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Offshoring and Immigrant Employment: Firm-level Theory and Evidence

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Offshoring and Immigrant Employment: Firm-level theory and evidence

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Abstract: We propose and solve a simple model of firm-level decisions to offshore production stages of lower skill intensity than that of activities that remain in the domestic location. In theory, offshoring is optimal only for the more productive among heterogeneous firms if it entails a fixed cost. In a large sample of Italian firms, offshoring - especially of intermediate production stages - is indeed more prevalent among firms that are larger and more productive, and is predicted by arguably relevant firm-level characteristics. We also document that offshoring decreases the share of unskilled employment in domestic production facilities as well as firms' propensity to employ immigrant workers, and we discuss the possible determinants and policy implication of the latter finding.

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1. Introduction

Offshoring of production to low-wage countries is often blamed for job destruction and immigrant inflows also appear to threaten the employment opportunities of unskilled workers in rich countries. The causes of these phenomena and the policy reactions motivated by employment and wage concerns are tightly related (as discussed in e.g. Jones, 2005). Liberalization of trade in goods triggers relocation of production from advanced to less developed countries if foreign labor costs are low. But the extent to which foreign wages fall short of domestic ones also affects migration incentives, and reflects obstacles to migration flows. If immigration affects domestic wages and employment (as discussed in Borjas 2003, Ottaviano and Peri 2005 and 2006 and in Peri and Sparber 2007) , it also influences the attractiveness of offshoring options, and the viability of manufacturing production in developed countries.

This paper takes empirical and theoretical steps towards a better understanding of firm-level links within this intricate set of interactions. A survey of Italian manufacturing firms makes it possible to assess firm-level relationships between the size and skill intensity of employment, size and productivity, the share of foreign born workers and offshoring decisions. The descriptive statistics we examine in Section 2 indicate that only some firms offshore production, that these firms are larger and more efficient, and that they employ a larger share of white-collar workers and relatively fewer foreign-born workers. While immigrant employment and offshoring tend to correlate positively across Italian provinces, clustering in those where manufacturing activity is strong, the firm-level negative relationship between the two indicators and discreteness and heterogeneity of individual choices observed in the data suggest a modeling perspective focused on firms. Within this perspective it is possible to analyze how firm-specific sources of competitiveness determine choices between configurations characterized by different marginal and fixed costs, like domestic and foreign production.

In Section 3 we specify a model of firm-level decisions to offshore portions of the production process. We adapt to the purpose insights drawn from the recent literature focused on the role of unobserved competitiveness in shaping heterogeneous firms' international activities. Our model adopts many ingredients of key contributions to this literature, briefly reviewed below, and extends it to characterize the skill composition of employment as well as of the size distribution of firms in terms of sales and of employment. Since offshoring entails a fixed cost, it is optimal only for highly productive (hence larger) firms. And to the extent that offshoring is meant to take advantage of different wage structures in domestic and foreign locations, it should be associated with differences in the skill intensity of domestic employment.

Section 4 confronts these theoretical implications with the data. Controlled regressions confirm that firms that do offshore some of their production activities have a larger share of skilled personnel in their remaining home activities. The data also indicate that such firms employ relatively few immigrant workers. Our modeling perspective can explain such evidence if the share of unskilled workers is larger among immigrants than among natives, as is realistic in Italy (see Murat and Paba, 2004). We find that offshoring is empirically related to employment of immigrants even after controlling for firm-level employment's skill composition. This could be so because the skills of migrants differ from the skills of local workers along more detailed dimensions than that of the rough indicators (white and blue collars) available in standard data. Indeed, recent works on the US show that even among low skilled workers, specific tasks require different sets of skills and that immigrant workers tend to specialize in manual tasks rather than in interactive and language intensive ones (Peri and Sparber, 2007).

Section 5 concludes reviewing how our firm-level results bear on more general interactions between offshoring and immigration. Evidence of a negative relationship between hiring of migrant workers and offshoring at the firm level has potentially important implications for the interaction between policies ruling migration flows and affecting firms' competitiveness and the incentive to offshore. Restrictions to the inflow of unskilled migrants not only increase incentives to offshore, but also jeopardize the profitability of firms that are unwilling to pursue the offshoring option and require unskilled workers at home. Symmetrically, recent calls in Europe and in the US for measures penalizing firms that offshore production may deprive domestic industries firms of an important strategic option, slow down the pace of transition of manufacturing towards high value added activities, and increase the demand for unskilled migrant workers.

1.2. Related literature

Much has been written on the impact of offshoring and other forms of internationalization on the relative demand for skills. In a representative-firm Hecksher-Ohlin framework, Helpman (1984), Helpman and Krugman (1985), Feenstra and Hanson (1996) show that fragmentation leads to an increase in the relative demand for skills and in wage differentials in the North. Many empirical studies have tried to estimate these effects on data where the wage gap between skilled and unskilled workers in advanced countries grows in parallel with flows of imports of manufactured products from developing countries. This literature generally measures offshoring either on the basis of input-output tables or of trade data (by looking at intraindustry trade) or by combining the two. Some consider the aggregate of all imported inputs; others distinguish between inputs originating from developing countries and from industrialized countries. Usually, a translog cost function specification is estimated, adding measures of offshoring and of technical change or R&D investment to control for the effect of skilled biased technical change on the skilled-labor cost share. Feenstra and Hanson (1996a, 1996b and 1999) and many follow-up studies on US data find evidence of a role for offshoring that is sizable, if not as important as that of technical change, in determining increases in the wage share of skilled workers.[1]

We build on a recent highly influential strand of literature, reviewed in Helpman (2006), which studies the role of heterogeneous firm-level competitiveness in shaping international activities. Melitz (2003) and Helpman, Melitz, and Yeaple (2004) focus on the choice of the output market (home vs. foreign) and of how to serve it (exports vs. FDI); Antras and Helpman (2004) on the choice of where to source inputs (inshoring vs. offshoring) and how (insourcing vs. outsourcing); Grossman, Helpman and Szeidl (2006) explore the joint choice of both internationalization patterns. In the equilibrium of these and other models, only the more productive firms find it optimal to engage in international activities entailing a fixed cost.[2] Our main focus is on the choice to offshore part of the production process to a foreign country. We model the choice in terms of a tradeoff between lower production costs in the foreign location and the cost of coordinating fragmented production (see Helpman and Krugman, 1985; Jones and Kierzkovski, 1990; Jones, 2005 for discussions of the structure of such costs).

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[1] Slaughter (2000) is also on the US; Ekholm and Hakkala (2005) on Sweden; Egger and Egger (2003) on Austria; Anderton and Brenton (1998) and Hijen, Gorg and Hine (2005) on the UK; Helg and Tajoli (2005), on Italy and Germany; Falk and Koebel (2002) also on Germany and Strauss-Khan (2003) on France. Amiti and Wei (2005a,b) on the US and the UK look at the effects on total labor demand and productivity of service offshoring; Egger and Egger (2006) examine the effects on the productivity of low skill workers.

[2] In other models heterogeneity in the access into the export market is not driven by fixed costs. Bernard, Eaton Jensen and Kortum (2002) obtain heterogeneity in the decision to export by assuming a model of Bertrand competition and Melitz and Ottaviano (2005) by using linear demand systems across a continuum of varieties.

We disregard organizational choices and assume a single integrated output market, in order to focus on the impact of offshoring on the level and skill composition of employment in domestic plants.[3] Yeaple (2005) similarly aims at characterizing the interaction between international activities and domestic employment, in the presence of firm and/or worker heterogeneity. We focus on imperfect substitutability across different type of labor, however, while Yeaple models worker heterogeneity in terms of efficiency units and shows that firms engaged in international activities endogenously employ more sophisticated technologies and more productive workers.

