Offshoring and Job Stability: Evidence from Italian Manufacturing*

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Abstract

This paper studies the relationship between offshoring and job stability in Italy in the period 1995–2001 by using a large administrative dataset on manufacturing workers. We find that the international fragmentation of production has a negative impact on job stability. Offshoring to low income countries significantly reduces job stability, but the effect depends on workers' skills. Intermediates purchases from developing economies foster white collar workers' job-to-job transitions within manufacturing, whilst they drive blue collar workers out of manufacturing. Policy intervention should thereby focus especially on this latter category of workers.

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1 Introduction

In the last decades low labour cost countries have gained a growing role in intermediate trade and in the process of international fragmentation of production. On the other hand, the rapid advances and diffusion of ICTs across the world has favoured the tradability of some service activities too. These phenomena have raised concerns, especially in the developed countries, about job security both for the high and low skill workers, even if more worries have risen for employees performing more simple and routinely tasks. As a consequence, a large strand of the theoretical and empirical literature on trade and labour has devoted the attention on the effects of offshoring of materials and services on productivity, on the equilibrium employment and on the skilled/low skilled relative wage[1]

Less attention, instead, has been devoted to the short run dynamics caused by offshoring, although they might be extremely relevant from a policy perspective. As a matter of fact, the analysis of the short run dynamics of the labour market that follow the offshoring practices are fundamental to understand and eventually reduce the associated adjustment costs. The theory, so far, has given little guidance on the overall effects from offshoring, due to the the long run equilibrium focus of offshoring theoretical models. The offshoring of some production phases or some tasks may well result in cost saving that boosts productivity and, in turn, the expansion of output and of the relative demand of the factor more intensively used in the sector affected from offshoring (Arndt, 1997; Grossman and Rossi-Hansberg, 2008). However, these productivity gains from offshoring are not always compared to the short run welfare losses coming from the possible rise in unemployment. The short run effects reproduced in two sector models with low or no inter-sector mobility highlight the theoretical possibility of increased unemployment from offshoring in the sector (Mitra and Ranjan, 2007, 2010), but it is essentially an empirical matter to ascertain whether an increase in a sector offshoring intensity causes an increase in job dismissals and, consequently, a reduced employment stability.

For this reason, the focus of our work is on the effect of offshoring on job stability.

This is a relatively less researched area consisting of a few and very recent works (Egger, Pfaffermayr, and Weber, 2007; Geishecker, 2008; Baumgarten, 2009; Munch, 2010; Bachmann and Braun, 2011) which provide relevant insights about the effects of foreign competitive pressure on the employees' probability to preserve their job.

Matching sector level measures of offshoring with employee level information on job durations, we contribute by estimating a single risk model and

[1]The works by Feenstra and Hanson (1996), Feenstra and Hanson (1999) and Amiti and Wei (2004) on the U.S.A. represent the seminal contributions in the field.

testing whether offshoring of materials and knowledge intensive business services (KIBS) affects the job exit rate in Italian manufacturing sectors. The employee level analysis helps in dissecting the impact across white and blue collars. In a second stance, we define and estimate a competing risk model where offshoring may affect the transition out of manufacturing and the transition to another manufacturing job. This second part of the analysis tries to shed light on the extent of the possible structural change occurring in the Italian economy by means of intersectoral reallocations of workers. Also, since higher adjustment costs are usually associated with such reallocations, this would immediately provide useful elements for policy actions, directed to cushion the negative effects.

Our final contribution relates to the search for an heterogeneity in the offshoring impact according to the origin country of intermediates. We distinguish between input purchases from high and low income countries since the type, the quality and technological content of intermediates may be very different across origin countries and the activity of offshoring may have different underlying reasons according to the income level of the trade partner. We would expect that firms delocalise some low skilled part of their product process to developing countries in order to benefit from the low labour cost, and at the same time exploit the competitive advantage of the other advanced countries in more technological intensive activities. As the literature suggests, these different activities may have heterogeneous consequences in terms of firm productivity, cost savings, competitiveness and evolution of the firm market shares and also in terms of the type of tasks the workers perform (Lööf and Andersson, 2010; Jabbour, 2010; Harrison and McMillan, 2007; Cadarso, Gomez, Lopez, and Tobarra, 2008; Falk and Wolfmayr, 2008; Lo Turco and Maggioni, 2012).

To the best of our knowledge, ours is the first study on the effect of offshoring on job security using Italian data. The case of Italy is of particular interest because, although the rigid Italian labour market[2] would imply the prevalence of stable and long lasting job relationship, the country is actually experiencing a large number of manufacturing job losses and an increase in the number of short term contracts. At the same time, several manufacturing firms announce every day their decision to offshore part of their production processes. Then, it is particularly interesting to understand whether and to what extent the two phenomena are related. Furthermore, the rigidity in the labour market might have hampered the displaced workers' possibility of finding another job in manufacturing. If the market takes a long time to reallocate workers across firms and across sectors, this will

[2]Differently from other developed economies already studied (e.g. US, Denmark, and Germany), the Italian labour market is less flexible. According to Nicoletti, Scarpetta, and Boylaud (2000) the employment protection legislation (EPL) is one of the strictest across the analysed countries for OECD countries in 1998. Only Greece and Portugal have more tight regulations.

impact on the unemployment rate and the wage and will have higher detrimental consequences for the welfare.

In line with our expectations, our results show that the sectoral purchases of foreign intermediates reduce the job stability of workers when they originate from developing countries. In particular, offshoring to low income economies raises the blue collars' probability to experience a transition out of manufacturing, while foster the job-to-job transitions in manufacturing for skilled workers. No significant role or mild effects are instead detected for offshoring to high income countries.

The work is structured as follows. Section 2 reviews the main literature dealing with the impact of trade openness and international outsourcing on the labour market. Section 3 presents the data and the sample. In Section 4 we report some empirical facts concerning the evolution of the Italian labour market and the job exit rates. Section 5 describes the econometric model for analysing the impact of offshoring on job stability. The estimation results are presented and commented in Section 6. Section 7 concludes.

2 Literature Review

The main focus in the theory and empirics of offshoring and the labour market has been on its effects on the relative wage of the low skilled workers (Feenstra and Hanson, 1996, 1999; Arndt, 1997; Egger and Falkinger, 2001). From the theoretical predictions of both positive and negative effects, empirical studies so far have shown that offshoring positively affects the relative skilled labour direct/inverse demand (Egger and Stehrer, 2003; Strauss-Kahn, 2004; Hijzen, Görg, and Hine, 2005; Helg and Tajoli, 2005; Hijzen, 2007; Geishecker and Görg, 2008; Broccolini, Lo Turco, Presbitero, and Staffolani, 2011). On the other hand, the empirical literature has also dealt with the general employment effects of trade in intermediate material and service inputs and despite some evidence of no overall employment effect from offshoring (Amiti and Wei, 2004; Moser, Urban, and di Mauro, 2010) some contributions have shown that competition from low wage countries is particularly harmful for employment levels in advanced countries (OECD, 2007; Harrison and McMillan, 2007; Cadarso, Gomez, Lopez, and Tobarra, 2008; Falk and Wolfmayr, 2008; Lo Turco and Maggioni, 2012).

Recently, the theory has devoted more attention on the unemployment-trade nexus in models that account for labour market frictions (Davis and Harrigan, 2007; Egger and Kreickemeier, 2009, 2010; Felbermayr, Prat, and Schmerer, 2008; Helpman and Itskhoki, 2010; Dutt, Mitra, and Ranjan, 2009). Equilibrium unemployment in these models may be importantly either positively or negatively affected by trade liberalisation in the long run. The specific role of offshoring in the short run is only taken into account by Mitra and Ranjan (2007) and Mitra and Ranjan (2010) who predict a rise

in unemployment due to offshoring when the labour force is immobile across sectors: the price reduction in the final good benefiting from cost saving caused by offshoring directs resources towards the relatively more rewarding non offshoring sector, thus causing a rise in unemployment in the offshoring sector.

Close to this line of research, some empirical contributions have investigated the consequences of openness on job creation and destruction at the industry or firm-level (Davis and Haltiwanger, 1999; Kletzer, 2000; Klein, Schuh, and Triest, 2002; Davidson and Matusz, 2005; Nucci and Pozzolo, 2010). Although these analysis convey a general insight on the potential restructuring effects driven by openness, they do not say much on the relationship between trade and individual employment stability and, in particular, on the specific role of trade in intermediates. These studies do not fully highlight the consequences of openness in manufacturing for the individual probability to loose a job, to transitate to another job or to permanently loose a manufacturing job. This poses a limit to their usefulness in inferring the social and welfare consequences of trade integration. In this respect, individual level studies may be more suitable for this purpose.

The first works making use of worker level databases have focused on United States. Kruse (1988) finds that among US manufacturing workers, displaced in 1979-83, the average duration of joblessness varied directly with the rise in their industry's import share. The result is driven by the fact that the workforce in industries with rising import shares tends to have demographic characteristics associated with labor market adjustment difficulties, such as higher proportions of women and blue-collar workers than are found in other industries. In the same line, Hungerford (1995) finds that U.S. net importing industries tend to adjust their labor force through layoffs to a greater extent than net exporting industries, but trade shocks seem to play a minor role in the incidence of layoff spells. More recently, Goldberg, Tracy, and Aaronson (1999) focus on the role of exchange rate fluctuations from 1977 through 1996 and find that dollar appreciations drove adjustments in job-changing and industry-switching probabilities. In particular, they find that employment instability rises with an appreciation of the import exchange rate.

