effect on returns to skills.

Table 6 reports the effect of the Euro shock on returns to skills. To evaluate this effect, we consider the period 1993-2005 to account for the slow and persistent increase in import penetration after the introduction of the fixed exchange rate (see Fig. 4). The “overall” model presented in Column 2 indicates that the increase in competition following the Lira appreciation in 1996 significantly increases the skill premium. The point estimate of the triple interaction term among import penetration, the WC dummy and the post 1996 dummy amplifies the considerable increase in the WC premium that occurs in all sectors after 1996 (as confirmed by the estimated interaction term between WC and the post shock dummies). This result indicates that the findings of Falvay et al. (2008) for Portugal and those of Guadalupe (2007) for the UK constitute a general feature of various economic systems, rather than a peculiarity associated with specific institutional

characteristics. Moreover, the appreciation of the Lira explains slightly more than 1/4 of the increase in the WC premium[24]. Interestingly, the magnitude of this effect is consistent with that obtained by Guadalupe (2007) for the revaluation of the British Pound.

Column 3 presents the short-term effect, which is computed over the period 1994-1999, excluding the two years in which the shock occurred, i.e., 1996 and 1997. Regarding the 1992 shock, the short-term effect is larger than the long-term one. However, the short-term effect of competition is only 9% larger than the long-term one, suggesting a sluggish adjustment in the supply of educated workers. Finally, Column 4 reveals that the effects of competition are only smaller for "stayers" than those obtained in the "overall" model. This again implies that the composition and price effects operate in the same direction. In Column 5, we demonstrate that our results are unaffected by adding sectoral proxies for technological change. This evidence is consistent with similar robustness checks performed by Guadalupe (2007), in which the skill dummy is interacted with R&D intensity, and suggests that the direct effect of competition shocks on skill premia dominates the indirect effect through technology.

To summarise, we observe perfect symmetry in the effects of the two international shocks. While the 1992 devaluation induced a decrease in returns to skills, the implicit appreciation generated by the introduction of the fixed exchange rate had the opposite effect.

Table 7 presents the effect of the 1996 shock divided by firm-size classes. The table confirms the second main result of our paper: for this shock, the increase in returns to skills also primarily concerns medium-sized firms, where the estimated triple interaction is statistically significant at the 95% level. In large firms, the estimated coefficient is not only insignificant, but its size is half that estimated for medium-sized firms. In small firms, in contrast, the effect is almost as large as in medium-sized firms, but the statistical significance is low due to the large standard deviation, which reflects the substantial degree of heterogeneity in the performance of smaller firms. Finally, it is worth noting that the effect is sizeable for medium-sized firms, for which the increase in competition explains approximately 37% of the total increase in the skill premium. The effect is even larger among small firms for which it accounts for 57% of the overall increase. This result is explained by the lower increase in the returns to skills in smaller firms compared to medium-sized ones during the period under consideration (0.017 versus 0.048 log points, respectively).

[24] More precisely, the WC premium increases by 0.035 log points during the period 1993-2005, while, at the average import penetration level before the shock, the effect of the Lira appreciation yields a 0.01 log point increase in the skill premium.

5.4 Product market deregulation

In the third quasi-experiment, we consider the process of deregulation occurring since 1999 in sectors related to electricity, gas and water supply and transport and communication. In this case, the precise timing of the shock is not well identified because sectors are heterogeneous in the timing of deregulation. We choose the period 1999-2001, as it is the one in which liberalisation began and the decrease in the PMR index was more pronounced (see Figure 5). Moreover, to ensure that all exposed sectors are affected by the shock, we do not consider these three years in the analysis.

Table 8 contains the main results that are organised as in previous analyses. Our variable of interest is the triple interaction term among the PMR index, the WC dummy and the post 1999-2001 dummy. Recall that in this case an increase in competition is expressed through a decrease in the PMR index; thus a negative coefficient implies a positive effect of competition on returns to skills.

Column 2 presents the results of the "overall" model. The point estimate of this effect confirms that greater domestic competition increases the skill premium, which increased during the post shock period, as confirmed by the estimated size of the interaction between WC and the time dummies. However, the effect is only near significance (p-value=0.141). The lack of significance is primarily a consequence of the large standard error, which is possibly masking very heterogeneous patterns across sectors and firms. As is evident from Column 3, when the effect of interest is estimated for the briefer 1996-2003 period, it becomes statistically significant because the standard error is reduced by 1/3. In turn, the short-term effect is only 8% larger than the long-term one.

Column 4 only considers "stayers". Although deregulation increases returns to skills, the coefficient of interest loses statistical significance. This result indicates that the increase in the skill premium in sectors more exposed to domestic competition was driven by new workers rather than stayers. Including variables to approximate the technological progress within the sector further reduces the estimated effect, which maintains its sign but it is far from being statistically significant (Column 5)[25]. In this case, the lack of robustness in the effect of deregulation seems to reflect the heterogeneous effect of PMR, which depends on firm size, rather than an indirect

[25] Note that we assess the validity of this experiment by conducting a placebo experiment. Specifically, we impose a shock in 1995 and estimate its effects for the period 1990-2002. The validity of the PMR shock is confirmed by this placebo experiment, which yields a positive sign for the triple interaction term. The results are available from the authors upon request.

effect of competition on innovation, which is not in keeping with the sluggish investments in new technologies by private Italian firms.