Our empirical analysis focuses on relationships between offshoring and the demand for skills at the firm level, rather than at the industry level. Few earlier papers exploit firm or plant specific evidence and, to the best of our knowledge, none specifically relates a broad measure of offshoring to the structure of the work force. Gorg and Hanley (2004) examine the effect on total labor demand for a sample of Irish plants by estimating a dynamic employment equation where offshoring (measured by imported intermediates) is introduced as a demand shifter. They find that offshoring has a negative effect on short term plant-level labor demand. Head and Ries (2002) and Hansson (2005) consider more directly the effects on the skill composition of the labor force, for Japan and Sweden respectively. But these studies are based on the activities of multinational firms. Measuring offshoring as the size of the foreign activities and estimating short run labor demand derived from translog cost functions, both studies find that the skill intensity of home activities increases with the share of foreign activities carried out in labor intensive countries.

The focus of this paper on skill intensity also makes it possible to characterize the link between offshoring and employment of migrant workers, insofar as it is related to the skill structure of the firm. The relevant literature has mostly focused on whether migrant flows and FDI are substitute or complements for a given location (country, province, region etc.) or pair of locations and has not looked at this link within firms. Some among these studies are Murat and Paba (2004) on Italy, Buch et al (2005) on Germany, Kirkegard (2005) on outsourcing of

[3] Other theoretical contributions analyze the link between offshoring and the demand for skills in representative-firm settings. See Jones and Kierzkowsky (1990) and Jones (2005). Egger and Egger (2003) also examine whether the effect is different under a competitive or a unionized labour market for unskilled workers. Markusen (2006) also studies how standard theories of international trade and FDI can explain the effects of the off-shoring of high skilled services.

services and immigration in the US, Aroca and Maloney (2005) on Mexico. Empirically, the inflow of migrants in a given location is typically found to be related to a reduction of outward investment or even an increase in inward investment. Such substitutability may be explained by factor cost effects within a standard Hecksher Ohlin model with competitive markets and no frictions, or brain drain factors driven by the complementarity between human capital and investment, or networking effects as migrants attract investment to their country of residence from their country of origin (although Kugler and Rapoport (2005) and Docquier and Lodigiani (2006) show that networking effects may also work in the opposite direction). Alternatively it could simply be driven by other variables like the size of markets and cultural and geographical proximity, which are factors of attraction for both FDI and migration flows.

2. Data and descriptive statistics

We analyze the Capitalia survey of 4289 Italian manufacturing firms, carried out in 2004 with current and retrospective yearly information for 2001-2003.[4] Like the earlier waves of a long-running series of similar surveys, the dataset includes all Italian firms with more than 500 employees as well as a representative sample of smaller firms, stratified on geographical area, industry, and size. Besides standard firm specific variables, including balance sheet entries, the data also report detailed information on international activities. As regards the relationship between internationalization and firm characteristics, the data appear to conform to similar datasets from other countries. Benfratello and Razzolini (2007), for example, find that larger and more productive firms are more likely to export some of their production and to produce abroad in order to serve foreign markets. Crucially for our purposes, the survey features additional detail as to the size and purpose of each firm's foreign operations, including information as to whether foreign operations are meant to supply intermediate parts, and data on the composition of domestic employment include the percentage of foreign workers.

[4] In the empirical analysis we excluded form the sample firms with incomplete information or with extreme observations for the variables of interest. The Data Appendix outlines the sample selection procedure in detail.

Table 1 reports descriptive statistics for the main variables used in the empirical analysis. The distributions of sales, valued added, and employment is heavily skewed, and the ratios of sales and value added to total employment are very heterogeneous across firms. Skill levels are also highly heterogeneous across firms: the interquartile range of white-collar employees as a ratio of total employment is in the order of 20 percentage points.[5] Finally, and very importantly for our purposes, we see, still in Table 1, that foreign workers are a rather small fraction of total employment (3.8% on average) but are highly dispersed across firms. While more than 50% of surveyed firms report no foreign employees, we see that 25% of the observations report at least 4.3% foreign employment (and 10% of the firms report a share higher than 10 percent).

We will be interested in exploring the relationship of these dimensions of heterogeneity to each other, and to firm-specific indicators of activity offshoring and labor force composition. Roughly 7.5% of the firms report that some of the production included in sales occurs in other countries; among these, 38% state that offshored production accounts for less than 10% of sales, 43% that it accounts for between 10 and 50%, and 19% that it accounts for over half of sales.

Not all offshoring is alike. Using input-output information, Daveri and Jona-Lasinio (2007) detect sizable differences in the association with productivity of offshoring of intermediates rather than services. The survey we analyze elicits information as to the motivation and destination of international production activities. Among firms that do offshore some activities, 72% state that lower labor costs as one of the two main reasons for doing so, and another 35% cite the need to avoid being priced out of the output market; only 22% view offshoring as a way to reduce costs of foreign market penetration. Romania is the destination country for 31% of the offshoring firms, China is the next most frequent at 21.5%, and virtually all countries mentioned in the survey as offshoring destinations are at much lower levels of development than Italy.

We define a dummy taking the value one when some offshoring activity is observed, and refer to such observations as 'offshoring firms.' Among such firms, we single out those that indicate both that the portion of their sales that is produced abroad includes intermediates (thus

[5] Another survey question refers to the number of specialized (plant managers and technicians) blue-collar employees. These are rather often reported to be absent or to coincide with total blue-collar workers, which may spuriously reflect survey respondents' inability or unwillingness to provide more precise information. , Indicators based on this variable proved uninformative when used alongside or in place of the standard white/blue collar distinction in regressions such as those reported below.

excluding those that offshore only production of finished products, and may be motivated by market proximity considerations rather than by production cost savings) and that some of their offshoring activities are re-imported. We refer to these as the 'restricted sample' of offshoring firms. As we shall see, these are slightly more different from non-offshoring firms in ways consistent with the modeling perspective we propose below.

Table 2 displays the main descriptive statistics separately for non-offshoring firms and for offshoring firms. On average, relative to other firms, offshoring firms are about three times larger in terms of sales and less than three times larger in terms of employment. Sales per employee are some 15% higher. This is to a large extent an obvious reflection of the fact that sales include production performed by the employees of foreign plants, on which we have no information. More interestingly, the value added per employee of offshoring firms is some 2% higher than that of non-offshoring firms, and the former employ a much larger share of white collar workers.[6] Offshoring firms also employ fewer extra-EU workers. All such differences are larger if the comparison focuses on a "restricted sample" of firms that offshore only a portion of their manufacturing process and therefore perform in their domestic plants at least some variable-cost production activities.

Availability of both immigrant employment and offshoring information offers a rare opportunity to assess empirically the relationship between the two phenomena. Our analysis will be focused on firm-level information, but will need to account and control for market-level interactions. To document the importance of those interactions, Table 3 reports the results of descriptive regressions of the offshoring dummy and of firm-level foreign employment share on a province-specific indicator of industrial 'competitiveness': the share of manufacturing employment on total employment. That indicator, the incidence of offshoring, and employment of immigrants are positively and very significantly correlated, suggesting that province-level factors play an important role in shaping labor cost considerations and immigration incentives[7].

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[6] The skill composition of the domestic labor force of offshoring firms may well be a reason why offshoring of manufacturing activities is associated with higher productivity of (not quality adjusted) labor, and why this is not the case when offshoring of services can be singled out (Daveri and Jona-Lasinio, 2007): services are likely performed by high value-added white-collar workers within manufacturing firms, and measured productivity will tend to be lower when such activities are performed elsewhere.