For Europe, this literature is more recent and counts very few contributions. Egger, Pfaffermayr, and Weber (2007) study the effects of trade and international outsourcing on the transition probabilities of employment between sectors for Austrian workers in the period between 1988 and 2001. They exploit a dynamic multinomial logit framework with fixed effects and distinguish among six different states. Their focus is on the the sectoral share of intermediate goods imports in total imports - based on the BEC classification - as a measure of sector outsourcing and they find that an increase in this share negatively affects the probability of staying in or changing into the manufacturing sector, even more so for industries with a comparative

disadvantage. The findings on the Danish manufacturing by Munch (2010) for the period 1992-2001 period are more reassuring in that the quantitative impact of offshoring is rather small, even if it increases the job change hazard rate, the job separation rate, and the unemployment risks of low-skilled workers. Differently from Egger, Pfaffermayr, and Weber (2007), his offshoring measure is retrieved from national Input-Output tables, thus more precisely identifying the import of intermediates in each sector. The three existing studies for Germany, convey different and somehow conflicting results. Geishecker (2008) bases his empirical analysis on the German manufacturing between 1991 and 2000. He makes use of an outsourcing measure obtained from the combination of IO Tables with national trade data and in the estimation of the duration model exploits the information on the job spells on a monthly base. His findings display that international outsourcing, defined in the narrow sense (Feenstra and Hanson, 1996), significantly raises the individual risks of leaving employment. However, no statistically significant differences in the impact of international outsourcing are found across skill groups, as measured by the worker educational attainment. This evidence is a bit counterintuitive and, in fact, it is at odds with the findings by Bachmann and Braun (2011). Using a different administrative data set on individual workers' employment histories on a daily bases and including workers in services, they find that the narrow offshoring effect varies strongly across skill levels and age groups. They estimate hazard rate models for match separations, as well as for worker flows from employment to another job, to unemployment, and to non-participation. A negative effect emerges in the manufacturing sector especially, where the hazard of transiting to non-employment rises with international outsourcing for medium-skilled and older workers. Their findings, however, corroborate the evidence of a limited impact of offshoring on the overall job stability in the manufacturing sector, and, instead, show that offshoring increases job stability in the service sector. Finally, Baumgarten (2009) builds on the same dataset and, besides material offshoring, he explores the effect of service offshoring. His main contribution relies in the identification of the nature of tasks performed in each job. His findings reveal that in the manufacturing sector the adverse effect from an increase in material offshoring are strengthened for lower intensities of non-routine and interactive tasks of the occupation although the quantitative importance is very limited. On the other hand, international service outsourcing is associated with a statistically as well as economically significant increase in occupational stability that is independent of the task contents of the occupation. This result is less clear-cut in the service sector. Whereas the overall effect of international service outsourcing is stability-increasing, workers employed in occupations characterized by low degrees of non-routineness and interactivity may suffer from greater instability.

Our work is in line with the latter group of works: we employ employee

level data matched with sector level measures of offshoring retrieved from the Input-Output Tables; we observe job duration in months as in Munch (2010) and Geishecker (2008); we focus both on material and service offshoring as in Baumgarten (2009).

Nevertheless, differently the previous works we will also consider a broad measure of material offshoring including all intermediate imports and not only imports from the same manufacturing sector, and, as far as service imports are considered, our focus is on offshoring of knowledge intensive business services (KIBS), so to explicitly take into account the imports of high skill intensive services that may substitute for the high skill workers, just as materials may substitute for the low skill ones. Finally, an important contribution that we provide is the split of material imports by origin country. None of the previous works on the topic has considered that heterogeneous effects may be related to different origins of the import flow. Nevertheless, some of the literature on offshoring and the labour market points in this direction. Harrison and McMillan (2007) show that imports from foreign affiliates located in low income economies reduce home employment in U.S multinationals, while imports from high income located affiliates positively affect it. Out of the evidence on multinational firms, Lo Turco and Maggioni (2012), at the firm level, and Cadarso, Gomez, Lopez, and Tobarra (2008) and Falk and Wolfmayr (2008), at the industry level for Spain and the EU respectively, show a a similar finding on imports from low income economies. This evidence supports our prior of the possibility of different offshoring effects on the job exit rate stemming from different motivations for imports, i.e. cost saving versus technology search.

3 The Data and Sample

To analyse the impact of offshoring on job security in the Italian labour market, we combine micro data on job durations and workers' characteristics with sector level data on international outsourcing, business cycle, import penetration, technological change, and regional proxies for the labour market conditions.

Micro data are from a longitudinal dataset provided by the Institute for the Development of Vocational Training (ISFOL) and based on the administrative records collected by the Italian Social Security Institute (INPS).[3] ISFOL collects information on every worker entering employment the 10^{th} of March, June, September and December of each year. Thus, 1 worker out of about 91 is included in the sample and the whole data set is composed

[3]The Italian Institute for National Social Security (INPS) collects data on all Italian workers employed in the private sector through an administrative procedure based on firms' declarations. Because of the administrative nature of the data we have the exact number of monthly duration for each job spell.

by more than 2,470,000 observations on about 963,000 job spells for about 310,000 workers for the years 1985-2002.[4]

From this database, we select a sample of fresh job matches which started between January 1995 and December 1998 and we follow them on a monthly basis until the end 2001. We keep only manufacturing workers aged between 20 and 50. For each worker we retain the first job spell in the first year the worker appears in the database and we calculate the corresponding duration in months of the job episode. Due to the ending of the observation period in December 2001, we treat as right-censored the job spells which are not completed yet in December 2001.

The restriction of our sample to jobs started in the period 1995–1998 is due to two reasons. First, we cannot use older job spells as data on offshoring are not available before 1995. Second, we prefer not to use job spells started later than 1998, as the Italian labour market went through a series of institutional changes, mainly introducing atypical forms of job arrangements. This restriction is therefore aimed at avoiding job heterogeneity induced by institutional changes in the labour market.

In our analysis we also use other variables at worker level. In particular, the daily gross wages, the individual age, work experience calculated as the total number of months the workers has worked up to the moment she enters the job under analysis, the number of previous jobs and a set of dummies respectively for female workers, white collars, Italian workers and firm size. Given the administrative nature of the data, information on education, family composition, and family background are not available.

Concerning the sectoral offshoring, the relative indicators are retrieved from the national Input-Output (IO) tables provided by the Italian Institute of Statistics (ISTAT) and they may be computed only on a 2-digit NACE Rev. 1 sector and on yearly basis. To measure material offshoring intensity, we use a "narrow" indicator defined, as in the previous literature (Feenstra and Hanson, 1996, 1999), as:

$$OFF_{narrow\ jt} = \frac{IM_{jjt}}{TI_{jt}} \ for\ j = 1, ..., m \tag{1}$$

where IM_{jjt} represents, for each j of the m manufacturing sectors, the cost for intermediate inputs from the foreign sector j at time t, and TI_{jt} represents the total of domestic and imported non energy inputs used in sector j. In other words, this is a measure of within industry intermediate inputs substitution, since it represents the share of intermediate costs which is shifted to the same industry abroad.

The extent of substitution may however involve products that belong to other industries and that were previously produced within the boundaries of the firm as intermediates for the final good production. For this reason

[4]For a detailed description of the dataset, see Centra and Rustichelli (2005)

we decide to compare the performance of the narrow measure of offshoring to the broader one, capturing the extent of both intra- and inter-industry substitution. Then, we also calculate the "broad" measure of material outsourcing for sector j, which refers to the overall imported inputs from all manufacturing sectors abroad:

$$OFF_{broad\ jt} = \frac{\sum_{i=1}^{m} IM_{jit}}{TI_{jt}}\ for\ j = 1, ..., m \tag{2}$$

Finally, the last offshoring measure we introduce in our estimations is the total imports of Knowledge Intensive Business Services (services belonging to NACE sectors 71, 72 and 73 according to the Economic Commission, 2009) - indexed as sectors $m+1$ to n in the economy - that sector j purchases from abroad over total non energy inputs:

$$OFF_{Ser\ jt} = \frac{\sum_{i=m+1}^{n} IM_{jit}}{TI_{jt}}\ for\ j = 1, ..., m \tag{3}$$

.

Thus, this is our indicator for offshoring of KIBS.

In a second stance, in order to take into account the different type, quality and technology level of inputs purchased from different countries, the measures of material offshoring have been computed separately according to the origin country group. We follow the traditional way to construct offshoring indicators split by origin when imports of intermediates are not directly available from the IO Tables (Feenstra and Hanson, 1996, 1999). Then, we combine IO Tables with sector level measures of import penetration, and our offshoring measures to high and low income countries are as follows:

$$\begin{aligned}
OFF^{High}_{narrow\ jt} &= \frac{IM_{jjt} * (\frac{M^{High}_{jt}}{M_{jt}})}{TI_{jt}} \\
OFF^{Low}_{narrow\ jt} &= \frac{IM_{jjt} * (\frac{M^{Low}_{jt}}{M_{jt}})}{TI_{jt}} \\
OFF^{High}_{broad\ jt} &= \sum_{i} (\frac{IM_{jit} * (\frac{M^{High}_{it}}{M_{jt}})}{TI_{jt}}) \\
OFF^{Low}_{broad\ jt} &= \sum_{i} (\frac{IM_{jit} * (\frac{M^{Low}_{it}}{M_{jt}})}{TI_{jt}})
\end{aligned}$$

with IM_{ji} and M_j respectively measuring imported intermediates from sector i used in sector j, and total sector j imports. Unfortunately, we are not able to split KIBS imports, due to the difficulty to retrieve data on imported

services out of the IO Tables, nevertheless it is sensible to presume that the bulk of these imports originate from high income economies.

Our baseline specification includes further controls to account for a number of sector and work location specificities that might affect the exit rate, other than offshoring. At the sector level we make use of the extent of ICT sector capital deepening, measured as the logarithm of the sectoral capital stock in office machines, telecommunication apparatus and software over total employment[5], the sectoral value added and an overall measure of sectoral import penetration calculated as the share of imports over total sectoral output. All these measures are from ISTAT National Accounts, apart from imports that are retrieved from the WITS-COMTRADE database together with the definition of high and low income countries. Finally, we use two controls at the regional level, namely the regional unemployment rate and the regional estimated share of illegal employment, always from ISTAT. Table 6 in Appendix displays the pairwise correlations of variables at sectoral and regional level.