The deregulation process impacted sectors dominated by large firms. In 1998, the share of employees in large firms in the sectors exposed to deregulation was 50%, while it was only 29% in the remaining sectors. Therefore, we should expect that deregulation has a large impact on large firms, forcing them to restructure and increase the share of employees with high abilities. In accordance with this expectation, the PMR analysis dividing observations by firm-size classes indicates that the increase in the WC premium has been concentrated among large firms, while it has no impact on small and medium-sized ones (see Table 9).

The aggregate effect, however, was modest compared to the increase in the WC premium that occurred between 1993 and 2007 (0.091 log points). Weighting the estimated triple interaction term by the share of workers employed in the sectors affected by the shock, the deregulation process explains only 3.6% of the increase in the skill premium (3.4% in large firms).

To recapitulate, our results for the domestic shock, i.e., the deregulation of the utility, transport and communication sectors, stress the crucial role played by initial conditions in mediating the effect of competition on returns to skills. We find that the impact of competition in sectors with a low initial degree of competition is entirely concentrated in large firms that upgrade the quality of their labour force to escape potential competition from entrants (Aghion et al. 2005). This effect was, however, modest, most likely indicating a partial or imperfect liberalisation process.

6. Conclusions

This paper explores the effects of three changes in product market competition on the returns to skills for a panel of Italian males. Our study confirms previous findings from different countries indicating a positive and sizeable effect of competition on skill premia and, more generally, skill upgrading. Also consistently with previous work, the short-term effects are generally stronger than long-term ones, as gradual adjustments in the skill composition mitigate the increase in skill premia. This result is not obvious given the several anomalies that distinguish the Italian labour market from those of other developed countries. Notably, Italy is well known as a country where family ties and professional and workers' organisations prevent an efficient allocation and compensation of talented individuals. In this immobile context, an increase in competition may represent an indirect means of addressing static and dynamic inefficiencies, although the

extremely poor performance in productivity growth indicates that this effect is far from being sufficient and other complementary reforms are needed for Italy to recover.

Our novel result concerns the heterogeneity in the effect of competition that depends on the nature of the shock and firm size. First, we observe perfect symmetry in the effects of the two opposite international shocks. The negative effect of the 1992 devaluation on returns to skills is remarkably different from the results obtained in previous contributions, but it is broadly consistent with previous empirical evidence for Italy. Our theoretical section offers a simple explanation for this effect that associates the scope for skill adjustment with the initial skill or technological level. Second and related to this, as the scope for skill adjustment should be greater for low productivity firms, it is unsurprising that the two international shocks have a larger effect on small and medium-sized firms, which are arguably characterised by lower initial skill and productivity levels. This result does not hold, however, for the domestic shocks provided that liberalisation has a larger impact on incumbents that were previously sheltered from any entry threat. This is not surprising because, in our data, large firms are prevalent in the service, transport and utility sectors.

Our analyses can be extended in two promising directions. On the one hand, using a matched employer-employee dataset, it would be interesting to provide a more precise interpretation of the role played by firm characteristics in mediating the effect of the shock on skills. On the other hand, it would be interesting to understand whether the bulk of the increase in the skill premium is explained by a change in rent-sharing behaviour within the firm or a decrease in the minimum wage established in Italy at the occupation-sector level.

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Tab. 1: Sample descriptive statistics[1]

	All firms	Small firms	Medium firms	Large firms
Real weekly wage (Euro 2010)	477.8	377.1	477.3	596.0
	[211.4]	[150.2]	[196.8]	[226.3]
Real weekly wage (logs)	6.08	5.87	6.10	6.32
	[0.41]	[0.35]	[0.37]	[0.36]
Age	36.7	34.2	36.6	39.9
	[10.7]	[11.1]	[10.4]	[9.6]
Experience	16.6	14.3	17.0	18.8
	[10.7]	[10.6]	[10.6]	[10.3]
Tenure	6.7	5.0	6.6	8.7
	[6.4]	[5.0]	[6.2]	[7.5]
Import penetration index	0.117	0.075	0.127	0.156
	[0.165]	[0.128]	[0.156]	[0.198]
Product market regulation index[3]	0.552	0.480	0.390	0.811
	[1.503]	[1.368]	[1.279]	[1.811]
Investment intensity index	0.227	0.193	0.222	0.270
	[0.113]	[0.086]	[0.098]	[0.136]
Firm's size[2]	39	5	48	1,359
Share of white-collar	28.6%	16.3%	25.4%	46.5%
Observations	126,644	46,011	41,434	38,822

[1]Mean of variables for the whole sample and by firm's size. Standard deviation in parenthesis. [2]Median firm's size.