[7] Regional and firm level outcomes can be reconciled in intuitive terms. If efficiency triggers the choice of offshoring, in regions with a strong concentration of highly competitive firms there will be a larger share of them producing abroad. At the same time average wages will be higher and attract more migrants. However, for given

3. Production offshoring by heterogeneous firms

While the regional patterns documented in Table 3 indicate that stronger manufacturing industries are associated with more intense offshoring and immigration, firm-level evidence, indicate the potential relevance of exogenously heterogeneous competitiveness in determining both firm-level and market-level outcomes. The descriptive evidence of Table 2 is consistent with a data-generating mechanism that associates higher efficiency and stronger skill intensity to firm-level offshoring decision.

We proceed to formulate a model of firm-level decisions that delivers the two implications on the basis of economically sensible assumptions. First, we show that sorting of highly productive firms into offshoring can be explained if the reorganization of production needed to take advantage of lower marginal costs in foreign locations entails fixed costs. Second, we show that different skill intensities across the domestic activities of offshoring and non-offshoring firms are a natural consequence of foreign locations' comparative advantage in low-skill activities. In the next section we discuss how this may bear on the evidence, especially as regards employment of immigrant workers.

3.1 Firm–level heterogeneity and offshoring

As pointed out by Melitz (2003), a firm's intrinsic efficiency bears on its choice across production and sales modes with different fixed and marginal cost and benefits. In Melitz's original contribution, more efficient firms are better able to take advantage of market access, and more inclined to bear the fixed cost of equipping themselves to export. In this paper's context offshoring is more attractive for stronger firms if, at the same time as it makes it possible to tap into cheaper labor pool and decrease marginal costs, it entails higher fixed costs. Substantial fixed costs may in fact be entailed not only by foreign direct investment in wholly owned plants, but also by the negotiations and know-how required by arms-length outsourcing relationships. This implies that, among heterogeneous firms within an industry, the more productive ones will select themselves into offshoring. We suppose that offshoring costs are the same for all firms,

local conditions, only highly productive firms will offshore and these will employ relatively more skilled workers and implicitly less migrants.

and disregard the distinction between "insourcing" or "outsourcing" arrangements for production relocation.

To focus on international factor cost differences as the driving force of the offshoring decisions we wish to characterize, we suppose that a firm's inverse demand function is $p(y) = ay^{-\frac{1}{\sigma}}$, where $\sigma > 1$, a is an index of demand strength, and y denotes the firm's total production independently of where its plants are located. This means that offshoring decisions are not based on product market considerations, such as foreign market penetration. The demand-strength parameter a, to which we will occasionally refer as 'competitiveness' for brevity, may depend on the stage of the firm's product's cycle or other firm-specific market-position phenomena. For a given firm, however, it is independent of the production process and location, because output is sold on an integrated world market or is transported back to the firm's specific national market.

Production costs (net of transport costs) may instead be affected by offshoring if factor prices are different across locations. Postponing to the next subsection an explicit model of marginal cost determination, we suppose production costs to be linear in production and proceed to characterize how profit-maximizing firms with revenue function $yp(y) = ay^{1-\frac{1}{\sigma}}$ choose the location and level of production if marginal and fixed costs depend on whether production is wholly domestic or is partly offshored.[8]

Let marginal cost $c(o_i)$ be independent of scale, but take different values depending on whether firm i offshores part of its production activities (indicated by o_i=1) or performs all of it domestically (o_i=0). And let the firm's fixed cost of production $f(o_i, m_i)$ similarly depend on the offshoring vs. domestic production choice, as well as on other firm-specific factors indexed by m_i.

Within each production regime o_i, maximization of profits

$$\Pi(y_i, o_i) = a_i y_i^{1-\frac{1}{\sigma}} - [f(o_i, m_i) + c(o_i, m_i) y_i]$$

requires that price, $a_i y_i^{-\frac{1}{\sigma}}$, be equal to marginal cost $c(o_i)$ times the mark up factor $\sigma/(\sigma-1)$.

[8] This functional specification represents monopolistically competitive firms producing differentiated goods, but can also be reinterpreted in terms of decreasing returns to production at the level of the firm.

The corresponding output is

$$y_i^* = \left(\tfrac{\sigma}{\sigma-1}\right)^{-\sigma} \left(c(o_i)/a_i\right)^{-\sigma} \quad . \tag{1}$$

To decide whether to offshore, the firm compares maximized profit levels

$$\Pi(y_i^*, o_i) = a_i^{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}\frac{1}{\sigma}c(o_i)^{1-\sigma} - f(o_i, m_i)$$

across the wholly domestic (o_i=0) and partly offshored (o_i=1) configurations of its production process.[9] Offshoring is optimal for a given firm if the unit cost difference implies a large enough operating profit difference to cover the fixed cost difference,

$$\left(a_i\right)^{\sigma}\left(c(1)^{1-\sigma} - c(0)^{1-\sigma}\right) > \sigma^{\sigma}\left(\sigma-1\right)^{1-\sigma}\left(f(1,m_i) - f(0,m_i)\right) \ ,$$

i.e. if a_i is so large that the additional profits from lower marginal cost at least cover the fixed cost difference.

Hence, the model predicts that among firms with similar cost structures but heterogeneous competitiveness offshoring is only observed by firms whose a_i exceed a critical level

$$\underline{a} = \exp\left[\left[\ln\left(\sigma^{\sigma}\left(\sigma-1\right)^{1-\sigma}\left(f(1,m_i) - f(0,m_i)\right)\right) - \ln\left(\left(c(1)\right)^{1-\sigma} - c(0)^{1-\sigma}\right)\right]/\sigma\right], \tag{2}$$

which depends intuitively on offshoring's impact on fixed and marginal costs. We model next how technology and labor costs bear on these aspects of the firm's cost structure.

3.2 Offshoring and the skill intensity of production

To model the relationship between the firm's offshoring choices and costs, we suppose that production involves two distinct stages, dubbed 'components' and 'assembly' in what follows. We make the simple definitional assumption that production of a unit of final output requires components and assembly activities in fixed proportions. But we allow each of the two stages of production to use skilled and unskilled labor in flexible proportions, and we allow wages of effectively equivalent labor to differ across locations (because barriers to migration and trade prevent factor price equalization).

[9] If the strength indicator *a* is so low as to imply that profits are negative for both offshoring choices, then the firm should shut down.

Adopting Cobb-Douglas functional forms, let x units of skilled labor and z units of unskilled labor produce the components of $Gx^{\gamma}z^{1-\gamma}$ units of output. If a unit of skilled labor costs s and a unit of unskilled labor costs u, a cost-minimizing firm therefore uses $x_{\gamma}=\frac{1}{G}\left(\frac{1-\gamma}{\gamma}\frac{s}{u}\right)^{\gamma-1}$ skilled workers and $z_{\gamma}=\frac{1}{G}\left(\frac{1-\gamma}{\gamma}\frac{s}{u}\right)^{\gamma}$ unskilled workers to produce the components of a unit of output, at total cost

$$\frac{1}{G}\left(\frac{1-\gamma}{\gamma}\frac{s}{u}\right)^{\gamma-1}s+\frac{1}{G}\left(\frac{1-\gamma}{\gamma}\frac{s}{u}\right)^{\gamma}u=\left(\frac{1}{\tilde{G}}\right)(s)^{\gamma}(u)^{1-\gamma}\text{, where }\left(\frac{1}{\tilde{G}}\right)\equiv\left(\frac{1}{G}(1-\gamma)^{\gamma-1}\gamma^{-\gamma}\right). \qquad (3)$$

We similarly suppose that the production function $Ax^{\alpha}z^{1-\alpha}$ implies employment of $x_{\alpha}=\frac{1}{A}\left(\frac{1-\alpha}{\alpha}\frac{s}{u}\right)^{\alpha-1}$ skilled workers and $z_{\alpha}=\frac{1}{A}\left(\frac{1-\alpha}{\alpha}\frac{s}{u}\right)^{\alpha}$ unskilled workers to assemble a unit of output. The marginal cost of assembly activities is therefore given, as a function of wages, by an expression similar to that of equation (3), in terms of A and α rather than G and γ.

