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Abstract

Like businesses in other developed countries, Spanish firms increased the share of skilled workers they employed during the 1990s. This paper attempts to examine whether this change in the Spanish labor market can be attributed to demand shifts or to skill-biased technological change. It finds, just as in the US, that skill-biased technological change is a more likely hypothesis. Using a type of decomposition methodology, I find that the increase in aggregate skill mix comes mainly from continuing firms increasing their labor skill mixes –presumably in response to the re-tooling or upgrades in technology in these firms–. Unlike the findings in the US, my results indicate that the increase in aggregate skill mix in Spain seems to be procyclical.

Going further, I also perform sub-decompositions that categorize firms according to dimensions that reflect the “idiosyncrasies” of Spain’s labor market; in particular the use of permanent vs. temporary contracts. The results support the idea that temporary worker contracts may be lending flexibility to the labor market as policymakers intended. Finally, I examine the dynamics of skill mix changes according to the firms’ rate of technological innovation. The results show that the most innovative firms account for the majority of the increase in skill mix during the 1990s in Spain, a finding that support the skill-biased technological change hypothesis.

1 Introduction

Over the past several decades there has been greater demand for skilled workers and a simultaneous increase in the wage gap between skilled and less-skilled workers in many industrialized countries[1]. For example, using data on individual Spanish workers, Bover, Bentolila and Arellano (2000) find that Spain had a measurable increase in earnings inequality during the 1980s, largely because of more rapid wage growth at the top of the earnings distribution towards the end of the decade. Similarly, Torres (2002) showed a growth in the skilled/unskilled earnings differential of slightly more than 1% beginning in 1984 and extending into the early 1990s, a similar pattern to what other authors have observed in other OECD countries.

As economists have attempted to explain the increasing demand and wage gap, they have developed two main theories. The first is that changes in product demand, possibly due to increased participation in international trade, have led to the expansion of skill-intensive products and industries. The expansion of these industries could then lead to a subsequent increase in the demand for skilled workers, and thus, in the wage premiums on their abilities. The alternative explanation ties changes in the demand for skilled workers to the introduction of skill-biased technologies across a broad spectrum of industries [Bound and Johnson (1992), Davis and Haltiwanger (1991), Sachs and Shatz (1994)]. If technology adoption is pervasive across industries, and if skilled labor is a complement to the new equipment or processes, then there will be an increase in the demand for skilled workers relative to less-skilled workers and a subsequent increase in their (skilled) wages relative to those of less-skilled workers.

Several studies have explored the relationship between technology and skill mix and/or wage structure with standard regression analysis. In the US, Berndt, Morrison and Rosenblum (1992), Berman, Bound and Griliches (1994), and Autor, Katz and Krueger (1997) model changes in workforce skill as a function of changes in industry capital intensity and industry-level investment in computer equipment. These studies find evidence that capital and skill are complements and that there is a positive correlation between changes in the skill of workers in an industry and the level of computer investment in the industry.

Krueger (1993) uses cross-sectional worker data and finds that workers using computers are better paid than non-users. Dunne and Schmitz (1995), using plant-level data, show that workers employed in establishments that use more technologies are paid higher wages. In their cross-sectional study, Doms, Dunne and Troske (1997) find that the most technologically advanced plants pay their workers higher wages than the least technologically advanced plants. However, in their longitudinal study, they find no correlation between technology adoption and worker wages, and conclude that most technologically advanced plants pay higher wages both pre and post adoption of new technologies.

Dunne, Haltiwanger and Troske (1996) (DHT henceforth) find that while observable indicators of changes in technology account of a significant fraction of the secular increase in the average non-production labor share, unobservable factors account for most of the secular increase. Also in the US, Luque and Miranda (2000) find that unskilled workers in

1. For example, see Castillo and Jimeno (1997), Castillo (1996), Bover, Bentolila and Arellano (2000) in Spain, and Berman, Bound and Griliches (1994), Davis and Haltiwanger (1994) in the US.

high-technology firms get penalized in terms of wages; this result seems to support the skill-biased technological change hypothesis.