[3]PMR is computing assigning a zero value to manufacture sectors.

Source: elaborations on AD-SILC and OECD data

Tab. 2: Association between sectorial competition and returns to skill

	Pooled	FE: sect+ind	FE1: FE + WC*year	FE2: FE1 + sect*year
white collar	0.2693***	0.0881***	0.1951***	-0.0413***
	[0.0069]	[0.0074]	[0.0101]	[0.0118]
log(firm size)	0.0334***	0.0195***	0.0196***	0.0211***
	[0.0010]	[0.0010]	[0.0009]	[0.0010]
import penet.	0.0547	0.0134	0.0755**	0.5202***
	[0.0433]	[0.0382]	[0.0369]	[0.0969]
white collar*imp. penet.	0.2076***	0.1176***	0.0371	0.039
	[0.0308]	[0.0270]	[0.0270]	[0.0279]
N	126,180	126,180	126,180	126,180
white collar	0.3224***	0.1119***	0.1976***	0.1931***
	[0.0065]	[0.0076]	[0.0098]	[0.0106]
log(firm size)	0.0339***	0.0194***	0.0194***	0.0209***
	[0.0010]	[0.0010]	[0.0010]	[0.0010]
PMR	-0.0032	-0.0033	-0.0013	0.0235**
	[0.0035]	[0.0031]	[0.0030]	[0.0111]
white collar*PMR	-0.0346***	-0.0132***	-0.0107***	-0.0112***
	[0.0028]	[0.0027]	[0.0027]	[0.0027]
N	126,180	126,180	126,180	126,180

Robust standard errors in parenthesis. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

Tab. 3: Association between sectorial competition and returns to skill by classes of firm's size

	Small firms	Medium firms	Large firms
import penet.	-0.0297	-0.0092	-0.1957***
	[0.1085]	[0.0820]	[0.0437]
white collar*imp. penet.	0.2066***	0.1222**	0.1566***
	[0.0744]	[0.0575]	[0.0352]
N	45,951	41,428	38,801
PMR	0.009	0.0036	-0.0015
	[0.0066]	[0.0066]	[0.0036]
white collar*PMR	-0.0184***	-0.0055	-0.0061*
	[0.0060]	[0.0061]	[0.0032]
N	45,951	41,428	38,801

Robust standard errors in parenthesis. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

Tab. 4: Effect of the 1992 Lira devaluation experiment on returns to skill

	Overall	Overall Short-term exp.	Stayers only	Overall + sect var.
log(firm size)	0.0193***	0.0174***	0.0098***	0.0195***
	[0.0025]	[0.0030]	[0.0035]	[0.0027]
white collar (WC)	0.0333**	0.0559***	0.0096	0.0866
	[0.0132]	[0.0125]	[0.0119]	[0.0611]
WC*imp. penet.	0.0188	0.0367	0.0838	0.0319
	[0.0520]	[0.0605]	[0.0689]	[0.0565]
imp. penet.*post92	0.0434	0.0997**	0.0206	0.0587*
	[0.0303]	[0.0412]	[0.0354]	[0.0334]
WC*post92	0.0723***	0.0647***	0.0668***	0.0803***
	[0.0078]	[0.0098]	[0.0080]	[0.0066]
WC*imp. penet.*post92	-0.0706**	-0.1380***	-0.0562	-0.1004***
	[0.0328]	[0.0478]	[0.0336]	[0.0351]
N	63,620	23,441	63,620	56,932

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

Tab. 5: Effect of the 1992 Lira devaluation experiment on returns to skill by classes of firm's size

	Small firms	Medium firms	Large firms
log(firm size)	0.0201***	0.0262***	-0.0118
	[0.0030]	[0.0061]	[0.0107]
white collar (WC)	0.0654**	0.0566***	0.0049
	[0.0260]	[0.0164]	[0.0085]
WC*imp. penet.	0.1506	-0.0703	-0.0032
	[0.1160]	[0.0692]	[0.0464]
imp. penet.*post92	0.0079	0.0906**	-0.0101
	[0.0374]	[0.0442]	[0.0418]
WC*post92	0.0440***	0.0774***	0.0641***
	[0.0112]	[0.0128]	[0.0095]
WC*imp. penet.*post92	-0.0559	-0.0999**	-0.0238
	[0.0472]	[0.0446]	[0.0373]
N	23,473	20,582	19,565