Wage rates, w_{pj}, differ not only across the skill levels ($p=s$ or u, for skilled and unskilled) but also across the possible locations ($j=d$ or f, for domestic and foreign) of the workers engaged in producing the firm's output. Our functional form and wage structure assumptions imply that marginal cost can be expressed, as a function $c(w_{sd},w_{ud},w_{sf},w_{uf},o_i)$ of domestic and foreign skilled and unskilled wages, and of the offshoring indicator o_i (equal to 1 if the firm offshores some of its production, to zero if it performs it all domestically):

$$c(w_{sd},w_{ud},w_{sf},w_{uf},0)=\left(\frac{1}{\tilde{G}}\right)(w_{sd})^{\gamma}(w_{ud})^{1-\gamma}+\left(\frac{1}{\tilde{A}}\right)(w_{sd})^{\alpha}(w_{ud})^{1-\alpha},$$

if all production facilities are local, and as

$$c(w_{sd},w_{ud},w_{sf},w_{uf},1)=\left(\frac{1}{\tilde{G}}\right)(w_{sd})^{\gamma}(w_{ud})^{1-\gamma}+\left(\frac{1}{\tilde{A}}\right)(w_{sf})^{\alpha}(w_{uf})^{1-\alpha}$$

if assembly takes place offshore.

If offshoring entails higher fixed costs, in order to be potentially optimal it must imply lower marginal cost. Imposing that ranking on the marginal cost expressions requires that the wage of effective labor abroad should be sufficiently lower than domestic wages to satisfy the condition

$$(w_{sf})^{\alpha}(w_{uf})^{1-\alpha}<(w_{sd})^{\alpha}(w_{ud})^{1-\alpha}. \qquad (4)$$

For a given firm, the lower marginal cost of offshored production increases the output level according to equation (1). The effects of offshoring on output and employment are interestingly different. For a given firm, offshoring is associated with larger output inasmuch as it decreases marginal cost; it has ambiguous implications for domestic employment, however, because while relocation of "assembly" lowers the local labor input requirement of each unit of final output, as more output is produced employment may increase in the "components" activity that remains domestic.

The implications for the composition of employment are however unambiguous if, as is realistic, the "assembly" production activities that may be performed offshore have lower skill intensity ($\alpha < \gamma$). We illustrate and elaborate on these results in the next subsection.

3.3 Observable implications

Figure 1 illustrates firm-level relationships between 'competitiveness', employment, and offshoring. The plots report (as dashed and dotted lines) theoretical relationships conditional on whether production is offshored or not. The circles refer to a sample of firms drawn from a lognormal distribution of competitiveness *a* (measured on the horizontal axis of panels A and C in the figure; to improve legibility, a small amount of unrelated noise is added to the variables implied by each draw of *a*). The firms that offshore production are those whose *a* draw is larger than the threshold defined in equation (2). Since offshoring entails a fixed cost and the parameters satisfy condition (4), offshoring firms have lower marginal costs and, as shown in panel A of Figure 1, are unambiguously larger in terms of production and sales: the selection into offshoring of exogenously more competitive firms reinforces the positive association between offshoring and production levels induced by the lower marginal cost of offshored production.

Panel C illustrates the implications of offshoring outcomes for firms' domestic employment levels. Since the lower marginal cost of an offshoring firm increases production at the same time as it decreases its domestic labor requirements, offshoring is in general ambiguously related to domestic employment. For the parameters used in plotting the Figure, we see in panel C that at a given level of exogenous competitiveness *a* offshoring reduces the size of firms in terms of employment: it increases their size in terms of sales in panel A, but not by enough to offset the lower domestic labor requirement of offshored production. But even after the parameters have pinned down a negative impact of offshoring for a given firm's size, the model yields an interestingly ambiguous cross-sectional association between employment levels and the actual, endogenous offshoring choices of heterogeneous firms. Since more competitive (and likely larger) firms selected into offshoring by fixed costs, in panel C the more competitive non-offshoring firms are larger in terms of employment than the least competitive offshoring firms.

As to the observable implications of firm heterogeneity and offshoring choices, we see in panel B of Figure 1 that offshoring firms are larger in terms of sales, but not necessarily in terms of domestic employment, and quite intuitively display higher sales/worker ratios. In reality as in the model, only some of the firms that operate in a given labor and product market offshore production. The model interprets these outcomes in terms of heterogeneous firm-level efficiency or 'competitiveness,' and predicts that firms that offshore a portion of their production activities should be larger in terms of output and sales but may or may not be larger in terms of local employment.

Figure 2 is of particular interest to our purpose. It illustrates the more detailed and informative implications of our model for the relationship between offshoring, firm size, and skill intensity. Its panel A again illustrates the basic mechanism whereby the structure of fixed cost and marginal costs implies that offshoring firms produce and sell more than non-offshoring ones. The other three panels of Figure 2 illustrate the implications of the model's explicit treatment not only of the cost, but also of the skill structure of employment. For the parameters used in plotting the figures, the 'assembly' activities candidates for offshoring are much more unskilled-labor intensive than the 'components' activities that are always performed in the firm's domestic plant. Thus, in panel C the heterogeneous 'competitiveness' indicator a is related to unskilled employment (circles refer to firm specific observations of unskilled employment) in very different ways across offshoring and non-offshoring firms: for given a offshoring implies much lower unskilled employment, but it actually implies a *higher* level of skilled employment (plus signs refer to firm specific observations of skilled employment), because component production is sufficiently skill intensive with respect to assembly that offshoring increases a firm's sales (in panel A) so as to more than offset the loss of domestic skilled labor entailed by delocation of assembly.

Panels B and D of Figure 2 relate the level of sales (on their and panel A's vertical axis) to skilled and unskilled employment levels, respectively. In panel D, the ratio of (higher) sales to (lower) unskilled employment levels is much larger for offshoring firms. In panel C, sales per skilled domestic worker are actually smaller when production is offshored, and are not nearly as different across offshoring and non-offshoring firms: as both of these perform domestically the activities that employ most of their skilled workers, the relationship between sales and skilled employment is very similar regardless of whether less skill-intensive activities are performed domestically or abroad.[10]

4. Empirical evidence

The structure of our theoretical offshoring model is inspired by the descriptive statistics of Section 2, as well as by recent advances in modeling of related phenomena, and is therefore by construction compatible with some key empirical features. In the data, offshoring firms are larger, have larger sales/employment and value added/employment ratios, and employ a larger share of skilled workers in their domestic operations, especially when offshored production includes intermediate products to be re-imported and assembled, rather than finished products only. In the model laid out in Section 3, offshoring is motivated by cost savings rather than output market proximity and, since a portion of variable production activities remains domestic, offshoring firms may be larger in terms of overall domestic employment, and should employ more skilled and less unskilled workers than non-offshoring firms.

To assess the empirical fit of the model along less obvious dimensions, we first revisit the empirical relationship between sales and employment (of different skill levels) in a graphical format similar to that we have used to illustrate theoretical insights. Figure 3 displays descriptive regressions aimed at assessing the fit between our data and theoretical perspective. As shown in Figures 1.B, 2.B, and 2.D, firm sales and employment should be linearly related when the variation across observations is driven only by the firms' competitiveness indicator, a_i. In reality, the relationship is of course affected by other unobservable heterogeneity, and a log-linear relationship fits the data much better. The plots of actual and predicted sales as functions of employment in Figure 3 are qualitatively consistent with their theoretical counterparts in Figures

[10] This paper's model focuses on marginal labor costs and disregards the labor content of fixed costs, which is likely to consist predominantly of relatively skilled workers. The implications of offshoring for the composition of domestic 'headquarters' employment would be qualitatively similar to those we analyze explicitly.