4 A Descriptive Analysis

In this section we show some empirical facts concerning the evolution of the Italian labour market and the job exit rates emerging from our database.

Table 1 displays the transitions out of the current job split by the exiting sectors, and for the job-to-job flows also by destination sector. It is evident that most of the spells ends with a transition out of employment in the private sector of the economy, this concerns about 65% of the job spells and about 80% of job spells ending with a transition out of a specific manufacturing sector. Focusing on the spells ending with a transitions into a new job, it is more likely that the worker will be employed in the same 2-digit sector, about 58% of workers who end a work relationship and enter a new job stay in the same sector of activity. Even if the remaining 42% go to another sector it is likely that workers remain within the main activity sector. As an example, in manufacturing, transitions to another 2-digit manufacturing sector represent about 85% of the overall transitions to other sectors. This confirms that skills and tasks required in different sectors might be very specific. The transitions from a main sector to another one may be difficult and may require important training costs of the workers. Nowadays the attention in advanced countries is however focused

[5]The ICT capital stock has usually better captured the extent of technical change at the costs of the size of the estimated offshoring effects (Feenstra and Hanson, 1999). Differently from some previous evidence making use of the R&D expenditures, we believe that the ICT capital stock is better able to capture the extent of technological change. The scope for the formal R&D is highly related to the kind of the performed activity and the use of this indicator may hide the real technological process experienced by a sector, especially the ones producing simpler and less complex goods.

Table 1: Transitions Out of Manufacturing and Job-to-Job within Manufacturing

Trasitions	**Freq.**	**Percent %**
Out of employment:	**36,075**	**65.46**
From Primary	*4,947*	*8.97*
From Manufacturing	*13,365*	*24.25*
From Services	*17,763*	*32.23*
To the same 2 digit NACE sector	**11,101**	**20.14**
To another 2 digit NACE sector:	**7,935**	**14.40**
From Primary to Manufacturing	*520*	*0.94*
From Primary to Services	*1,355*	*2.46*
From Manufacturing to Primary	*233*	*0.42*
From Manufacturing to Services	*1,292*	*2.34*
From Services to Primary	*282*	*0.51*
From Services to Manufacturing	*1,020*	*1.85*
Within Primary	*10*	*0.02*
Within Manufacturing	*1,714*	*3.11*
Within Services	*1,509*	*2.74*
Total	**55,111**	**100**

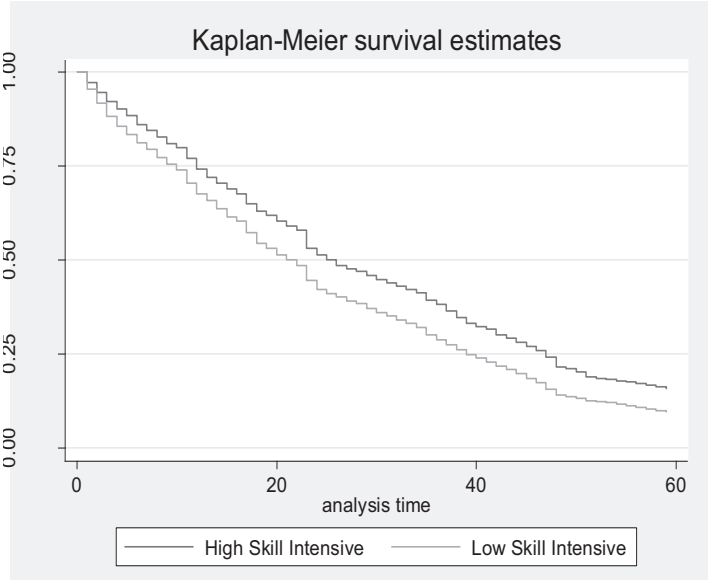
Own calculations on ISFOL data.

on this kind of transitions. More and more it is suggested the necessity of a structural change in the economic systems of high income countries towards more advanced activities and especially towards service sector in order to face the expansion of emerging countries. This process of tertiarisation of the economy, that would be pushed and speeded up by the internationalisation of production, finds some empirical support in Table 1 showing that when there is a change in the main sector the most important destination sector is the service sector.

Focusing on manufacturing, Figure 1 shows the survival probability in the job market according to the skill intensity of the sector, calculated as the ratio of white to blue collar workers. Workers employed in sectors performing technological intensive, sophisticated, and complex activities are more likely to preserve their job position or to move from a job to another one. This may be consistent with the idea that low skill intensive sectors are more exposed to foreign competition, economic slowdown, technological progress and other external pressures that drive a larger share of individuals out of their occupations.

Thus, we have presented the dynamics the Italian labour market went through during our period of analysis. The aim of the present paper is to test whether the process of production fragmentation across countries has significantly contributed to these changes. The reason of the focus on the offshoring activity as potential responsible in shaping the evolution of labour

Figure 1: Survival Estimates by Skill Intensity - Manufacturing Sectors



market lies on the growing role that emerging and developing countries have started to play, in the last two decades, in trade of the intermediates due to the delocalisation of production phases from developed economies. Additionally, there has been a further integration among developed countries stemming from the deepening of market business relationships with foreign suppliers and customers and the growing importance of the intra-firm trade flows within cross-border groups. As a consequence, Italy has experienced a growth in the shares of imported inputs. As we can see from the Figure 2 in the Appendix, in the years 1995-2004 offshoring of materials has increased in the great part of its activity sectors even if not monotonically and with some heterogeneity. For example, in sectors *Paper and paper products* (NACE sector 21) and *Editing and printing* (NACE sector 22) material offshoring has been characterised by alternate phases of growth and drop. While, as we expected, the purchases of intermediates from abroad significantly raised in sectors *Textiles*, *Apparel* and *Leather products and footwear* (NACE sectors 17, 18 and 19). Moving the attention on services, the picture is more clearcut: even in activities where the imports of material intermediates were declining or staying stable, the purchase of services from abroad always was expanding and this is strictly linked with the rapid advances and diffusion of ICTs across the world that has fostered the tradability of services, and had caused an internal reorganisation of production processes within firms. However, the Figure also displays that material offshoring is still more important than service offshoring in terms of magnitude of shares.

Some further insights can be gathered focusing on the split of material offshoring according to the origin of inputs. Input purchases from developing countries have generally significantly increased, even in contrast with offshoring shares to developed countries that were sometimes reducing (see for example, NACE sector 26 *Other non metal mineral products*). High income countries are nonetheless still the main partners for Italy in trade of intermediates, with shares that are greatly larger than the ones of developing countries. Only in *Apparel* and *Leather products and footwear* low income countries represent the most important sources of materials (Figure 3).

The next sections are devoted to empirical test whether the process of international fragmentation of production activities has contributed to shape the dynamics in the Italian domestic labour market.

5 Econometric Framework

5.1 Mixed Proportional Hazard Job Separation Rates

In order to detect the impact of offshoring on job separation rates we make use of a mixed proportional hazard (MPH) framework with time-varying variables. As we only observe the labour market state occupied at the end of each month, the observed durations are measured in discrete time. To avoid the dependency of parameters to the time unit of observation (Flinn and Heckman, 1982), we follow van den Berg and van der Klaauw (2001) and specify the discrete time-process as if it was generated by a grouped continuous-time model. Gaure, Røed, and Zhang (2007) report from Monte Carlo analysis that, despite the time grouping of duration, the true structural parameters can still be robustly recovered from the observed data, to the extent that the discreteness of the data measurement is taken into account when setting up the likelihood function.

Job duration is defined as the time until the job is terminated, either because of a transition to another job or because of a transition out of employment. Let $\mathbf{x}$ denote the vector of explanatory variables which are constant over time and $\mathbf{z}$ the set of time-varying covariates. The variable t (with $t \in \mathbb{N}_0$) denotes the job duration as measured from the moment of job inflow, while the variable τ (with $\tau \in \mathbb{N}_0$) denotes calendar time. The job separation rate of a spell started at time τ and after t months is specified in the following MPH form

$$\theta\big[t|\mathbf{x}, \mathbf{z}(\tau+t), v\big] = \exp\big[\alpha(t) + \boldsymbol{\beta}'\mathbf{x} + \boldsymbol{\delta}'\mathbf{z}(\tau+t)\big]v, \tag{4}$$

where

- $\exp[\alpha(t)]$ is the piecewise constant baseline hazard capturing the duration dependence. The time axis of each job spell is divided into Q intervals $I_q = [h_q, h_{q+1})$ with $q = 1, \ldots, Q$, $h_1 < h_2 < \ldots < h_Q$,

$h_1 = 1$, and $h_Q = \infty$.[6] The baseline hazard function can be rewritten as

$$\exp\big[\alpha(t)\big] = \exp\Big[\sum_{q=1}^{Q} \alpha_q d_q(t)\Big], \tag{5}$$

where $d_q(t)$ is a dummy indicator equal to one if the job separation occurs during interval I_q and α_q is the corresponding intensity parameter.[7]

- $\mathbf{x}$ is a K dimensional vector of time-invariant covariates controlling for observed heterogeneity.
- $\mathbf{z}(\tau + t)$ is a J dimensional vector of time-variant covariates, among which offshoring indexes and a set of further variables controlling for time-variant heterogeneity at the transition month $(\tau + t)$.
- $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$ are the parameter vectors associated (and conformable) to the time-variant and time-invariant covariates, respectively.
- v is the non-negative time-invariant individual heterogeneity which is assumed to be independent on $\mathbf{x}$ and $\mathbf{z}$.