On the other hand, the results using European data have been less clear. In France, Entorf, Gollac and Krazmarz (1999) conduct a study using longitudinal data, but find no evidence of skilled-biased technological change. They attribute this result to wage inflexibility in the French economy. Similarly in Spain, Bover, Bentolila and Arellano (2000) find little evidence of a relationship between technology and skill mix. They speculate that this result could be due their poor measure of a firm's technical progress. Finally, arguing against the earlier papers featuring US data, DiNardo and Pischke (1997) use German data to argue that the "computer premium" noted by Krueger has less to do with computer use than it does with worker ability.

Perhaps most importantly for the paper at hand, DHT's decomposition results, using US data, indicate that aggregate changes in the nonproduction labor share are dominated by within-plant changes. Evidence that the "within" component plays a large part in aggregate skill intensity changes is consistent with pervasive, general re-tooling of firms' means of production and the hiring of additional skilled workers. This supports the skill-biased technological change hypothesis. Their other main finding is that within-plant secular increases are concentrated in recessions.

To sum up, while several studies have provided evidence in favor of the skill-biased technological change hypothesis, some recent evidence does not support it and even contradicts these earlier results, particularly for European economies. To further explore these issues, I use firm-level data from Spain to examine the connection between technology changes and shifts in the skill mix of the firms' employees. I examine these effects both over time and across types of firms. To accomplish this, first I follow Dunne, Haltiwanger and Troske (1996) methodology and decompose aggregate skill mix changes into four distinct components: a within-firm effect that reflects a general increase in workforce skill, a between-firm effect that captures the reallocation of the employment from continuing low-skill to continuing high-skill firms, a covariance term and finally a net entry term that will be positive if entering high-skill firms are displacing lower-skill exiting firms.

These simple exercises have the potential to shed light on the two competing hypotheses. For example, if international trade and/or integration into the European community have increased the demand for skilled workers, then the observed change in skill mix should be primarily a "between-firm" phenomenon because employment should shift to more skill-intensive continuing firms. Similarly, if skill intensive industries are growing particularly rapidly then this should be reflected in the net entry term. Entering firms would be expected to be more skill-intensive than exiting firms.

Alternatively, if the observed aggregate skill upgrading is largely due to skill-biased technological change, then changes in aggregate skill intensity are primarily caused by a broad spectrum of firms re-tooling and upgrading their means of production. This process should be reflected in the decomposition's "within" component which captures the part of aggregate skill mix attributable to continuing firms of all industries changing their individual labor skill mixes. There is also a role for net entry in this theory. Several authors [Caballero and Hammour (1994) and Campbell (1997)] have suggested that production technologies are so deeply imbedded in existing capital, that firms wishing to retool must build their plants from scratch. In terms of the decomposition we would again expect the changes in skill levels to come to some extent from net entry.

After performing the decomposition for the entire eight year period, I explore the cyclical pattern of these changes by dividing the sample into two four-year periods, each one of them corresponding to a recessionary (1990-1994) and recovery (1994-1998) period in Spain.

As a preview, my results are consistent with the skill-biased technological change hypothesis. The main decomposition indicates that the changes in aggregate skill-mix primarily come from the within component. also perform supplementary exercises on the net entry term that support this hypothesis. When I examine the cyclical pattern of these changes, I find that, unlike in the US, they seem to be procyclical. That is, the bigger increase in skill mix occurs during Spain's recovery period while in the US, the bigger increases occurred during recessions.