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

Tab. 6: Effect of the 1996 Lira revaluation experiment on returns to skill

	Overall	Overall Short-term exp.	Stayers only	Overall + sect var.
log(firm size)	0.0170***	0.0149***	0.0097***	0.0168***
	[0.0023]	[0.0040]	[0.0036]	[0.0024]
white collar (WC)	0.0416***	0.0691***	0.0159	-0.0368
	[0.0118]	[0.0227]	[0.0202]	[0.0571]
WC*imp. penet.	-0.0827**	-0.1289*	-0.0070	-0.0915**
	[0.0396]	[0.0737]	[0.0659]	[0.0436]
imp. penet.*post96	0.0088	-0.0029	0.0015	-0.0033
	[0.0277]	[0.0294]	[0.0296]	[0.0304]
WC*post96	0.0607***	0.0410***	0.0586***	0.0609***
	[0.0088]	[0.0132]	[0.0105]	[0.0112]
WC*imp. penet.*post96	0.0842***	0.0917**	0.0729**	0.0791***
	[0.0266]	[0.0390]	[0.0278]	[0.0286]
N	78,254	23,392	78,254	75,643

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

Tab. 7: Effect of the 1996 Lira revaluation experiment on returns to skill by classes of firm's size

	Small firms	Medium firms	Large firms
log(firm size)	0.0126***	0.0248***	-0.006
	[0.0027]	[0.0056]	[0.0099]
white collar (WC)	0.0746***	0.0555***	-0.0115
	[0.0258]	[0.0166]	[0.0207]
WC*imp. penet.	0.0618	-0.1626**	-0.0099
	[0.1114]	[0.0737]	[0.0716]
imp. penet.*post96	-0.0102	0.0842**	-0.0518
	[0.0598]	[0.0410]	[0.0680]
WC*post96	0.0454**	0.0518***	0.0483**
	[0.0190]	[0.0158]	[0.0202]
WC*imp. penet.*post96	0.1290	0.1427**	0.0656
	[0.0778]	[0.0634]	[0.0571]
N	28,000	26,003	24,251

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

Tab. 8: Effect of the service sectors deregulation experiment on returns to skill

	Overall	Overall Short-term exp.	Stayers	Overall + sect. var.
log(firm size)	0.0180***	0.0117***	0.0091**	0.0179***
	[0.0021]	[0.0026]	[0.0035]	[0.0021]
white collar (WC)	0.0263**	0.0209	0.0117	0.0879
	[0.0102]	[0.0199]	[0.0153]	[0.0766]
WC* PMR	-0.0022	-0.001	0.0012	-0.0061
	[0.0031]	[0.0042]	[0.0038]	[0.0041]
WC*post99-01	0.1196***	0.1073***	0.1129***	0.1296***
	[0.0108]	[0.0117]	[0.0122]	[0.0125]
PMR*post99-01	0.0005	0.0013	-0.0017	0.0028
	[0.0059]	[0.0044]	[0.0062]	[0.0071]
WC*PMR*post99-01	-0.0072	-0.0078**	-0.0064	-0.0041
	[0.0048]	[0.0033]	[0.0049]	[0.0054]
N	66,412	24,053	66,412	63,801

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.

Source: elaborations on AD-SILC data

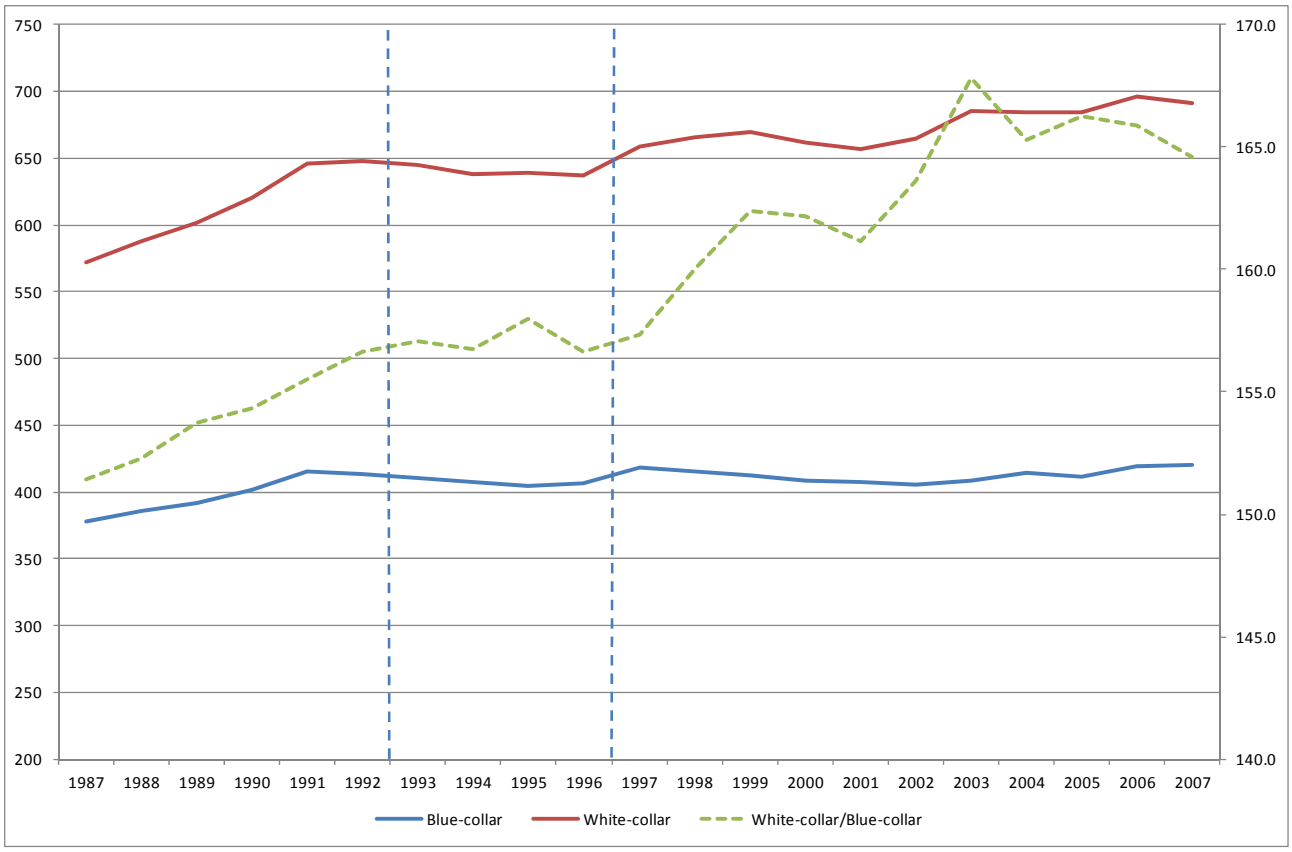
Tab. 9: Effect of the service sectors deregulation experiment on returns to skill by classes of firm's size