1 and 2. Offshoring firms (marked by circles) visibly tend to be larger in terms of sales than non-offshoring firms (marked by dots). There is much more overlap across the distributions along the (horizontal) employment dimension. The effect of offshoring on the slope of the sales/employment relationship is positive, and much more pronounced for blue collars than for white collars: regressing sales on white collar employment and its interaction with the offshoring dummy indicates that, as suggested by Figure 2.B, the sales/skilled labor relationship is not very significantly affected by whether the firm offshored (unskilled-intensive) production activities.

The model of Section 3 explains in terms of fixed costs' relevance Section 2's descriptive evidence of offshoring choice discreteness and of (employment, sales, and value added) size differentials across offshoring and non-offshoring firms, that in the model reflect the role of firm-level competitiveness in determining how easily marginal cost savings may offset the fixed cost of organizing foreign production. The model also features a novel role for different skill intensity of the activities that may or may not be offshored, and can explain differences across the two groups of firms in terms of employment composition. In what follows, we assess the statistical significance of these patterns, and attempt to provide more structural evidence of the model's fit, by specifying and estimating formal models that, unlike graphical illustrations, make it possible to controlling for observable heterogeneity across sectors an geographical location. To characterize the relationship between offshoring and migration, we estimate a system of two equations. The first one relates the (endogenous) offshoring outcome to other observable firm-level characteristics, and the second relates (instrumented) offshoring information to the structure of firms' employment.

4.1 Determinants of offshoring decisions

The fit between theory and evidence is qualitatively intriguing but, of course, far from perfect. In Figures 1 and 2 the distribution of intrinsic efficiency was assumed to be lognormal and only a modest amount of uncorrelated noise was added to artificial data. The distribution of sales and employment in the real data in Figure 3 is much more strongly skewed and, unsurprisingly, much noisier than the model illustrations. Our theoretical framework itself suggests reasons why this is the case, and ways in which noise may be reduced by controlled regression techniques.

In the theoretical model, the chief determinant of a firm's decision to offshore is its intrinsic 'competitiveness', indexed by the firm-specific a_i variable in the model. As Figures 1 and 2 make clear, this variable jointly determines the volume of sales, the size and composition of employment, and offshoring decisions. In practice, 'competitiveness' is not directly observable. It might in principle be estimated by standard production function methods, which however would be particularly problematic from a theoretical perspective where the factor intensity of production in domestic plants is naturally different across offshoring and non-offshoring firms. In fact, simple descriptive regressions that control for capital and intermediate inputs confirm the broad message of the regressions displayed in Figure 3, as regards the relationship between offshoring and the elasticities to blue and white collar employment. To account for production function heterogeneity across offshoring and non-offshoring firms, observable variables relevant to that choice could be used to endogenize selection of firms into different technologies, and improve estimation of production function parameters and TFP residuals. Estimating structural production functions would remain problematic on cross-sectional data, however, since simultaneity and unobserved heterogeneity would still be worrisome sources of bias for the resulting productivity indicators. In light of these problems, we choose to report results based on an admittedly simple minded approach to TFP estimation, controlling only for capital intensity on all data pooled in cross-section.

For our main purpose of detecting linkages between internationalization of production and domestic employment, we adopt the semi-structural approach of instrumenting the offshoring dummy with variables that plausibly drive offshoring but, for given offshoring, do not directly influence the composition of employment. In reality sales, employment, and offshoring depend on many more firm characteristics than just intrinsic efficiency. While the theoretical illustrations in Figures 1 and 2 kept those constant across firms, they are likely to vary across sectors and local labor markets in the data. To some extent this heterogeneity may be controlled by industry and geographical dummies. Moreover, it is possible to use the survey's information to try and control for additional dimensions heterogeneity that may select firms into the offshoring mode of operation.

At the firm level, for given competitiveness and given market conditions, the choice between offshored and domestic immigrant-intensive production may be driven by heterogeneity of the fixed costs of offshoring (as indexed by m_i in the model of Section 3). Some of the relevant variation may be observable, at least in principle: firms located near airports, or firms whose managers' previous career includes overseas postings, might well find it easier to set up and control offshore production facilities. These and other organizational features, however, can hardly be viewed as completely exogenous, since a firm that finds the offshoring option attractive for unobservable reasons might well choose its location or managers so as to make that convenient. Moreover, our data do not include location information beyond the provincial dummies that we include in our specifications to control for a myriad of phenomena, nor do the data offer information about the previous career or linguistic skills of managers.

The data do include survey questions meant to single out family firms: we know whether members of the owner's family are senior managers, and whether firms employ managers who are not members of the family. This information can arguably provide instruments for the purpose of detecting the implications offshoring decisions. It is hard to see how exploiting international production opportunities could have causal effects on the aspects of manager selection that reflect family histories and demographic developments (in our data, non-family managers are significantly and increasingly likely to be employed by older firms). But the presence of family and non-family managers arguably can affect a firm's propensity to offshore production, because less diversified family owners may well be more reluctant to risk and innovate than the managers of public firms,[11] and will affect offshoring costs if external managers are more likely than the entrepreneurs' offspring to have relevant skills.

Formally, let the offshoring $OS_i = 1$ outcome be observed if a latent variable $OS_i^* \geq 0$, while $OS_i = 0$ otherwise. We consider specifications for the latent variable in the form

$$OS_i^* = \alpha g(X_i) + \varepsilon_i \ , \qquad (5)$$

where $g(X_i)$ is a suitable function of a set of firm-level variables.

The first and third columns of Table 4 report the results of the estimation of reduced form probit models for offshoring outcomes that specify $g(Y_i)$ as a linear function of the TFP proxy for productivity, computed as the residual from the cross-sectional estimation of a two-factor Cobb-Douglas accounting for capital intensity and augmented with province and (2-digit NACE) industry dummies, to control for production-function and wage-driven relationships between

[11] Tucci, Barba Navaretti and Faini (2006) discuss how risk aversion in family firms may increase the perceived cost of carrying out risky foreign operations.

firms' production and sales. Like the less formal evidence reported in Table 2 above, these regressions indicate that offshoring is rather tightly related to productivity proxies in our data.

The other two columns of Table 4 specify $g(X_i)$ as a linear function of the arguably relevant determinants of offshoring decisions introduced above, namely the presence of family members and of others in the firms' top management. The explanatory power of these organizational indicators is also very high: the significantly negative coefficient of the FF dummy indicates that the presence of a family member reduces the management's propensity to offshore production, while the presence of external managers has the opposite effect. The two indicators are imperfectly correlated in our data: about a fifth of firms report employment of a single manager (and about one out of eight reports zero managers), but while the number and the share of external managers is positively related to the size of the firm, firms of all sizes may or may not employ non-family managers: among the firms that employ a single manager, for example, about a fifth report that the person is not a member of the owner's family (or the owner herself).

4.2 Offshoring, skill intensity, and immigrant employment

This evidence reported in the previous subsection is consistent with our theoretical model's focus on offshoring decisions driven (at a given market wage) by firm-level competitiveness and/or by determinants of offshoring costs. In the model, offshoring in turn affects the skill composition of employment, in that the activities which remain in the domestic country have higher skill requirements than those that may be performed abroad. To assess the realism of this implication we run regression in the form

$$\left(\frac{L_j}{L}\right)_i = \beta_1 OS_i + v_i \qquad (6)$$

where the dependent variable may be the ratio of skilled to total employees, or the ratio of foreign employees to total employment, in the domestic operations of surveyed firms. On the right hand side, the coefficient β_1 measures the relevance of offshoring in those respects.