To avoid parametric assumptions on the distribution of the unobserved heterogeneity, we follow Heckman and Singer (1984) and assume that v is a random draw from a discrete distribution with a finite and unknown number M, unknown location, and unknown probability masses of the points of support. The probability weights sum to one and are denoted by $p_m = \Pr(v = v_m)$, $\forall m = 1, \ldots, M$. Empirically, we specified them as logistic transforms, i.e. $p_m = \exp(\lambda_m)/\sum_{r=1}^{M} \exp(\lambda_r)$, with $\lambda_M = 0$. As a pre-specified low number of points of support may result in substantial bias, we choose M on the basis of information criteria (Hannan-Quinn and Akaike information criteria), as suggested by Baker and Melino's (2000) and Gaure, Røed, and Zhang's (2007) Monte Carlo simulations.

5.2 The Likelihood Function

In our sample we observe both complete and incomplete job spells. The contribution to the likelihood function of a complete job spell started at calendar time τ and terminated after t months is derived in Appendix A

[6] We split the time axis into 9 intervals at 3, 6, 9, 12, 18, 24, 30, and 36 months.

[7] α_1 is normalized to 0. This normalization is innocuous as the scale of the job separation rate is captured by v.

and takes the following form

$$\begin{aligned} L(t|\mathbf{x},\mathbf{z},v;\Theta) &= \prod_{r=1}^{t-1}\exp\Big\{-\theta\big[r|\mathbf{x},\mathbf{z}(\tau+r),v\big]\Big\} \\ &- \prod_{d=1}^{t}\exp\Big\{-\theta\big[r|\mathbf{x},\mathbf{z}(\tau+r),v\big]\Big\} \\ &= \prod_{r=1}^{t-1}\exp\Big\{-\exp\big[\alpha(r)+\boldsymbol{\beta}'\mathbf{x}+\boldsymbol{\delta}'\mathbf{z}(\tau+r)\big]v\Big\} \\ &- \prod_{r=1}^{t}\exp\Big\{-\exp\big[\alpha(r)+\boldsymbol{\beta}'\mathbf{x}+\boldsymbol{\delta}'\mathbf{z}(\tau+r)\big]v\Big\} \\ &\equiv S(t-1|\mathbf{x},\mathbf{z},v)-S(t|\mathbf{x},\mathbf{z},v), \end{aligned} \tag{6}$$

where Θ is the set of parameters to be estimated. As we specify the discrete time-process as if it was generated by a grouped continuous-time model, the contribution to the likelihood function of exiting a job spell after t months is given by the difference between the probability of job surviving for $t-1$ months and the probability of surviving for t months.

The contribution to the likelihood function of a job spell started at calendar time τ and incomplete after t months because right censored at the end of the observation period[8] is given by the survivor function evaluated at t months:

$$\begin{aligned} L^c(t|\mathbf{x},\mathbf{z},v;\Theta) &\equiv S(t|\mathbf{x},\mathbf{z},v) \\ &= \prod_{r=1}^{t}\exp\Big\{-\theta\big[r|\mathbf{x},\mathbf{z}(\tau+r),v\big]\Big\} \\ &= \prod_{r=1}^{t}\exp\Big\{-\exp\big[\alpha(r)+\boldsymbol{\beta}'\mathbf{x}+\boldsymbol{\delta}'\mathbf{z}(\tau+r)\big]v\Big\}. \end{aligned} \tag{7}$$

Let c_i be an indicator variable equal to one when the job spell of individual i is right censored and 0 if completed. Under the assumption that the distribution of the unobserved heterogeneity is discrete, we can integrate it out when constructing the likelihood function of individual i with job duration t_i :

$$\mathscr{L}_i(t_i|\mathbf{x}_i,\mathbf{z}_i;\Theta)=\sum_{m=1}^{M}p_m\big[L_i^c(t_i|\mathbf{x}_i,\mathbf{z}_i,v_m;\Theta)\big]^{c_i}\big[L_i(t_i|\mathbf{x}_i,\mathbf{z}_i,v_m;\Theta)\big]^{(1-c_i)}. \tag{8}$$

[8]Given the small number of observations with a complete spell longer than 60 months, observations lasting more 60 months are censored at 60 in order to reduce the computational time in model estimation. In other words, we exogenously impose that every job spell has an observation period of maximum 60 months.

The log-likelihood function sums the logarithm of Equation (8) over all the individuals in the sample, i.e. $\mathscr{L} = \sum_{i=1}^{N} \mathscr{L}_i(t_i|\mathbf{x}_i, \mathbf{z}_i; \Theta)$.

5.3 Identification

In duration models, the failure to control for selectivity issues due to unobserved heterogeneity can lead to substantial biases in the estimation of the structural parameters of the hazard function. We control for the selection on unobservables on the basis of a discrete distribution with an unknown number of points of support, unknown probability masses, and unknown location of the points of support. Elbers and Ridder (1982) showed that under the MPH assumption, exogenous time-invariant regressor variation, and an auxiliary assumption on the first moment of the unobserved heterogeneity distribution, the model components are non-parametrically identified. If exogenous information from time-varying variables is available, like in this study, the MPH assumption is not necessary for identification and the impact of the covariates on the hazard function can be allowed to be heterogeneous over time (Brinch, 2007).

A further concern in credibly identifying the impact of international outsourcing on job stability is time-varying heterogeneity. There might indeed be other time-varying determinants of job stability which, if left out of the model specification, could give rise to spurious effects. In order to disentangle the true effect of outsourcing from the spurious one determined by further time-varying heterogeneity we include in the model specification a rich set of time-varying variables at national, regional, and sectoral levels which might explain the job duration distribution. More in detail, we will control for: i) time dummies to take into account idiosyncratic changes, like those determined in legislation changes; ii) unemployment rate and the share of informal workers to control for the state of the labour market; iii) sectoral ICT per employee; iv) the sectoral value added which is a proxy for the business cycle; v) the import penetration ratio which captures the competitive pressure from foreign firms in the same sector, and may also reflect the general trade openness of the sector.

The combination of micro data on the duration of individual job spells and sectoral level indicators for offshoring helps in mitigating endogeneity concerns related to reverse causality. It is indeed unlikely that the individual behaviour is able to affect the sectoral performance in terms of foreign intermediate purchases.

6 Estimation Results

The tables presenting the estimation results are organised as follows: the first and second column display the results for the sample of all workers, the third and fourth for white collar workers only, and the last two columns for

the blue collars. Also, in the estimations we use both the narrow measure of offshoring, in the first, third and fifth columns, and the broad measure in the remaining columns.

Table 2 reports our findings for the MPH job hazard function described in the previous section. Confirming our expectations, the sectoral purchases of foreign intermediate inputs significantly increase the worker's probability of experiencing a job separation. This positive effect on the job exit rate is robust to the definition of the offshoring measure - narrow or broad - we use[9] Concerning the magnitude of the effect, we find that an increase by 10 percentage points in the narrow (broad) offshoring increases the monthly job exit rate by 0.33% (0.30%). Also, the purchases of services and not only of material intermediates abroad decreases the job stability in manufacturing. Thus, the general process of fragmentation of production across countries seems to be associated to labour saving firm organisation choices.

Thus, our analysis reveals that the offshoring is an important factor contributing to shape the dynamics of labour market and this significant role is detected despite the inclusion of other sector and location controls. As mentioned above, in order to disentangle the pure effect of offshoring from the spurious one determined by a growing international integration among countries we include a sector level measure of import penetration among our regressors. This variable, in particular, allows us to shed light on the impact of competitive pressure from foreign countries for the individual job security. We find that tougher foreign competition positively and significantly affects the job hazard rate. Another relevant phenomenon we account for in our model is technological change. Contrary to some previous evidence (Geishecker, 2008), the advancements in technology, measured by the sectoral ICT capital stock, do not explain the changes in the job stability.

Turning on the conditions of the local labour market, neither the regional unemployment rate nor the state of the economy at sectoral level (approximated by the logarithm of the sectoral value added) display any significant effect, while the presence of informal work has a positive impact on the job stability. The latter finding can be explained by at least two arguments. First, the informal labour market might expand in a period of upturn and, if this is the case, the variable on informal work could partially capture the evolution of the state of the economy. Secondly, a rise of the informal labour market, once we control for the unemployment rate, could suggest that firms are using more intensively a cheap source of labour, with an increase in competitiveness and in the stability of both formal and informal jobs.

Finally, we briefly comment on the estimated coefficients of the time-invariant covariates and the profile of the job baseline hazard. The impact

[9]This finding contrasts with Geishecker (2008), who finds no support for a significant effect of the broadly defined outsourcing.