	Small firms	Medium firms	Large firms
log(firm size)	0.0160***	0.0258***	-0.0076
	[0.0036]	[0.0067]	[0.0099]
white collar (WC)	0.0856***	0.0252	-0.0345*
	[0.0219]	[0.0210]	[0.0202]
WC* PMR	-0.0241***	-0.0089	0.0087
	[0.0069]	[0.0071]	[0.0068]
PMR*post99-01	0.1050***	0.1054***	0.1339***
	[0.0252]	[0.0154]	[0.0154]
WC*post99-01	-0.0039	-0.0077***	0.005
	[0.0032]	[0.0027]	[0.0110]
WC*PMR*post99-01	0.0004	0.0048	-0.0154*
	[0.0091]	[0.0073]	[0.0082]
N	23,938	22,122	20,352

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.

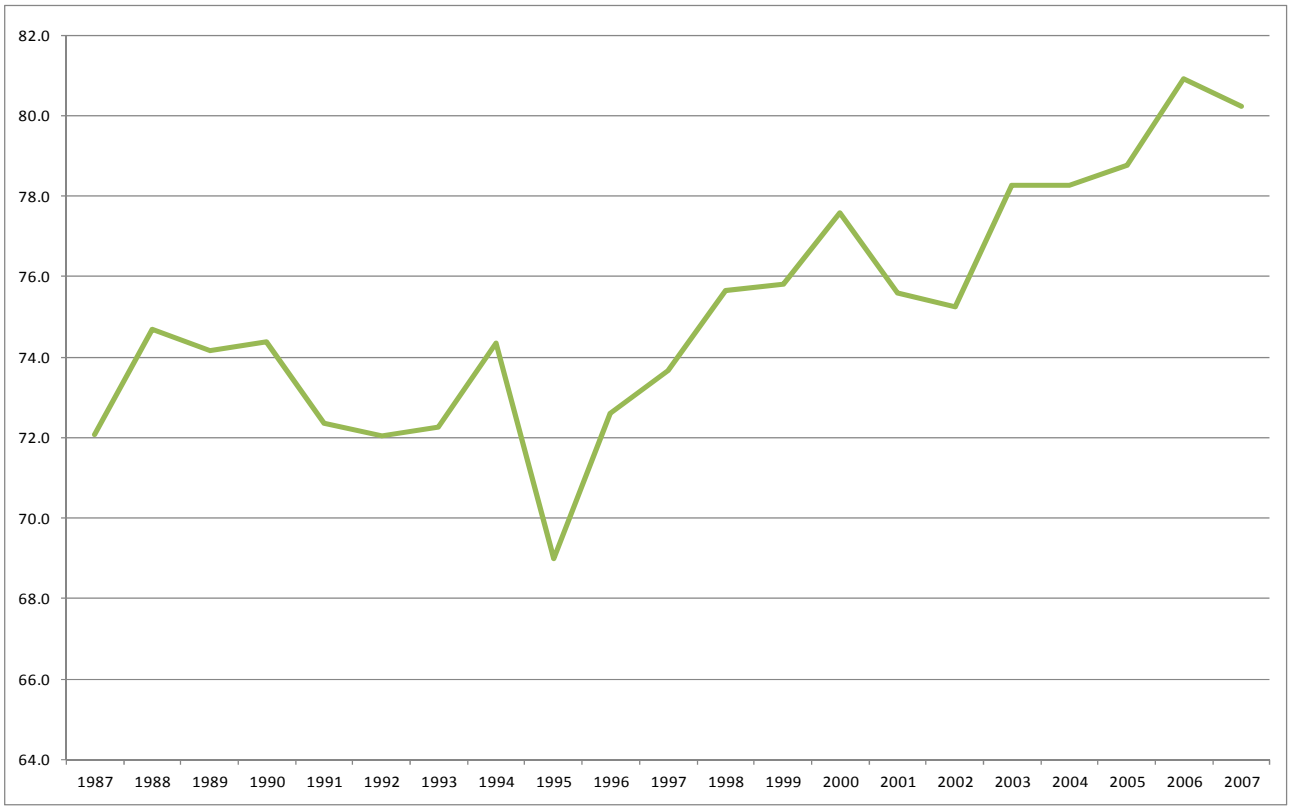
Source: elaborations on AD-SILC data

Fig. 1: Trend of mean weekly gross wages in Italy by employees' skills (left axis) and of skill premium for white collars (Index number: blue-collars mean weekly gross wage=100; right axis)



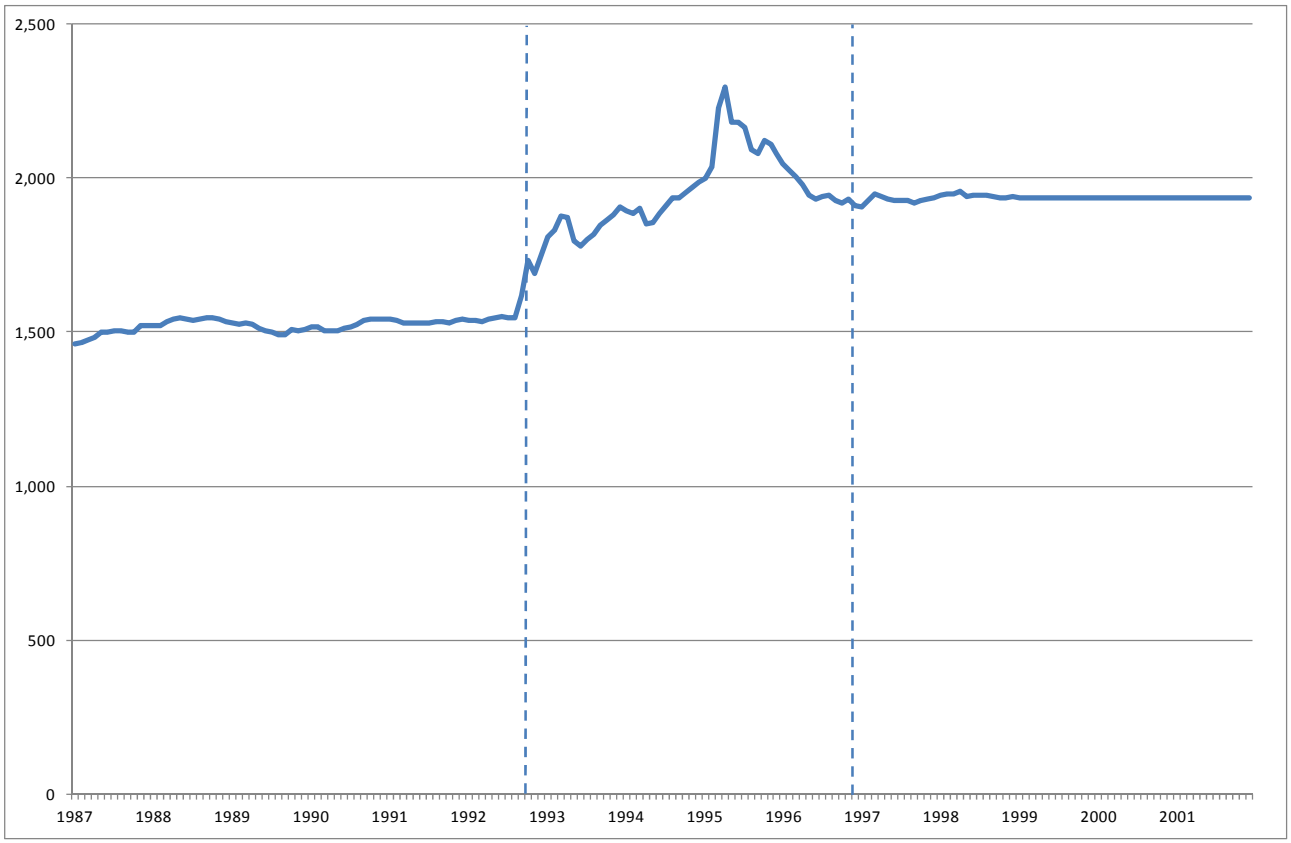
Source: elaborations on AD-SILC data

Fig. 2: Trend of the share of Theil index of wage inequality due to within sectors inequality.