If a single exogenous 'competitiveness' characteristic determined all aspects of firm heterogeneity, the offshoring indicator OS_i would be uniquely determined by firm-level efficiency. As mentioned, however, more than one dimension of relevant heterogeneity determines offshoring and employment in reality. The parameter of interest β_1 can be estimated consistently by OLS only if the unobservable determinants relegated to the error terms of (5) and (6) are not correlated, $E(\varepsilon_i \nu_i) = 0$. This however rules out the plausible possibility that unobserved firm characteristics may jointly affect the skill structure and nationality of the workforce and management's inclination to offshore. If, for example, entrepreneurs who discriminate against immigrant workers also like to internationalize their activities, then $E(\varepsilon_i \nu_i) < 0$ and the OLS estimates of β_1 will be biased downwards. More generally, the bias will depend on the correlation between the unobservables in (5) and (6).

To try and disentangle structural mechanisms from such spurious relationships, we estimate (6) by instrumental variables (IV), using the predicted propensity to offshore OS_i^* from the reduced-form relationship (5) to instrument the observed offshoring outcome.[12] Table 5 reports the results of OLS and IV regressions of the share of white collar employees on observed offshoring (OLS) and on instrumented offshoring (IV), using province and industry dummies to control for the effects of technological differences in the skill intensity of production activities and of locally determined wages.[13]

The positive sign of the coefficients is consistent with our theoretical perspective: if within each sector and province the production stages that may be offshored are low-skill intensive, firms that do offshore for the reasons we model should employ a larger share of high-skill workers. This is the case in all specifications, and the effect is stronger when estimated on the 'restricted' sample of firms that we expect to conform more closely to our theoretical perspective. The coefficients are larger when estimated by IV, indicating that unobservable reasons why a specific firm decides to offshore may indeed be related to the skill composition of its employment in ways that bias the OLS estimates towards zero.

The TFP-based IV estimates are implausibly large and rather imprecisely estimated. This may indicate that accounting capital stock information is too imprecise to allow estimation of production functions on cross-sectional data. The *a priori* more reliable identification strategy

[12] While the data do not deny the relevance of our productivity-based explanation to individual firms' offshoring decisions, it is of course impossible to rule out uncontrolled endogeneity bias. Egger and Egger (2003) use a formally similar approach to industry-level data, and model heterogeneity in terms of offshoring costs and incentives proxied by variables excluded from the determinants of employment's skill intensity.

[13] We report results of linear regressions. Specifications that account for the limited range of the dependent variable yield essentially identical results.

based on firm-specific organizational characteristics indeed yields smaller (if still quite large and highly significant) estimates for the response to offshoring decisions of the white collar component of employment.[14]

Recall that the descriptive statistics of Section 2 found immigrant employment to be negatively related to offshoring activity. The theoretical model of Section 3 only distinguished workers according to their skill, not to their national origin. If, at a given level of skill, immigrants are perfect substitutes for native workers, firms should be indifferent between hiring either, at a given market wage. This does not however deny that a relationship may be observed between offshoring and immigrant employment at the firm level, because within each firm's hiring pool the proportion of unskilled workers may differ across the immigrant and domestic components: if an unskilled worker is more likely to be immigrant than a skilled worker, the higher skill requirements of offshoring firms implies that immigrants should be a smaller fraction of their domestic employment.

In what follows we run regressions, controlling for (rough) firm-level skill indicators, meant to assess whether this simple statistical mechanism or more structural relationships underlie the observed correlation. Table 6 reports estimates of regressions in the form (6) with the share of immigrants as the dependent variable. If the reason why offshoring is related to immigrant employment is that unskilled workers are more likely than skilled workers to be immigrant, we expect a negative sign. This is the case in both OLS and IV estimates, again more strongly when the sample is restricted to firms that are more likely motivated by our theoretical model's mechanisms. All the IV coefficients are larger in absolute value, and similar across the different sets of instrumental variables. Evidence of downward bias in OLS coefficients again indicates that the unobservable (and unrelated to TFP and organizational instruments) component of what determines decisions to offshoring choices is negatively related, at the firm level, to the unpredictable inclination to hire immigrants (in simple words, entrepreneurs who for some reason prefer to outsource their activities abroad also, for equally unexplainable reasons, prefer

[14] Other productivity proxies, with additional controls or without attempting to account for capital, yield qualitatively similar results. When using as IVs firm-level investments in telecommunication (TLC) equipment, we have obtained reasonably plausible results (a point estimate around 0.2 for the offshoring dummy), which are however not easy to interpret. While efficient communications are arguably related to offshoring decisions, and TLC investments are less likely than more general technological investments (such as PCs) to directly affect the skill structure of the firm's domestic operations, they are likely to be jointly endogenous to production offshoring decisions.

not to hire foreign workers).

We consider next whether and how the mix of skills across the pools of migrant and domestic workers is different in ways that are not captured by our rough measures of the skill composition of the work force. To assess the extent to which offshoring and the resulting skill intensity of domestic activities account for the national origin of each firm's employees, we estimate regressions relating the share of migrant workers to the share of skilled workers as well as to off-shoring,

$$\left(\frac{L_E}{L}\right)_i = \beta_2\left(\frac{L_w}{L}\right)_i + \beta_3 OS_i + u_i \,, \tag{7}$$

where we again instrument the offshoring dummy with its predicted probability from estimation of (5). If both β_2 and $\beta_{3,}$ turn out to be significant, then offshoring affects the share of migrant workers both directly, and indirectly through the share of skilled workers. This is an indication that immigrants, as a group, are less well endowed with the skills that are used intensely in the domestic activities of offshoring firms. For example, if foreign white-collar workers lack the language and communication skills needed for coordination and quality control activities, the offshoring dummy can have a direct effect on the share of migrant workers, rather than only an indirect effect through the share of white-collar workers engaged in those and other activities.

The results are reported in Table 7. The offshoring dummy is significantly and negatively associated with the share of immigrants, both in OLS and in IV estimation. The IV estimates are again larger than OLS ones (but the coefficient is not significant when TFP is the instrument), and the estimated relationships are stronger when offshoring is defined in the more theoretically suitable "restricted" way.

Even after controlling for offshoring, there is strong evidence of a relationship between the skill composition of each firm's employment (as measured, albeit imperfectly, by the share of white collar workers) and the incidence of immigrant worker employment. This indicates that offshoring does on average substitute for immigrant employment. The skills of typical immigrants, on a finer scale than that of the available white vs. blue collar distinction, are likely to be different from those of typical native workers. If immigrants' characteristics are less useful in the stages of production that must be performed onshore then, independently from the white vs. blue collar skill structure of the firm's employment, offshoring is negatively related to the share of immigrants in domestic operations.

5 Conclusions and policy implications

This paper has explored the relationship between offshoring of production and employment of local, possibly immigrant workers. Aiming to characterize how firm-level mechanisms may induce positive or negative covariation between the two phenomena, we have focused on heterogeneous firms' profit-maximizing discrete choice of whether to offshore production. Our theoretical framework, inspired by recently developed modeling approaches, delivers intuitive implications for the amount and skill composition of domestic employment. Bringing these implications to bear on a large sample of Italian firms, we estimate economically sizable and statistically significant relationships between firms' characteristics and offshoring decisions. We find that the tendency of offshoring firms to employ a larger share of skilled workers only partly explains their lower share of immigrant employees.