Table 2: Estimation Results of the Systematic Part of the Job Hazard Function

	ALL EMPLOYEES		**WHITE COLLARS**		**BLUE COLLARS**	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.013	-0.013	-0.071*	-0.072*	0.014	0.014
	[0.020]	[0.020]	[0.040]	[0.040]	[0.023]	[0.023]
Age	-0.137***	-0.137***	-0.064**	-0.064**	-0.155***	-0.155***
	[0.011]	[0.011]	[0.026]	[0.026]	[0.012]	[0.012]
WhiteCollar	-0.194***	-0.194***				
	[0.021]	[0.021]				
Italian	-0.229***	-0.228***	-0.369***	-0.367***	-0.219***	-0.220***
	[0.044]	[0.044]	[0.126]	[0.127]	[0.046]	[0.046]
Wage	-0.064***	-0.064***	-0.075*	-0.077*	-0.085***	-0.085***
	[0.023]	[0.023]	[0.045]	[0.046]	[0.027]	[0.027]
WorkExp	-0.518***	-0.517***	-0.508***	-0.506***	-0.534***	-0.531***
	[0.051]	[0.051]	[0.094]	[0.094]	[0.062]	[0.062]
PrevJobs	-0.147	-0.148	-0.417	-0.432	-0.064	-0.07
	[0.206]	[0.206]	[0.429]	[0.430]	[0.237]	[0.237]
Quarter2	0.374***	0.374***	0.390***	0.390***	0.365***	0.365***
	[0.022]	[0.022]	[0.048]	[0.048]	[0.024]	[0.024]
Quarter3	0.669***	0.669***	0.752***	0.750***	0.645***	0.645***
	[0.026]	[0.026]	[0.057]	[0.057]	[0.029]	[0.029]
Quarter4	0.810***	0.809***	0.862***	0.857***	0.795***	0.794***
	[0.028]	[0.028]	[0.063]	[0.063]	[0.032]	[0.032]
Size2	-0.096***	-0.096***	-0.143**	-0.141**	-0.084***	-0.084***
	[0.024]	[0.024]	[0.059]	[0.059]	[0.026]	[0.026]
Size3	-0.119***	-0.119***	-0.148***	-0.147***	-0.112***	-0.112***
	[0.023]	[0.023]	[0.053]	[0.053]	[0.026]	[0.026]
Size4	-0.185***	-0.185***	-0.173**	-0.171**	-0.192***	-0.192***
	[0.038]	[0.038]	[0.071]	[0.071]	[0.045]	[0.045]
Size5	-0.317***	-0.317***	-0.287***	-0.285***	-0.340***	-0.340***
	[0.026]	[0.026]	[0.057]	[0.057]	[0.030]	[0.030]
OFF_{ser}	0.548***	0.491***	0.657***	0.435***	0.243	0.268
	[0.128]	[0.122]	[0.193]	[0.158]	[0.176]	[0.179]
OFF_{narrow}	0.033***		0.011		0.041***	
	[0.012]		[0.022]		[0.014]	
OFF_{broad}		0.030***		0.050***		0.014
		[0.009]		[0.016]		[0.012]
$ImpPen_j$	0.397***	0.382***	0.459***	0.388**	0.352***	0.358***
	[0.087]	[0.087]	[0.174]	[0.174]	[0.100]	[0.100]
$Unemp^{reg}$	-1.544	-1.547	-6.893	-7.016	0.190	0.213
	[1.681]	[1.682]	[4.425]	[4.438]	[1.829]	[1.828]
$InformalLab^{reg}$	-3.652**	-3.645**	0.973	0.808	-3.066	-2.992
	[1.834]	[1.835]	[4.592]	[4.598]	[2.012]	[2.012]
VA_j	-2.91	-1.532	15.006***	16.257***	-8.475***	-7.728***
	[2.264]	[2.298]	[5.071]	[5.078]	[2.567]	[2.659]
ICT_j	1.089	1.095	-0.01	-0.418	1.701	1.966
	[1.106]	[1.097]	[2.179]	[2.137]	[1.291]	[1.289]
Cons.	0.626	-1.162	-16.787***	-19.025***	6.069**	5.277**
	[2.113]	[2.189]	[4.860]	[4.874]	[2.413]	[2.558]
NT	511,919	511,919	146,218	146,218	365,701	365,701
N	19,259	19,259	4,589	4,589	14,670	14,670
Log-likelihood	-65,592.4	-65,591.2	-14,486.7	-14,481.8	-48,468.3	-48,471.7

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are shown in brackets. Dummy indicators for regions, years, sectors are included in all estimations but not reported for the sake of brevity. The reference categories are Firms with less than 20 employees for the Size of Firm where the worker is employed, and the first quarter of the year for the period of hiring.

of time-invariant covariates on the job exit rate are broadly in line with those previously found for other advanced countries. White collar workers and workers with Italian nationality have a significant lower probability of experiencing a job separation. Additionally, both the wage and previous working experience are positively associated with job durations. As in Munch (2010), we find that older workers are less likely to exit the job. This finding contrasts with Geishecker (2008) who, instead, finds that the job stability is decreasing with age. We find that the firm size matters and being employed in a larger firm decreases the job exit rate. This might be explained by the fact that bigger firms are less sensitive to the business cycle and shocks in the final product market. Differently from the results for other countries (Geishecker, 2008; Bachmann and Braun, 2011; Baumgarten, 2009), we find that men and women have the same job exit rate.

In the previous discussion we have considered offshoring to have a homogeneous impact on job stability regardless of the type of tasks and activities the worker is performing. This is however a strong assumption since workers with a higher skill level and committed with knowledge and technology intensive tasks may be less substitutable with foreign inputs than workers performing simple and routinely jobs. As a consequence, the increasing international integration is likely to affect the low skilled more than the high skilled, also due to their relative scarcity in advanced countries and to the growing role of low skilled labour abundant countries in world trade flows. In particular, offshoring practices are often meant to spare on the labour intensive fragments of production more than to acquire new technologies from abroad (OECD, 2007).

In order to test whether offshoring differently affects the job security of workers according to their skills we use, as standard in the literature, the distinction between blue and white collars to capture the skill intensity of the job. Table 2, from columns 3 to 6, shows the estimations of our single risk model split by skill level. The two measures of offshoring, broad and narrow, deliver us different results about the role of purchases from abroad on the probability of job separation. According to the narrow indicator, the purchases of foreign inputs decrease the job stability only for blue collars, with no effect for skilled, consistently with our expectations. The opposite picture is however detected when we use the broad offshoring measure. Even if we believe that the narrow measure of offshoring is able to better capture the delocalisation of the phases of the production process constituting the core business of the firm, we think that this non conclusive evidence we have found may be related to some heterogeneity that we have not taken into account. In this regard, in the next subsection we control for another source of potential heterogeneity, that is the origin of the offshored intermediates.

Interestingly, services purchased abroad significantly increase the job hazard rate of only white workers and this is probably due to the fact that services activities in general, and this is of course the case for KIBS, are char-

acterised by higher knowledge requirements and may need specific abilities and, as a consequence, are usually performed by high skill workers.

The displayed effect of the remaining controls stay invariant with respect to the base specification on the sample of all employees. There are nevertheless some interesting exceptions. The employees' gender seems to be relevant for white collars, and surprisingly women have a lower probability to experience a job separation even if the coefficient is significant only at 10%. Also, in the estimations by skill level the previous significant impact of the regional share of informal work turns to be non significant, while the value added seems to play an opposite role for the white and blue collars. The sectoral value added positively contributes to the job stability of blue collars, while increases the hazard of job separation for white collars. While the finding for unskilled workers is more intuitive since an economic expansion period is also characterised by a higher stability of the employment, the result for skilled would deserve further investigation.

The role for the origin of imports

As we have argued above, even if the analysis of the skill level of employees helps us to deeper investigate how offshoring shapes the dynamics of labour markets, we still could miss out some important sources of heterogeneity. Thus, aware of the strong expansion that emerging and low labour cost countries have experienced in our analysis time span, both in terms of economic growth and trade flows in intermediates, and aware of the different reasons driving input flows from different countries we move forward and take into account the importance of the country where the production is offshored. We expect offshoring to low income countries to play the major role on the recent labour market evolution, due to its recent growth in magnitude and to its general labour saving purpose. In opposite, imports from high income countries usually coincide with the search for better technology. The different reasons behind the delocalisation process and the activity of input purchases abroad may lead to heterogeneous outcomes for the labour market, especially when we also cross heterogeneous import origins with the different occupation skills.

In the following, for the sake of brevity, we only display the results for our offshoring measures and other sectoral and regional variables[10].

Using both the broad and the narrow measures of offshoring, Table 3 shows that considering the sample of all workers the main negative impact for the job stability is caused by the process of production fragmentation to developing countries. The most interesting insights are however delivered when we take simultaneously into account the two heterogeneity sources, worker skill and origin of inputs. Material offshoring to low income countries

[10]The results for variables at individual level are available from the authors upon request.

represents a detrimental factor for the stability of the blue collars' jobs. A 10 percentage point increase in the narrow (broad) offshoring share increases the monthly exit rate of blue collar workers by 11.8% (10.6%). This is in line with some prior empirical evidence, and especially is also supported by Lo Turco and Maggioni (2012) who find that in Italy offshoring affects the firm labour demand only if it is towards low income countries.[11]

In opposite, both KIBS imports and material offshoring to high income countries - when computed according to the broad definition of offshoring - increase the probability for white collars of experiencing a job separation. While the finding on the substitutability between KIBS and white collars within the firm is more intuitive, the finding on material imports might not be so straightforward. However, if purchases from advanced economies consist of more knowledge intensive goods, then they may well substitute for white collars, especially for material imports not directly related the core business of the firm. As a matter of fact, taking a car producing firm as an example, imports of computers may well substitute for the work of some of the firm administrative employees, so as importing advanced technology electronic devices may well turn engineers and designers redundant. Both imports are not included in the narrow definition of offshoring, while they belong to the broad one and affect white collars only.

The above results have proved stable across a number of checks. Firstly, we have relaxed the imposed proportionality of offshoring indexes and we have tested whether freshly hired workers are more affected by an increase in offshoring measures. The results show that the offshoring effect is homogeneous, regardless of the worker's tenure. Secondly, we have tested whether heterogeneous effects could be detected on differenlty aged workers and, differently from Bachmann and Braun (2011), we have found no such evidence in our sample. Finally, we have substituted output for non energy intermediates in the denominator of our offshoring measures and all the previous evidence stays unchanged. All these sets of estimates are not shown here for the sake of brevity, nevertheless they are available from the authors upon request.

Competing risks

So far, we have studied the job stability in a single risk framework, without distinguishing between different destination states. In what follows we re-estimate the duration model in a competing risks framework with two risks of job exit: transition to another job in the manufacturing sector and transition out of the manufacturing sector.[12] We decide to focus on job-to-job

[11] This negative effect is especially important in Traditional Sectors, where the share of low skilled workers is usually higher.

[12] The derivation of the likelihood function in the competing risks framework is reported in Appendix B.