One of the main differences between the US and Spain's labor market is flexibility.While the US labor market is fairly flexible in terms of the hiring and firing of workers, Blanchard et al. (1995) remarked that the microeconomic aspects of the Spanish labor market make it one of the most rigid in the industrial world. These rigidities, in the form of binding employment contracts carrying high separation costs have been well documented in papers such as Bentolila and Saint-Paul (1992). In response to these contracts' negative effect on employment trends, the Spanish government in 1984 created alternative types of temporary employment of workers with little or no separation costs (legal or pecuniary) upon contract termination. These flexible contracts have allowed larger employment responses over the course of business cycles, particularly in the downward direction, but their effect on skill mix changes is unclear. They have also created a "dual" labor market with workers hired on permanent contracts, who enjoy strong employment protection legislation and bargaining power through labor unions on one side, and workers employed under temporary contracts who lack employment protection and bargaining power, and have much higher turnover rates and generally lower salaries. [See, for instance, Dolado, García-Serrano and Jimeno (2001).]

Given the dual nature of the Spanish labor market, interesting questions arise: How are these skilled-labor shares being accomplished? What types of firms are the ones accounting for most of the change in the aggregate skill mix? Do the percentage changes in skilled and less-skilled workers come about due to changes in the shares of permanent or temporary-contract workers? And, how are these dynamics affected by the business cycle?

To address these questions, I perform sub-decompositions of aggregate skill mix changes in which I classify firms according to a few key variables that are particularly relevant to the "idiosyncrasies" of the Spanish labor market. For example, I classify firms according to whether their workforce has a relatively high or low share of workers with permanent labor contracts ("high-permanent" or "low-permanent" firms respectively). I then perform sub-decompositions according to this distinction to examine the contribution of the two types of firms to aggregate skill mix change. This exercise could have implications for debates on Spanish (and other European countries') labor market liberalization if it identifies and quantifies the relative contribution of different types of employers to aggregate labor skill mix.

The results from the sub-decompositions by type of firm and time period show that during the recessionary period (1990-1994), the firms with a relatively high percentage of temporary contracts account slightly more for the change in skill-mix, while in the recovery period (1994-1998), the firms that account for most of the change are the firms with a relatively high percentage of permanent contracts. Nevertheless, when I drill down and examine the cyclicality of the changes in the percentages of skilled and less-skilled workers of "high-permanent" and "low-permanent" firms, the "low-permanent" firms are more sensitive to the business cycle and may be fulfilling their role of lending more flexibility to the Spanish labor market.

I also divide firms according to their level of technological (process or products) innovations and perform sub-decompositions according to these classifications. As could be expected given the results supporting the skill-biased technological change hypothesis, I find that "High-Technology" firms are mainly responsible for the aggregate changes in skill-mix both during the recessionary and recovery periods.

In sum, the paper makes three contributions to the empirical literature on aggregate skill mix change. First, it explores changes in aggregate skill mix in the Spanish labor market during the last decade and sheds light on the competing hypotheses regarding the increase in the skill mix (or ratio) in a European Union country –which can then be contrasted with DHT's findings from the US– including the counter-cyclical skill mix changes they document. The second main contribution is to explore the contributions to aggregate skill-mix changes of different types of firms, such as those with relatively large (small) shares of permanent-contract workers. As indicated earlier, I do this by performing sub-decompositions that will show not only what types of firms are mainly responsible for the skill-mix increase experienced during the 1990s in Spain, but also how they may achieve these contributions differently (within vs. between effects). Thirdly, I explore their behavior across the 1990s Spanish business cycle.

The structure of the paper is as follows. The next section introduces a review of the theoretical background underlying the empirical study. Section II follows with a description of the estimation methodology, continuing with Section III, which describes the data that I use. Section IV first presents a detailed account of the results obtained from the main decomposition of changes in skill-mix during the 1990s, and in addition, clarifies which of the competing hypothesis they tend to support; I will also explore the cyclical pattern of the skill-mix changes and how these changes occur. Secondly and also in the Results Section, I will drill down and present the results of sub-decompositions on three fronts: i) what types of firms are mainly responsible for the changes in aggregate skill mix, ii) how these changes seem to occur, and iii) the cyclical pattern of these changes. I finally conclude in Section V.