These results offer indications of sensible and economically relevant tradeoffs between various means of ensuring viability of manufacturing industries in Italy. In a high-wage country, manufacturing firms should either be more 'competitive' (in terms of disembodied productivity or product market strength), or outsource production to countries where labor is cheaper, or hire similarly productive immigrant workers locally. Italy has seen a recent surge of external immigration flows and re-location of production to cheap labor countries. Both patterns have been and will be important in preserving (to some extent) the country's manufacturing competitiveness. Immigration can provide a suitable local supply of labor, and fragmentation of production and relocation to cheap labor countries can give firms sufficient competitive leeway to preserve part of their activities in Italy. Immigration and competitiveness are both influenced by a large and separate set of policies and institutions, whose implications should be evaluated jointly if, as we argue theoretically and show empirically, offshoring and employment of immigrants are intimately related along several possible dimensions.

Our approach and findings therefore may have important policy implications, and open promising directions of further research. In our model, the implications of offshoring for factor-income distribution and for efficiency are similar to those of other forms of economic integration driven by wage and factor endowment heterogeneity. Offshoring depresses domestic employment opportunities for unskilled workers relative to those of skilled workers. As suggested by Grossman and Rossi-Hansberg (2006), offshoring can however foster overall employment creation through its productivity-enhancing effects. Allowing easier immigration can reduce incentives to offshore production to cheap labor countries, while immigration pressure can be increased by policy actions meant to reduce the incidence of offshoring.[15] Less intuitively, policies that improve domestic firms' competitiveness can increase the incidence of offshoring, since a stronger market position makes it easier for firms to overcome fixed organizational costs and exploit foreign locations' lower marginal costs.

In order to flesh out these and other policy implications, further research should proceed to bring our theoretical and empirical results to bear on aggregate evidence of the type displayed in Table 3. Embedding our firm-level theoretical relationships in structural models of local labor markets, focusing in particular on a fuller analysis of relationships between the skill level and national origin of workers, will make it possible to assess how heterogeneity not only across firms, but also across provinces and sectors may bear on the extent to which immigration may bid down the wages of substitutable native workers with equivalent skills, and affect incentives to offshore production.

[15] For example, in May 2005 the European Parliament's Regional Development Committee expressed strong support for a European Commission proposal to impose financial penalties on recipients of received EU funding that decide to relocate their activities. The Committee also asked for legal measures to ensure that firms receiving European subsidies do not relocate for a "long and predetermined" period.

Data Appendix

Sample selection

The 2004 release of the Capitalia survey includes information on a sample of 4289 Italian manufacturing firms. All firms with more than 500 employees are included whereas firms with less than 500 employees are selected with a stratified sampling method. We removed from the sample firms with missing or non-manufacturing activity codes. Furthermore, we removed those with missing values on balance sheet data, on work force composition (question B1.1) and on offshoring activities (question D3.1). Finally, we also excluded firms with TFP below the 0.5 or above the 99.5 percentiles of the overall distribution. Our final sample is made up of 3280 observations. Table A.1 reports the distribution of firms by size-classes before and after our cleaning procedures.

Table A.1. Employment distribution before and after the cleaning, %

	Before	After
11-20	22.15	21.80
21-50	29.54	31.31
51-250	36.93	38.90
251-499	5.27	4.63
≥500	6.11	3.35

Variable Definitions

Offshoring Dummy (*OS*)**:** In the questionnaire (question D3.1) each firm is asked to answer whether it currently performs a portion of its manufacturing activities in another country. Our dummy is set equal to 1 is the answer is yes and 0 otherwise.
Number of employees (L)**:** average number of employees (question B1.1.6) over the three year period.
Sales, value added, fixed capital (Q, Y, K)**:** three-year average of balance sheet entries.
Share of white collar workers (L_W/L): ratio of white collar employees (B1.1.1+B1.1.2 + B1.1.2.2 + B1.1.3 + B1.1.4) to total employment (B1.1.6)
Share of extra-EU workers (L_W/L)**:** ratio of extra-EU workers (B1.1.6.4) to total employment (B1.1.6).
Industry Dummies: these take the value 1 (zero otherwise) for firms whose main production activity is in each of 21 NACE two-digit industries (15+16 - food, beverages and tobacco; 17 - textiles; 18 - clothing; 19 - leather; 20 - wood; 21 - paper products; 22 - printing and publishing; 23 - oil refining; 24 - chemicals; 25 - rubber and plastics; 26 - non-metal minerals; 27 - metals; 28 - metal products; 29 - non-electric machinery; 30 - office equipment and computers; 31 - electric machinery; 32 - electronic material, measuring and communication tools, TV and radio; 33 - medical apparels and instruments; 34 - vehicles; 35 - other transportation; 36 - furniture).
Provincial Dummies: these take the value 1 (zero otherwise) if the administrative headquarters of the firm is located in each of the 103 provinces of Italy in the 2001-03 period.
EM dummy: takes the value 1 if the firm has external senior managers (35.3% in the full sample), zero otherwise.
FF dummy: takes the value 1 if the owner or a member of her family has a senior management position in the firm (70.5% in the full sample), zero otherwise.

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Table 1. Descriptive Statistics, all firms

	Mean	Std.dev.	1stQ	Median	3rdQ
Sales (Q)	24.8	78.7	4.9	9.5	19.8
Value added (Y)	6.1	18.1	1.0	2.3	4.8
Employees (L)	106.5	258.5	28.0	46.6	96.0
Sales/Employees (Q/L)	0.244	0.225	0.125	0.185	0.289
Value added/Employees (Y/L)	0.052	0.026	0.017	0.047	0.061
Share of white collar workers (L_w /L)	0.325	0.181	0.202	0.286	0.405
Share of extra-EU workers (L_E /L)	0.038	0.080	0.000	0.000	0.043

Note: All statistics are computed for 2001-03 unweighted average data on the full sample of 3280 firms. Sales, value added, and their ratios to employment are measured in millions of euro.

Table 2. Descriptive Statistics, offshoring vs. non-offshoring firms

	Non-off. firms	Off. firms Full sample	Off. firms Restr. sample
Observations	3033	247	124
Sales (Q)	21.9	60.5	63.6
Value added (Y)	5.4	15.0	14.6
Employees (L)	94.1	258.4	269.7
Sales/Employees (Q/L)	0.241	0.279	0.319
Value added/Employees (Y/L)	0.052	0.053	0.055
White collar workers (L_w /L)	0.322	0.376	0.412
Extra-EU workers (L_E /L)	0.039	0.026	0.016

Note: All statistics are computed for 2001-03 unweighted average data. Sales, value added and their ratios to employment are in millions of euro. The restricted sample of offshoring firms excludes firms that declare both to offshore only the production of finished products (question D3.2.1) and not to re-import the offshored production (question D3.2.5). **Source:** Authors' elaboration of Capitalia data.

Table 3. Correlation with Provincial Employment Structure

Observations	Full sample	Restr. sample	Full sample	Restr. sample
Estimation Method	Probit	Probit	OLS	OLS
Dependent variable	OS	OS	L_E/L	L_E/L
Share of provincial empl. in man.	0.859(0.41)	0.676(0.41)	0.191(0.03)	0.196(0.03)
Pseudo R^2	0.003	0.002		
R^2			0.040	0.042

Note: Robust standard errors in parentheses. **Source:** Dependent variables computed from Capitalia data; independent variable, author's computation on ISTAT Censimento 2001 data.