Table 3: Estimation Results of Outsourcing by Occupation and Origin Countries

	ALL EMPLOYEES		**WHITE COLLARS**		**BLUE COLLARS**	
	(1)	(2)	(3)	(4)	(5)	(6)
OFF_{serv}	0.556***	0.505***	0.643***	0.451***	0.241	0.254
	[0.129]	[0.124]	[0.192]	[0.160]	[0.177]	[0.182]
OFF^{High}_{narrow}	0.02		0.024		0.010	
	[0.015]		[0.024]		[0.019]	
OFF^{Low}_{narrow}	0.077***		-0.064		0.119***	
	[0.030]		[0.079]		[0.032]	
OFF^{High}_{broad}		0.017		0.054***		-0.016
		[0.011]		[0.018]		[0.015]
OFF^{Low}_{broad}		0.076***		-0.023		0.108***
		[0.026]		[0.068]		[0.028]
$ImpPen_j$	0.394***	0.385***	0.458***	0.393**	0.344***	0.360***
	[0.087]	[0.087]	[0.174]	[0.174]	[0.100]	[0.101]
$Unemp^{reg}$	-1.64	-1.651	-6.801	-6.928	0.002	-0.011
	[1.684]	[1.684]	[4.427]	[4.435]	[1.832]	[1.832]
$InformalLab^{reg}$	-3.721**	-3.701**	1.043	0.912	-3.19	-3.122
	[1.834]	[1.835]	[4.595]	[4.599]	[2.013]	[2.012]
VA_j	-1.999	-0.547	13.840***	14.886***	-6.786***	-5.753**
	[2.302]	[2.327]	[5.142]	[5.173]	[2.600]	[2.648]
ICT_j	0.559	0.546	0.645	0.016	0.705	0.763
	[1.162]	[1.134]	[2.258]	[2.174]	[1.355]	[1.339]
Cons.	-0.505	-2.415	-15.330***	-17.233***	3.987	2.806
	[2.193]	[2.256]	[4.995]	[5.051]	[2.493]	[2.585]
NT	511,919	511,919	146,218	146,218	365,701	365,701
N	19,259	19,259	4,589	4,589	14,670	14,670
Log-likelihood	-65,591.2	-65,590.0	-14,486.2	-14,482.0	-48,465.6	-48,466.5

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are shown in brackets. Dummy indicators for regions, years, sectors are included in all estimations but not reported for the sake of brevity. The reference categories are Firms with less than 20 employees for the Size of Firm where the worker is employed, and the first quarter of the year for the period of hiring.

transitions within manufacturing and on transitions out of manufacturing since the welfare consequences may be very different. Transition out of manufacturing employment have immediate detrimental effects for the economy in terms of deterioration of sectoral specific human capital and, thereby, higher risk of future nonemployment, skill obsolescence, and costs related to re-training programs. Instead, job-to-job transitions within manufacturing might not represent a real damage, as they might put an end to bad job matches and move employees towards more technology and knowledge intensive firms and/or sectors, which are also less exposed to international competition.

We skip the discussion of the results for the measure of the total offshoring, that are presented in Table 7 in the Appendix, for the sake of brevity and we focus on the more insightful analysis of offshoring by input origin. Table 4 displays the findings for the competing risks duration model with the indicator of offshoring split by country groups. The upper and bottom panels shows the effects for out of manufacturing and job-to-job transitions, respectively. For the total sample of employees only the input purchases from low income countries turn to significantly increase the transitions out of manufacturing, while offshoring to developed countries displays no role. However, when we separately consider white and blue collars, the detrimental effect of offshoring to low income countries for job stability only concerns the latter group of workers. A 10 percentage point increase in the narrow (broad) offshoring share increases the monthly exit rate out of manufacturing of blue collar workers by 11.4% (10.5%). Thus, consistently with our expectations, the process of delocalisation of production towards developing countries throws only blue collars out of the market. These results are robust to the different definitions, broad or narrow, of offshoring.

A very different picture is displayed for job-to-job transitions. Also in this case it is the offshoring to developing countries that seems to have a greater impact on the job separations, but, contrary to the case of out of unemployment transitions, in the case of job-to-job transitions the main effect is revealed for white collar workers.

The role of offshoring to high income countries is not clearcut. These flows of inputs has no impact on the worker probability of exiting manufacturing sector, while there is evidence of a mild positive effect on the probability of changing work for unskilled workers. However, this effect is significant only at 10% and is detected only through the broad measure of offshoring.

Turning the attention on the flows of KIBS from abroad, they do not contribute to the workers' exits from manufacturing sector, while, contrary to our expectations, they seem to more impact on the job-to-job transitions of blue collars than white collars. This is in contrast with the results from the single risk model showing an impact on white collars. It could be driven by the high heterogeneity of services even if defined as KIBS or by the small

numbers of white collar workers that do not allow to precisely identify an effect through a competitive risk model.

Finally, the results concerning other sectoral and regional variables show no meaningful evidence, with the exception of the role for sectoral import penetration that seems to drive workers out of manufacturing especially when they are unskilled, thus revealing that this category of employees is, in general, more exposed to the growing international integration across countries.

Summing up, the overall analysis shows that it is mainly the purchase of inputs from low labour cost economies that increases the job separations, but this effect is heterogeneous according to the worker skill level. While for blue collars this effect mainly consists in a greater probability to be driven out of manufacturing, skilled workers experience a transition to another manufacturing job. Thus, the main focus of policy intervention should be on low skilled workers that are the ones to be more affected by the process of fragmentation of production across countries and, more in general, by the deeper and deeper integration of countries, as also shown by the indicator of import penetration.

7 Conclusions

Theoretical models show that offshoring activities have both short and long run effects. The consequences of the increasing purchases of foreign intermediates depend on the time horizon. In the short run, the theoretical predictions highlight the possibility that an expansion in offshoring activities might increase the job destruction rate in the short run because of both a process of externalization abroad and the replacement of domestic suppliers by foreign suppliers. However, in the long run the economic theory suggests that productivity gains from offshoring may arise for all the workers involved in production. However, even if offshoring is associated with internal reorganizations leading the firm to focus on more value-added tasks and on activities with higher comparative advantages, it may well take a long time before these gains are delivered. The adjustment process, then, may produce long-lasting economic and social costs. Then, regardless of the potential beneficial long run outcome of delocalisation, the short run consequences of offshoring are a relevant issue to focus on, since any policy intervention should be firstly concerned with restraining the immediate welfare costs and with easing the transition to a new equilibrium. For this reason, the focus of our paper is on the short run dynamics of the labour market.

To this purpose, we use two types of duration models in order to detect the role of offshoring for the job stability. First, we estimate a single risk model to understand the impact of offshoring on the job exit rate. Second,

Table 4: Estimation Results of Competing Risks Model

	ALL EMPLOYEES		**WHITE COLLARS**		**BLUE COLLARS**	
	(1)	(2)	(3)	(4)	(5)	(6)
			OUT OF MANUFACTURING			
OFF_{serv}	0.231	0.189	0.008	-0.024	0.299	0.254
	[0.178]	[0.172]	[0.298]	[0.290]	[0.221]	[0.213]
OFF^{High}_{narrow}	0.014		0.015		0.015	
	[0.021]		[0.040]		[0.025]	
OFF^{Low}_{narrow}	0.096**		0.018		0.114**	
	[0.039]		[0.086]		[0.045]	
OFF^{High}_{broad}		0.008		0.014		0.008
		[0.016]		[0.030]		[0.019]
OFF^{Low}_{broad}		0.091***		0.026		0.105***
		[0.034]		[0.072]		[0.039]
$ImpPen_j$	0.376***	0.375***	0.199	0.186	0.419***	0.420***
	[0.132]	[0.132]	[0.265]	[0.266]	[0.153]	[0.153]
$Unemp^{reg}$	-1.098	-1.078	1.982	1.915	-2.113	-2.057
	[2.466]	[2.466]	[5.339]	[5.336]	[2.841]	[2.841]
$InformalM^{reg}$	-1.263	-1.193	3.541	3.600	-2.015	-1.959
	[2.674]	[2.672]	5.604]	[5.600]	[3.084]	[3.083]
VA_j	2.248	3.417	-6.441	-5.656	4.783	6.039
	[3.442]	[3.466]	[7.384]	[7.447]	[3.934]	[3.952]
ICT_j	0.885	0.943	-3.047	-3.202	2.219	2.357
	[1.784]	[1.730]	[3.728]	[3.599]	[2.041]	[1.984]
			JOB to JOB in MANUFACTURING			
OFF_{serv}	0.717***	0.635***	0.378	0.290	0.797***	0.722***
	[0.181]	[0.170]	[0.389]	[0.362]	[0.205]	[0.192]
OFF^{High}_{narrow}	0.041*		0.055		0.034	
	[0.022]		[0.043]		[0.262]	
OFF^{Low}_{narrow}	0.064		0.231**		0.013	
	[0.048]		[0.093]		[0.055]	
OFF^{High}_{broad}		0.037**		0.041		0.034*
		[0.017]		[0.035]		[0.020]
OFF^{Low}_{broad}		0.077*		0.208***		0.038
		[0.041]		[0.080]		[0.048]
$ImpPen_j$	0.362***	0.332***	0.505**	0.476**	0.324**	0.296**
	[0.118]	[0.118]	[0.225]	[0.225]	[0.139]	[0.140]
$Unemp^{reg}$	-4.369*	-4.428*	-8.843*	-8.863*	-2.680	-2.753
	[2.371]	[2.371]	[5.055]	[5.052]	[2.718]	[2.718]
$InformalM^{reg}$	-4.778*	-4.853*	-13.512**	-13.527**	-2.681	-2.759
	[2.642]	[2.646]	[5.864]	[5.889]	[2.983]	[2.987]
VA_j	-3.950	-1.226	3.175	7.360	-6.711*	-4.460
	[3.204]	[3.258]	[6.912]	[7.032]	[3.628]	[3.697]
ICT_j	1.516	1.226	2.267	2.300	1.390	1.010
	[1.603]	[1.557]	[3.258]	[3.183]	[1.859]	[1.809]
NT	511,919	511,919	146,218	146,218	365,701	365,701
N	19,259	19,259	4,589	4,589	14,670	14,670
Log-likelihood	-60,507.4	-60,505.1	-14,318.4	-14,318.2	-46,179.1	-46,177.8

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are shown in brackets. Dummy indicators for regions, years, sectors are included in all estimations but not reported for the sake of brevity. The reference categories are Firms with less than 20 employees for the Size of Firm where the worker is employed, and the first quarter of the year for the period of hiring.

in a competing risks framework, we analyse the impact of offshoring on the transitions out of manufacturing and on the job-to-job transitions within manufacturing.