2 Estimation Methodology

2.1 Theoretical Background

As mentioned above, decompositions of aggregate skill mix into "Within", "Between" and "Net Entry" components can help us disentangle the relative contributions of skill biased technological change and demand shifts in accounting for overall skill mix changes. However, before examining the decomposition methodology in more detail, it is useful to succinctly present the underlying theoretical framework that helps explain how a firm chooses a given skill level (e.g. a given number of skilled and unskilled workers).

Following some of the literature [see for instance, Dunne, Haltiwanger and Troske (1996), and Doms, Dunne and Troske (1997)], a firm's optimal choice of skill mix is determined by short run cost minimization given a certain level of output (y_{it}), and a given state of technology (X_{it}), which is embodied in the firm's capital. I, thus, treat skilled and unskilled labor as variable inputs to be determined given y_{it} and X_{it}. That is, the firm *i* minimizes $w^s_t L^s_{it} + w^u_t L^u_{it}$ [where w^s_t and w^u_t are the wages of skilled and unskilled workers respectively at time (*t*)] subject to $y_{it} = F(X_{it}, L^s_{it}, L^u_{it})$ where w^s_t and w^u_t are given. F(.) is assumed to be strictly concave[2].

The standard condition that equates the ratio of the marginal products to the ratio of the wages of skilled to unskilled labor gives us the optimal L^s_{it} and L^u_{it}. For the purpose of this paper, it is useful to express the optimal skill mix (Mit) as:

$$M_{it} = L^s_{it}/(L^u_{it} + L^s_{it}) = m(X_{it}, w^s_t/w^u_t, y_{it}) \qquad (1)$$

The skill mix, M_{it}, is decreasing in the relative wages of skilled-to-unskilled labor. The sign and magnitude of the complementarity between X and skill (m_x) will depend on the degree of the skill-biased technological change. Short-run nonhomotheticity (m_y) will reflect the changes in the skill mix due to changes in the level of output (for a given X).

2.2 Empirical Methodology

The previous section examined how the firm makes its decision about the optimal number of skilled and unskilled labor for a given output and state of technology. It focused on the optimal within-firm skill mix determination. However, one of the main focuses of this paper is to see how the aggregate skill mix in the manufacturing sector changes over time. For this purpose, I need to take into consideration not only the within-firm component but also changes that occur because of changes in the employment shares across firms.

The type of decomposition I perform follows the one used in DHT (1996) and Foster, Haltiwanger and Krizan (1998), which is a modified version of that used by Baily, Hulten, and Campbell (1992). As shown in Foster, Haltiwanger, and Krizan (1998), there are alternatives as to the precise decomposition used and they can impact the results significantly[3]. Therefore, I use a decomposition that I believe has the most direct economic interpretation of the terms in the decomposition. Virtually all of the studies in the literature that use the decomposition methodology, consider some form of decomposition of an index of industry-level (in this paper, skill mix):

2**.** It is assumed that there is some additional factor other than X.

3**.** This decomposition differs somewhat from others that have appeared in the literature in subtle but important ways that are documented in Foster, Haltiwanger and Krizan (1998).

$$M_t = \sum_{i \in I} s_{it} m_{it} \tag{2}$$

where M_t is the index of industry skill mix, s_{it} is the share of firm i in the industry (e.g., output or employment share), and m_{it} is an index of firm-level skill mix. The decomposition, then, considers the roles of changing shares versus changing the skill mix at the micro level in a manner that permits an integrated treatment of the contribution of entering and exiting firms.