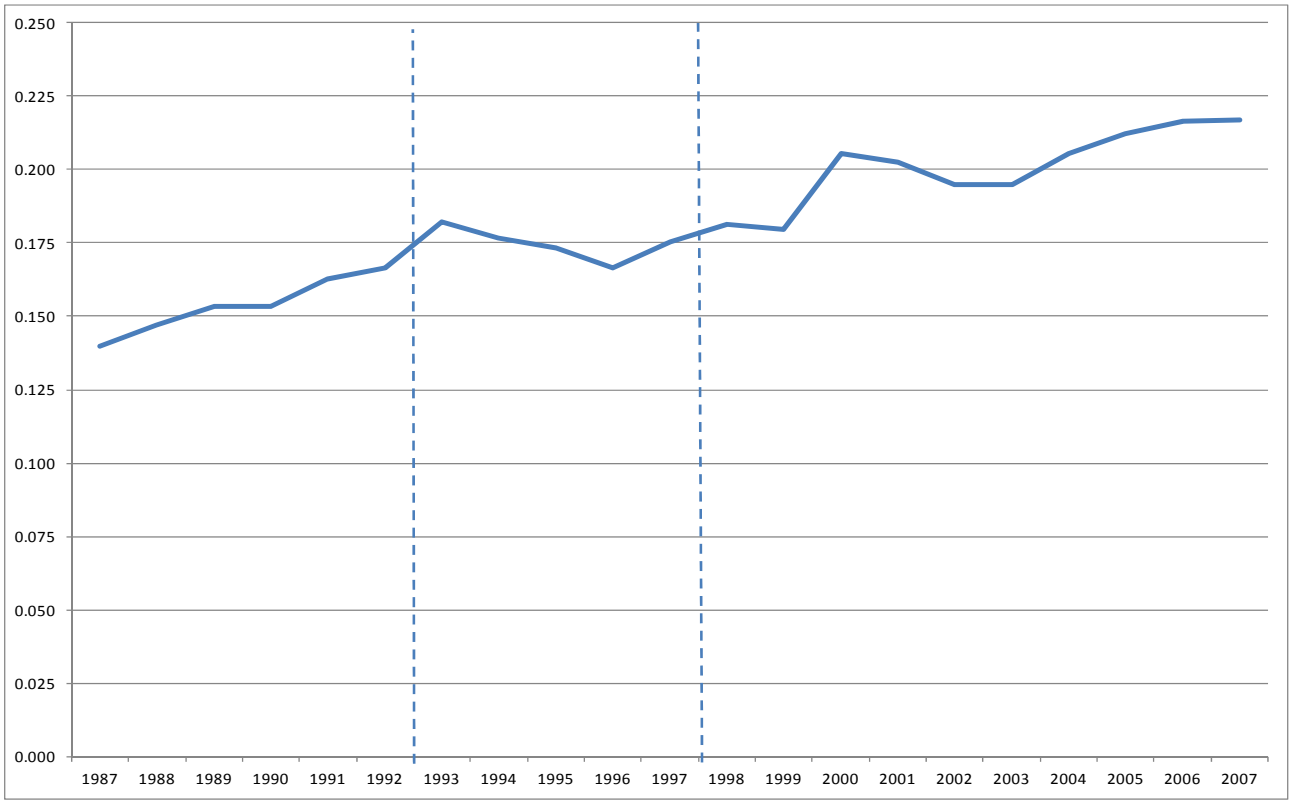
Source: elaborations on AD-SILC data

Fig. 3: Lira/ECU exchange rate: 1987-2001 (monthly data)