Our findings suggests that the process of international fragmentation of production has contributed to significantly reduce the job stability in the Italian manufacturing sectors. The effect of offshoring is however heterogeneous across skill groups and depends on the origin country of inputs. As a matter of fact, imports of intermediates from low labour cost countries appear to significantly reduce the job stability of workers. However, while these foreign input flows foster the within manufacturing job-to-job transition for white collars, they instead contribute to drive blue collars out of manufacturing. Thus, it is especially this latter category of workers that policy intervention should focus on, since the job-to-job transitions that skilled workers experience due to offshoring do not cause any relevant social costs and instead may be related to a process of structural change within economy fostered by the international fragmentation of production. In opposite, the cost of offshoring seems to concern only the unskilled workers. Additionally, our evidence shows that also the competitive pressure from foreign countries on the domestic markets, captured by the sectoral import penetration, has the same effect to increase the probability of unskilled workers to exit the manufacturing sector. These findings suggest that the general international integration process is driving the dismantling of manufacturing activities, at least of those ones characterised of less knowledge/technology intensive and of more routinary tasks. As a consequence, policy makers should devote their attention on the low skilled workers and should be seriously committed to ease the re-training and the skill upgrading of these displaced workers, in order to foster their transition to those more knowledge intensive jobs, which are less affected by the international competition in terms of job displacement.

Appendix

A Deriving the Likelihood function with Single Risk

In what follow we suppress the set of observed and unobserved characteristics for the sake of keeping the notation as simple as possible. We are however implicitly conditioning on them. In the data duration is measured in discrete time. We assume that the discrete time process is generated by some underlying continuous time process. Since we have monthly data, we do not exactly know when the job exit occurs within two consecutive months. Hence, we model the probability of observing the job departure within two consecutive months. The contribution to the likelihood function of a complete job spell after t months is the unconditional probability $\Pr(t-1 \leq T < t)$ that can be rewritten as the difference of two survivor

functions, i.e.

$$\Pr(t-1 \leq T < t) = \Pr(T \geq t-1) - \Pr(T > t). \tag{9}$$

The survivor function until the end of the $(t-1)$-th month is given by

$$\begin{aligned}
\Pr(T \geq t-1) &= \exp\Big\{ -\int_0^{t-1} \exp\big[-\theta(r)\big]dr \Big\} \\
&= \exp\Big\{ -\int_0^{1} \exp\big[-\theta(r)\big]dr - \int_1^{2} \exp\big[-\theta(r)\big]dr - \dots \\
\dots &\quad -\int_{t-2}^{t-1} \exp\big[-\theta(r)\big]dr \Big\}.
\end{aligned}$$

Under the assumption that the job hazard rate is constant within two consecutive months, the hazard rates can be taken out of the integrals, yielding

$$\Pr(T \geq t-1) = \prod_{r=1}^{t-1} \exp\big[-\theta(r)\big] \equiv S(t-1). \tag{10}$$

We can similarly formalize $Pr(T > t)$, which yields the contribution to the likelihood function of a complete job spell as reported in Equation (6).

B Deriving the Likelihood function with Competing Risks

In a competing risks framework, at each point of time the origin spell can be terminated because of multiple reasons of exit. Suppose that after t months spent in a job, a transition to the destination state k is observed, with $k = 1, \dots, K$. Denote D_k an indicator variable equal to 1 if a transition to k is observed and 0 otherwise. As in the previous subsection, we suppress the set of observed and unobserved characteristics, although we are implicitly conditioning on them.

The contribution to the likelihood function is the unconditional probability of jointly observing the departure from the origin state and the transition to k after a sojourn of t months, i.e. $\Pr(t-1 \leq T < t, D_k = 1)$. Since we have monthly information, we do not exactly know when the transition occurs within two consecutive months. Hence, we model the probability of observing the departure within two consecutive months. This probability can be rewritten as

$$\Pr(T \geq t-1) \Pr(t-1 \leq T < t, D_k = 1 | T \geq t-1), \tag{11}$$

which is the product of the survivor function and of a conditional probability.

The survivor function in the origin state for $t-1$ months is given by

$$\begin{aligned}\Pr(T\geq t\text{–}1) &= \exp\left\{ -\int_0^{t-1} \sum_{k=1}^{K} \theta_k(r)dr \right\} \\ &= \exp\left\{-\int_0^1 \sum_{k=1}^{K} \theta_k(r)dr - \int_1^2 \sum_{k=1}^{K} \theta_k(r)dr - \ldots - \int_{t_s-2}^{t_s-1} \sum_{k=1}^{K} \theta_k(r)dr\right\},\end{aligned}$$

where $\theta_k(r)$ is the transition intensity towards the destination state k, i.e. the instantaneous probability of moving to k conditional on surviving r months in the origin state. As in the single risk case, the K transition intensities are assumed to have a MPH form. Assuming that the transition intensities are constant within two consecutive months, we obtain

$$\Pr(T \geq t-1) = \prod_{r=1}^{t-1} \exp\left\{ -\sum_{k=1}^{K} \theta_k(r) \right\} \equiv S(t-1). \tag{12}$$

The conditional probability in (11) can be written as

$$\Pr(t-1 \leq T < t, D_k = 1 | T \geq t-1) = \frac{\int_{t-1}^{t} \theta_k(\tau) \exp\left\{ -\int_0^r \sum_{k=1}^{K} \theta_k(r)dr \right\} d\tau}{\exp\left\{ -\int_0^{t-1} \sum_{k=1}^{K} \theta_k(r)dr \right\}} \tag{13}$$

and exploiting again the assumption that the transition intensities are constant within two consecutive quarters, Equation (13) can be rewritten as

$$\left[1 - \exp\left\{ -\sum_{k=1}^{K} \theta_k(t) \right\}\right] \times \frac{\theta_k(t)}{\sum_{j=1}^{K} \theta_j(t)}. \tag{14}$$

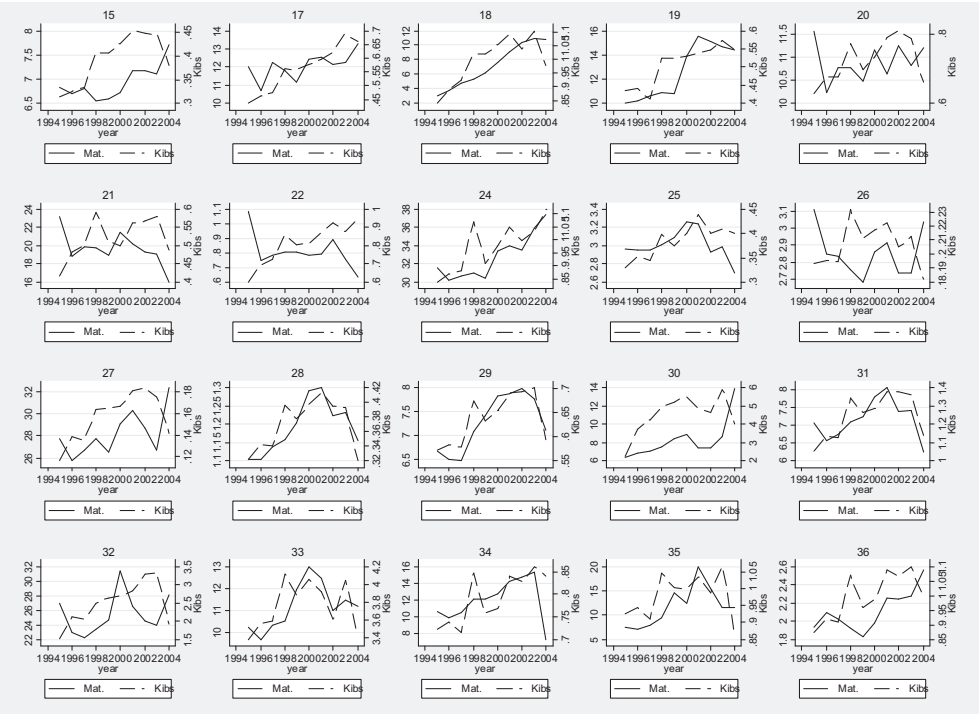
Multiplying (12) by (14), we get the contribution to the likelihood function of a complete spell ending in k.