Using the notation from the previous section we would have:

$$\Delta M_t = \sum_{i \in c}(L_{it-1}/L_{t-1})\Delta M_{it} + \sum_{i \in c}(M_{it-1} - M_{t-1})\Delta(L_{it}/L_t) + \sum_{i \in c}\Delta(L_{it}/L_t)\Delta M_{it}$$
$$\sum_{i \in N}(L_{it}/L_t)(M_{it} - M_{t-1}) - \sum_{i \in E}(L_{it-1}/L_{t-1})\ (M_{it-1} - M_{t-1}) \tag{3}$$

where M_t is the aggregate skill mix in period t (number of skilled workers divided by total number of workers) L_t is aggregate total employment and M_i and L_i are the corresponding firm-specific terms defined accordingly. The first three terms with subscript C refer to continuing firms, the forth term with subscript N refers to entering firms and the last term with subscript E refers to exiting firms.

Going back to our decomposition (2), the first term represents a within-firm component (for continuing firms) based on firm-level changes of skill mix between t and $t-1$. This firm-level change is weighted by the initial employment share of the firm. As mentioned above, one way to look for evidence of skill-biased technological change is to look at the "within" component of a decomposition of aggregate skill mix change. If the frequently observed wage gap is largely due to skill-biased technological change, then this process should be reflected in the decomposition's "within" component which captures the part of aggregate skill mix attributable to continuing firms of all industries changing their individual labor skill mixes.

The second term represents the between-firm component for continuing firms, which reflects changing employment shares. This change in employment share is weighted by the deviation of initial firm skill mix from the initial sector skill-mix index. For a continuing firm, this implies that an increase in its share contributes positively to the between-firm component (and thus, aggregate skill mix) only if the firm has a higher skill mix than the initial average skill mix of the sector. This term may provide evidence on the importance of demand-driven factors in the evolution of aggregate labor skill mix. For example, if international trade and/or integration into the European community have increased the demand for skilled workers, then the observed change in skill mix should be primarily a "between-firm" phenomenon because employment should shift to more skill-intensive continuing firms.

The third term represents a cross (i.e., covariance-type) term that tells us whether continuing firms that are increasing their employment share are also increasing their skill mix and viceversa.

The last two terms represent the contribution of entering and exiting firms, respectively. This term could reflect changes either in demand, or skill-biased technological change, or both. For example, we have theoretical models [e.g., Campbell (1995); Caballero and Hammour (1994); Lambson (1991)] that seem to back up the hypothesis of skill-biased technological change and are consistent with the within firm technology adoption discussed earlier. These models point at entry as the main way in which new technology is adopted and introduced into the economy. In this type of models firms or plants with outdated technology will end up exiting.

On the other hand, changes in product demands that require skill-intensive labor will induce the entry of firms that produce those skill-intensive products and therefore, this will contribute to the aggregate skill mix change. Later on, in the results section I will try to discern the different interpretations of the contribution of entry and exit.

3 Data

3.1 General Characteristics of the ESEE

The data come from the Encuesta Sobre Estrategias Empresariales (ESEE), a firm-level survey conducted by the Fundación SEPI. The ESEE is an annual survey sent to a panel of Spanish manufacturing firms, particularly large firms, and includes a representative sample of firm births and deaths for each year. Thus, in the context of this paper when I say "aggregate" change in skill mix, I will be referring to a change in the Spanish manufacturing sector. The survey is designed to change as industry composition evolves and was designed, in part, as a research tool.

At the time this paper was written, the survey covers the period from 1990-1998 with an average of over 1500 firms in each year. The reference population for the ESEE is manufacturing businesses with 10 or more employees in Spain. In the base year, firms were selected according to a selective sampling scheme. All firms with more than 200 employees (large firms) were asked to participate, and approximately 70% of the large firms respond in a given year. Firms employing 200 or less employees were chosen, according to a within-industry random sampling scheme.

The ESEE is an unbalanced panel that attempts to capture the representativeness of the industry sector in Spain. Thus, aside from making every effort to maintain the continuing firms in the sample, the survey also strives to capture the entry and exit of manufacturing firms over the sample period. Newly created firms are selected and mailed surveys using the original selection criteria. Firm exits are recorded each year and can be considered a sample representing the population of firms leaving the market over the period.