Table 4: Reduced form probit model for offshoring

Observations	Full sample	Full sample	Restr. sample	Restr. sample
Estimation method	Probit	Probit	Probit	Probit
Dependent variable	OS	OS	OS	OS
TFP	0.131(0.067)		0.179(0.093)	
Family Firm (FF) Dummy		-0.146(0.082)		-0.278(0.099)
External Manager (EM) Dummy		0.660(0.080)		0.593(0.098)
Industry dummies	[0.00]	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.12]	[0.11]	[0.36]	[0.27]
Pseudo R^2	0.146	0.192	0.162	0.207
OS=0 correct predictions	0.996	0.992	0.998	0.996
OS=1 correct predictions	0.057	0.089	0.048	0.064

Note: Robust standard errors in round brackets. P-values of the null that each set of coefficients is equal to 0 in square brackets. The number of observations used is smaller than original sample sizes since offshoring is predicted perfectly by province dummy in all provinces where all firms have no offshoring activities. TFP is computed as the residual from the cross-sectional estimation of a two-factor Cobb-Douglas augmented with industry and provincial dummies. The FF dummy variable equals 1 if the owner or a member of her family has a senior management position in the firm (70.5% in the full sample) and zero otherwise. The EM dummy variable equals 1 if the firm has external senior managers (35.3% in the full sample) and zero otherwise.

Table 5: Models for the skill composition of the labor force

Full sample			
Observations	3280	2758	2758
Estimation method	OLS	IV (TFP)	IV (FF and EM)
Offshoring (OS)	0.053(0.013)	0.656(0.177)	0.404(0.122)
Industry dummies	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.00]	[0.00]	[0.00]
Restricetd sample			
Observations	3157	2474	2474
Estimation method	OLS	IV (TFP)	IV (FF and EM)
Offshoring (OS)	0.087(0.019)	1.186(0.412)	0.705(0.177)
Industry dummies	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.00]	[0.00]	[0.00]

Note: See Table 4. The prediction from the offshoring equations in Table 4 are used as instrument for the offshoring dummy in IV estimates.

Table 6: Models for the share of Extra-EU workers

Full sample			
Observations	3280	2758	2758
Estimation method	OLS	IV (TFP)	IV (FF and EM)
Offshoring (OS)	-0.014(0.004)	-0.080(0.050)	-0.106(0.026)
Industry dummies	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.00]	[0.00]	[0.00]
Restricetd sample			
Observations	3157	2474	2474
Estimation method	OLS	IV (TFP)	IV (FF and EM)
Offshoring (OS)	-0.022(0.004)	-0.154(0.067)	-0.150(0.044)
Industry dummies	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.00]	[0.00]	[0.00]

Note: See Table 4. The predictions from the offshoring equation in Table 4 are used as instruments for the offshoring dummy in IV estimates

Table 7: Models for the share of Extra-EU workers

			Full sample			
Observations	3280	2758	2758	3280	2758	2758
Estimation method	OLS	IV (TFP)	IV (FF and EM)	OLS	IV (TFP)	IV (FF and EM)
Offshoring (OS)	-0.011(0.003)	-0.043(0.052)	-0.092(0.026)	-0.011(0.004)	-0.046(0.054)	-0.096(0.027)
White collar workers (L_W/L)	-0.054(0.007)	-0.056(0.010)	-0.049(0.009)			
Industry dummies	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Constancy test for (L_W/L)				[0.00]	[0.00]	[0.00]
			Restricetd sample			
Observations	3157	2474	2474	3157	2474	2474
Estimation method	OLS	IV (TFP)	IV (FF and EM)	OLS	IV (TFP)	IV (FF and EM)
Offshoring (OS)	-0.017(0.004)	-0.098(0.064)	-0.132(0.045)	-0.017(0.004)	-0.116(0.069)	-0.145(0.046)
White collar workers (L_W/L)	-0.051(0.007)	-0.047(0.012)	-0.043(0.011)			
Industry dummies	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Provincial dummies	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Constancy test for (L_W/L)				[0.00]	[0.00]	[0.00]

Note: See Table 4. The predictions from the offshoring equation in Table 4 are used as instruments for the offshoring dummy in IV estimates. The last three columns allow the coefficient of the white-collar employment share to vary across industries: the point estimates are not reported; the null hypothesis of constancy across industries of that coefficient is strongly rejected by the data.

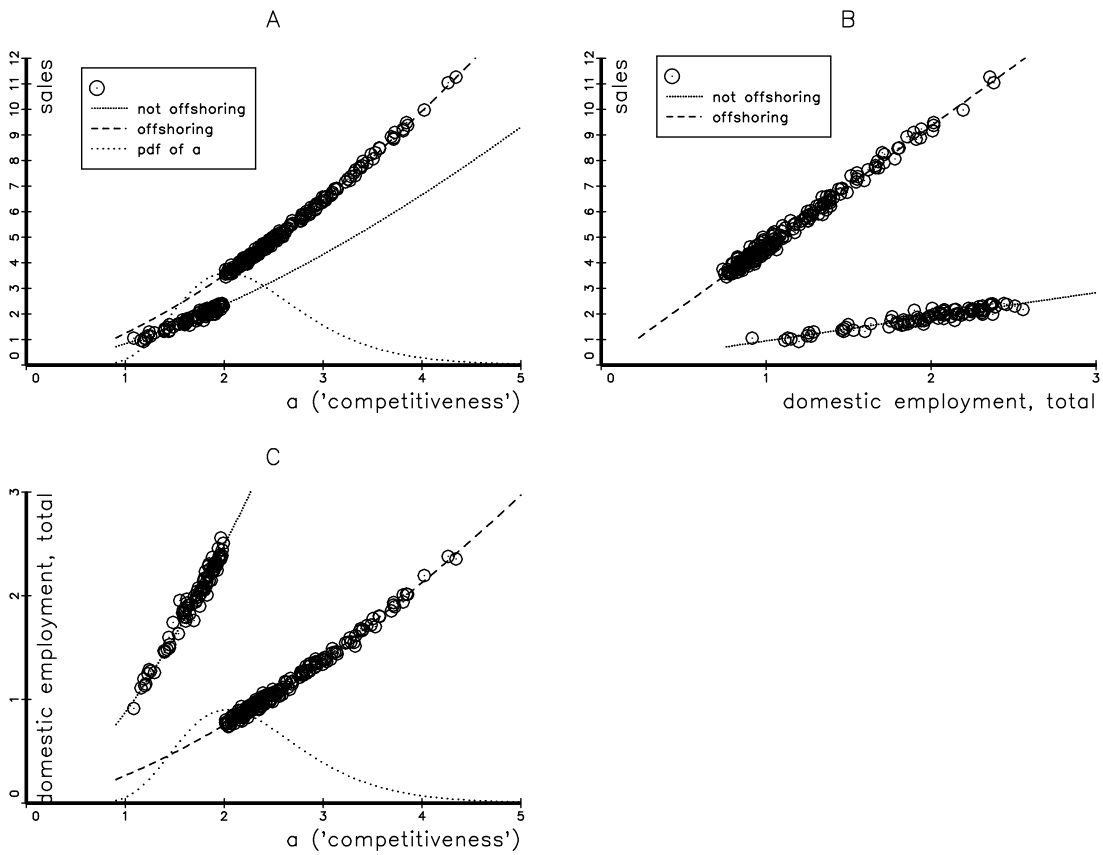

FIGURE 1: Illustration of the model's implications for the joint distribution across firms of exogenous strength (a), sales, domestic employment, and offshoring. The program that plots these figures use the following parameter set: α =0.1, γ =0.66, σ =1.5; G=10, A=1; $f(1)-f(0)=2$; w_{sd} =0.4 , w_{ud} =0.3 w_{sf} =0.5, w_{uf} .=0.1. The firm-level productivity indicators are a sample of 275 independent draws from a lognormal distribution with log mean 0.8 and log standard deviation 0.3, whose density is plotted in panels A and C (for illustrative purposes, not to scale).