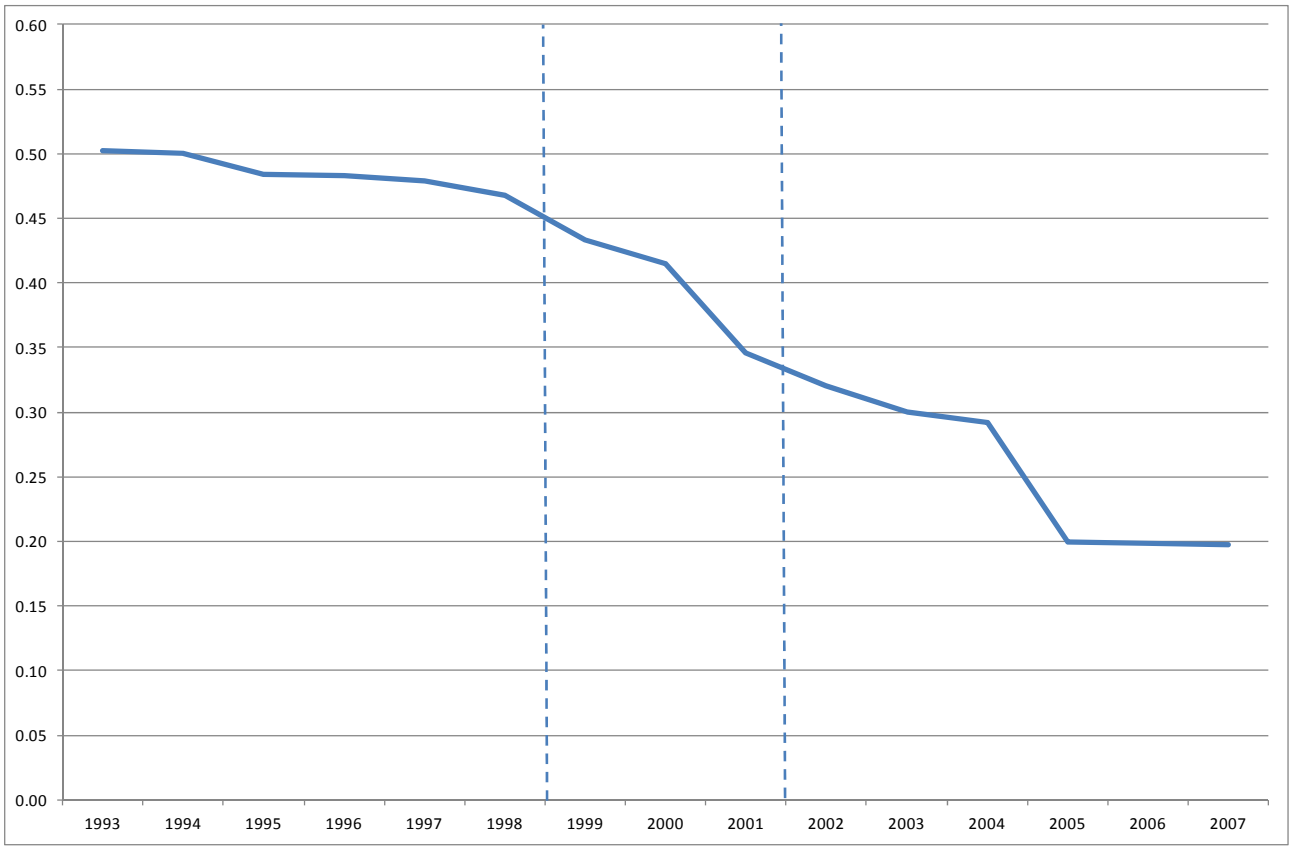
Source: elaborations on EUROSTAT data

Fig. 4: Trend of the average import penetration index in Italy



Source: elaborations on OECD data

Fig. 5: Trend of the PMR index in the sectors characterized by the deregulation process.



Source: elaborations on OECD data

Appendix

In this Appendix we show the results of the "overall" model of Tables 4, 6 and 8, carried out replacing the occupational dummy WC with a proxy of worker's skills built interacting occupation and education. In detail, we build a variable with three categories: high skilled workers (tertiary graduates, independently on their job, and upper secondary graduates working as white-collars), middle skilled workers (upper secondary educated working as blue-collars and at most lower secondary educated working as white-collars) and low skilled workers (at most lower secondary educated, working as blue-collars), that is the omitted category in Table A1. As in the main Tables, competition changes are identified by the values of the import penetration index in the two external shocks (1992 and 1996), while PMR is used as exposure variable for the domestic shock.
The key variables of interest are the interactions between the competition proxy, the post shock dummy and medium (or high) skill dummies. It is worth noticing that, consistently with Guadalupe (2007), the effect of competition on returns to skills affects only the high skilled (compared to both medium and low skilled), whereas no significant increases emerge for middle skilled compared to low skilled.

Tab. A1: Effects of three experiments on returns to skill considering a different proxy of skills

	3 skill groups, import pen. post 1992	3 skill groups, import pen. post 1996	3 skill groups, PMR post 1999-2001
log(firm size)	0.0215***	0.0175***	0.0181***
	[0.0024]	[0.0024]	[0.0021]
competition*post shock	0.0388	0.0035	-0.0011
	[0.0384]	[0.0315]	[0.0050]
med. skill	0.0361**	0.0516***	0.0749***
	[0.0179]	[0.0138]	[0.0119]
high skill	0.0913***	0.1086***	0.0988***
	[0.0268]	[0.0205]	[0.0157]
med. skill* competition	0.0229	0.0033	-0.0048
	[0.0402]	[0.0495]	[0.0056]
high skill* competition	0.0305	-0.0956*	0.0002
	[0.0505]	[0.0537]	[0.0045]
med. skill*post shock	0.0206**	0.0155	0.0217***
	[0.0085]	[0.0137]	[0.0080]
high skill*post shock	0.0701***	0.0690***	0.1314***
	[0.0091]	[0.0127]	[0.0137]
med. skill* competition*post shock	-0.0284	0.0111	0.0041
	[0.0404]	[0.0498]	[0.0032]
high skill* competition*post shock	-0.0823**	0.0887**	-0.0042
	[0.0375]	[0.0396]	[0.0035]
N	57,881	78,254	66,412

Robust standard errors using sectors as cluster units. * p<0.10; ** p<0.05; *** p<0.01.
Source: elaborations on AD-SILC data