The sample's representativeness has been well documented by a number of authors. For example, Fariñas and Jaumandreu (1999) performed a series of cross checks with other data sources like the EPA (Encuesta de Población Activa or Active Population Survey) and the CB (Central de Balances from the Bank of Spain) to see if the evolution of key ESSE sample variables like employment, production and prices, is representative of the underlying population. They indeed find that the evolution/growth rates of these variables from 1990 through 1999 is consistent with that derived from the other data sources. Also ESSE figures are reasonably consistent with other sources like the "Encuesta Industrial"[4]. In addition, the representativeness of the sample is, among other things, annually checked by the Fundación SEPI in its annual analysis and results publication. When comparing their figures to those offered by other sources of the aggregate population they find their "results always reasonable"[5].

3.2 Special Characteristics Used in this Paper

For this analysis I choose to focus on data from the 1990, 1994, and 1998 surveys. One of the reasons I focus on these three years is that they contain some data essential to this paper that the other years' files do not, namely information about firms' technology innovations and workforce skill, which is critical for my analysis. Also, while 1990 and 1998 were years of

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4**.** See *Un Panorama de la Industria Española* published by the Ministerio de Industria, Comercio y Turismo of Spain in 1992.
5**.** See, for instance, *Resultados 2000* from Fundación Empresa Pública published by the Ministerios de Ciencia y Tecnología.

relatively high economic performance in Spain, 1994 represented the low point of a recession. Using these three years, then, allows me to look for business cycle effects in the results.

3.3 Definition of Skill Mix

Regarding the grouping of workers into high skilled and low skilled, the ESEE classifies workers into: i) "those with a Bachelor's degree", ii) "those with some college and/or high school diploma" and iii) "the rest of workers". For the purposes of this paper, I consider skilled labor those individuals with at least a Bachelor's degree and less-skilled labor the workers in the other two categories. The skill mix, M_t, is defined as in previous sections: the ratio between high-skill workers and all workers (including the high-skill group) in a given year.

4 Results

4.1 Basic decomposition of skilled labor mix changes

In this section, I present basic aggregate decompositions of the changes in skill mix focusing on the relative contributions of within firm changes, between firm changes, covariance term and *net* entry to the aggregate change in the skilled labor share.

Table 1 below presents the results from the basic decomposition given in equation (3) the two four-year changes, 1990-1994 (recessionary period) and 1994-1998 (recovery period) as well as for the 1990-1998 long difference change in skill mix.

Table 1

Simple Decompositions of Skill Mix Changes					
Years	**Total Change in Skill Mix**	**Within Share**	**Between Share**	**Covariance Share**	**Net Entry Share**
1990-1994	0.005	0.83	-0.04	0.31	-0.10
1994-1998	0.012	0.93	0.00	-0.03	0.09
1990-1998	0.016	0.67	-0.02	0.28	0.07

Within Component

The largest component is the within-plant component, which accounts for 67% of the 8-yr change, and 83% and 93% of the 4-yr periods respectively. That is, 67% of the total change in skill mix in manufacturing from 1990 to 1998 is accounted for by continuing firms becoming more skill intensive. In the four-year decompositions, the within effect accounts for almost the entire change. These results are qualitatively similar to those obtained by DHT. They also found that the within share was the largest single source of aggregate skill mix growth.

These results are consistent with models of lumpy capital adjustment together with skill-biased technological change. For example, in their 1997 paper Cooper, Haltiwanger, and Power present a model in which existing firms adopt technology by retooling their plants and introducing new capital. The large within effect observed here would be consistent with this type of behavior if the newly introduced technology required skilled workers (that is if new technologies and skill are complements).