The contribution to the likelihood function of an incomplete job spell of length t is simply given by the survivor function, i.e.

$$\Pr(T \geq t) = \prod_{r=1}^{t} \exp\left\{ -\sum_{k=1}^{K} \theta_k(r) \right\} \equiv S(t).$$

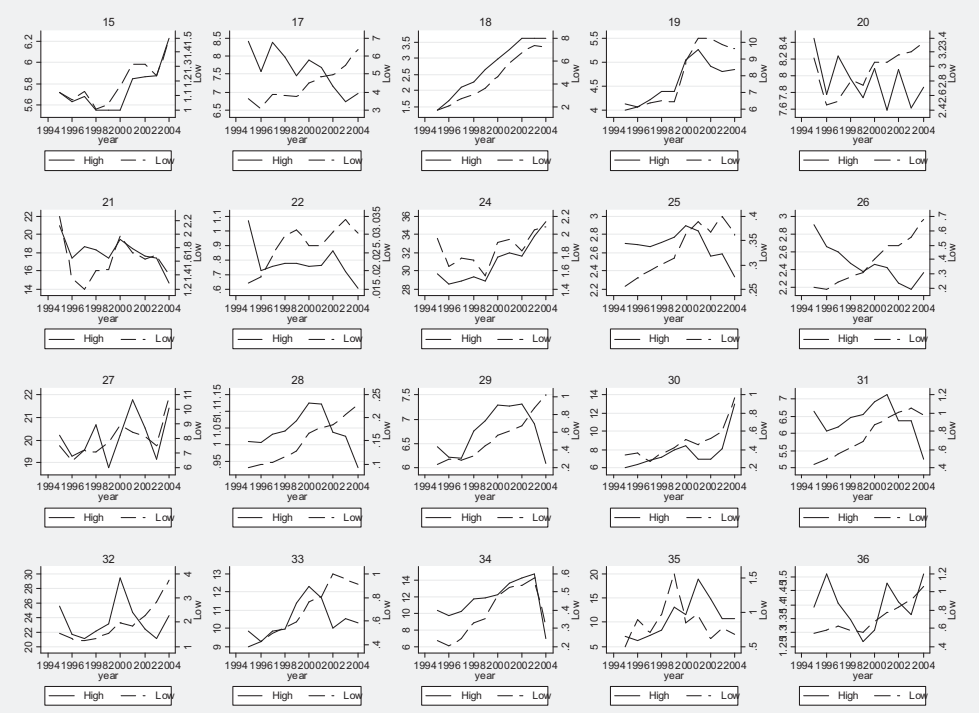
C Additional Figures and Tables

Figure 2: Evolution of Material and Service Offshoring by 2 digit NACE Manufacturing Sector



The graphs present two scales, the one on the vertical axis on the left for material offshoring and the one on the right for offshoring of KIBS. Source: WITS-COMTRADE database and ISTAT.

Figure 3: Offshoring evolution split by origin of material intermediates and 2 digit NACE Manufacturing Sector



The graphs present two scales, the one on the vertical axis on the left for material offshoring to high income countries and the one on the right for offshoring to low income countries. Source: WITS-COMTRADE database and ISTAT.

Table 5: Definition of Variables

Variable	Description
Female	Dummy for the employees' gender. 1 for Female, 0 for Male. Source: ISFOL database
Age	Age of the employee. Source: ISFOL database
WhiteCollar	Dummy for the skill level of job. 1 for white collar jobs, 0 for Blue Collar jobs. Source: ISFOL database
Italian	Dummy for the employees' nationality. 1 for Italian workers, 0 for migrants. Source: ISFOL database
Wage	Logarithm of the daily gross wage. Source: ISFOL database
WorkExp	Worker experience computed as the number of months the employee has worked till the start of the current job. Source: ISFOL database
PrevJobs	Number of previous jobs of the worker. Source: ISFOL database
Quarter2	Dummy with value 1 for workers hired in the months April-May-June. Source: ISFOL database
Quarter3	Dummy with value 1 for workers hired in the months July-August-September. Source: ISFOL database
Quarter4	Dummy with value 1 for workers hired in the months October-November-December. Source: ISFOL database
Size2	Dummy with value 1 for workers employed in firms with more than 20 employees but less than 50. Source: ISFOL database
Size3	Dummy with value 1 for workers employed in firms with more than 50 employees but less than 250. Source: ISFOL database
Size4	Dummy with value 1 for workers employed in firms with more than 250 employees but less than 550. Source: ISFOL database
Size5	Dummy with value 1 for workers employed in firms with more than 550 employees. Source: ISFOL database
OFF_{serv}	Offshoring of KIBS. Source: Istat and WITS-COMTRADE
OFF_{narrow}	Narrow indicator of Offshoring of Material Intermediates. Source: Istat and WITS-COMTRADE
$\text{OFF}_{narrow}^{High}$	Narrow indicator of Offshoring of Material Intermediates to High Income Countries. Source: Istat and WITS-COMTRADE
$\text{OFF}_{narrow}^{Low}$	Narrow indicator of Offshoring of Material Intermediates to Low Income Countries. Source: Istat and WITS-COMTRADE
OFF_{broad}	Broad indicator of Offshoring of Material Intermediates. Source: Istat and WITS-COMTRADE
$\text{OFF}_{broad}^{High}$	Broad indicator of Offshoring of Material Intermediates to High Income Countries. Source: Istat and WITS-COMTRADE
OFF_{broad}^{Low}	Broad indicator of Offshoring of Material Intermediates to Low Income Countries. Source: Istat and WITS-COMTRADE
ImpPen_j	Sectoral Import Penetration. Source: Istat and WITS-COMTRADE
Unemp^{reg}	Regional Unemployment Rate. Source: Istat
InformalLab^{reg}	Regional estimated share of illegal (informal) employment. Source: Istat
VA_j	Sectoral Value Added. Source: Istat
ICT_j	Logarithm of the sectoral capital stock in office machines, telecommunication apparatus and software over the total sectoral employment. Source: Istat

Table 6: Pairwise Correlations

	OFF_{narrow}	OFF_{broad}	OFF_{serv}	OFF^{High}_{narrow}	OFF^{Low}_{narrow}	OFF^{High}_{broad}	OFF^{Low}_{broad}	$ImpPen_j$	$Unemp^{reg}$	$InformalLab^{reg}$	VA_j	ICT_j
OFF_{narrow}	1											
OFF_{broad}	0.623	1										
OFF_{serv}	0.170	0.649	1									
OFF^{High}_{narrow}	0.974	0.660	0.221	1								
OFF^{Low}_{narrow}	0.506	0.114	-0.125	0.297	1							
OFF^{High}_{broad}	0.599	0.980	0.660	0.674	-0.041	1						
OFF^{Low}_{broad}	0.264	0.223	-0.021	0.085	0.792	0.025	1					
$ImpPen_j$	0.105	0.096	0.115	0.167	-0.194	0.148	-0.235	1				
$Unemp^{reg}$	-0.008	-0.012	0.038	-0.008	-0.005	-0.007	-0.026	-0.065	1			
$InformalLab^{reg}$	0.000^{+}	-0.012	0.046	-0.006	0.021	-0.013	0.004	-0.082	0.892	1		
VA_j	-0.245	-0.582	-0.670	-0.199	-0.272	-0.542	-0.223	0.318	-0.086	-0.081	1	
ICT_j	0.451	0.784	0.800	0.510	-0.039	0.806	-0.029	0.100	0.016	0.022	-0.658	1

$^{+}$ Non significant. All other correlations are significant at 1% level.

Table 7: Estimation Results of Competing Risks Model

	ALL EMPLOYEES		**WHITE COLLARS**		**BLUE COLLARS**	
	(1)	(2)	(3)	(4)	(5)	(6)
			OUT OF MANUFACTURING			
OFF_{serv}	0.210	0.16	-0.001	-0.444	0.275	0.222
	[0.177]	[0.169]	[0.297]	[0.286]	[0.220]	[0.209]
OFF_{narrow}	0.035**		0.015		0.041**	
	[0.016]		[0.030]		[0.019]	
OFF_{broad}		0.027**		0.018		0.030**
		[0.013]		[0.026]		[0.015]
$ImpPen_j$	0.386***	0.375***	0.195	0.182	0.433***	0.422***
	[0.131]	[0.131]	[0.265]	[0.266]	[0.153]	[0.152]
$Unemp^{reg}$	-0.959	-0.950	2.100	2.095	-1.956	-1.960
	[2.464]	[2.464]	[5.326]	[5.324]	[2.837]	[2.835]
$InformalLab^{reg}$	-1.152	-1.085	3.612	3.573	-1.867	-1.784
	[2.673]	[2.673]	[5.600]	[5.600]	[3.084]	[3.085]
VA_j	1.042	2.136	-6.625	-5.869	3.369	4.615
	[3.423]	[3.459]	[7.155]	[7.185]	[3.915]	[3.962]
ICT_j	1.841	1.874	-3.066	-3.102	3.394*	3.468*
	[1.669]	[1.664]	[3.555]	[3.534]	[1.900]	[1.895]
			JOB to JOB in MANUFACTURING			
OFF_{serv}	0.720***	0.635***	0.388	0.295	0.803***	0.727***
	[0.181]	[0.168]	[0.387]	[0.350]	[0.205]	[0.192]
OFF_{narrow}	0.047***		0.098***		0.029	
	[0.018]		[0.036]		[0.021]	
OFF_{broad}		0.046***		0.079***		0.035**
		[0.014]		[0.029]		[0.017]
$ImpPen_j$	0.364***	0.330***	0.511**	0.470**	0.326**	0.297**
	[0.118]	[0.118]	[0.224]	[0.223]	[0.139]	[0.140]
$Unemp^{reg}$	-4.331*	-4.360*	-8.504*	-8.440*	-2.698	-2.726
	[2.371]	[2.373]	[5.095]	[5.105]	[2.714]	[2.716]
$InformalLab^{reg}$	-4.750*	-4.834*	-13.386**	-13.486**	-2.695	-2.774
	[2.641]	[2.646]	[5.892]	[5.913]	[2.983]	[2.986]
VA_j	-4.127	-1.646	0.998	5.165	-6.239*	-4.305
	[3.143]	[3.206]	[6.957]	[7.097]	[3.549]	[3.638]
ICT_j	1.677	1.580	3.699	3.774	1.18735	1.077
	[1.535]	[1.509]	[3.096]	[3.045]	[1.789]	[1.760]
NT	511,919	511,919	146,218	146,218	365,701	365,701
N	19,259	19,259	4,589	4,589	14670	14670
Log-likelihood	-60,509.0	-60,506.8	-14,319.7	-14,319.2	-46,180.7	-46,179.6

Notes: * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are shown in brackets. Dummy indicators for regions, years, sectors are included in all estimations but not reported for the sake of brevity. The reference categories are Firms with less than 20 employees for the Size of Firm where the worker is employed, and the first quarter of the year for the period of hiring.

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