Between Component

The between component turns out to be the smallest of all the components for both the long and four-year differences; that is, the reallocation of workers from low to high skill-intensive firms (or viceversa) contributes little to the overall change in skill mix in Spanish manufacturing. It could be helpful to interpret this result in light of the extremely low worker mobility observed in Spain by several other authors.

Effective reallocation requires that laid-off workers find new employment sources either through re-training, relocating, or both. However, Ahn, Rica and Ugidos (1998) conclude that a majority of unemployed Spanish workers are unwilling to relocate to find work. For example, they show that less than 1% of working age males relocate to a different region within a given year. This rigidity is largely unaffected by unemployment duration. A complementary finding comes from Bentolila and Chino (2000). They argue that stronger extended family networks in Mediterranean countries frequently provide additional unemployment insurance for their citizens. Either alone, or in combination, these factors may affect the rate and form of variations in aggregate skill mix changes.

As I mentioned earlier, the between component would reflect increases in skill mix prompted by changes in the demand for more skill-intensive products; thus, the results appear to fail to support the hypothesis that skill upgrading is determined by demand driven forces.

It is also worth noting that the between-firm effects are much smaller than those in the US according to the results obtained by DHT. They found that while the between effect was not dominant, it did contribute up to 25% of overall skill mix long-run change between 1977 and 1982. By contrast, the between effects among Spanish manufacturing firms are either insignificant or actually negative. A negative between term means that workers are actually moving from more skill-intensive firms to less skill-intensive firms. Or, more specifically, from firms with a skill mix above the manufacturing sector's average to firms with a skill mix below the manufacturing sector's average.

Covariance Term

A difference between these results and those obtained by DHT with US data is that here the share of the covariance term (or proportion of the total change in skill mix accounted for by the covariance term) is relatively large and generally positive (both in the short 1990-1994 and long 1990-1998 differences). By contrast, DHT's covariance share was much smaller and negative in two out of the four changes in skill mix.

In Spain, however, Table 1 shows evidence that expanding firms increased their skill shares (and that shrinking firms' skill-shares declined) in most cases. Most interestingly, the results obtained with Spanish data tell us that the four-year positive covariance term occurs during the recessionary period (1990-1994); that is, firms expanding their share of employment during the recession are also increasing their skill mix. Although the bigger change in aggregate skill mix does not occur during the recessionary period (as it does in the US), the firms that are expanding their employment during the recessionary period are also significantly increasing their employee's skill mix at the same time.

This finding seems consistent with creative destruction models that feature experimentation, the expansion of successful firms and the contraction of unsuccessful plants [Roberts and Weitzman (1981), Javonovic (1982), and Ericson and Pakes (1995)]. It is reasonable to expect that part of the experimentation process would involve the adoption of new technologies and, in the presence of skill-biased technological change, the hiring of additional skilled workers.

To explore the covariance term in more detail, I divide the 1990-1998 *continuing* firms into four quadrants based on their changes in employment share and skill mix. Each quadrant's contribution to the long-run aggregate skill mix changes is presented below in Table 2. I define the quadrants as follows:

Q1: Firms increasing employment share, upgrading of skill mix

Q2: Firms increasing employment share, downgrading of skill mix

Q3: Firms decreasing employment share, upgrading skill mix

Q4: Firms decreasing employment share, downgrading skill mix.

Table 2

Decomposition of 1990-98 Change in Skill Mix by Long-Run Quadrant *(Continuing Firms)*	
Quadrant	**Contribution to Aggregate Skill Mix Change by Quadrant**
Q1	0.75
Q2	-0.09
Q3	0.51
Q4	-0.17

Table 3

Employment and Skilled-Labor Share by Long-Run Quadrant (1990-98) *(Continuing Firms)*				
	Employment Share in Q	**Employment Share in Q**	**Skilled-Labor Share in Q**	**Skilled-Labor Share in Q**
Quadrant	**1990**	**1998**	**1990**	**1998**
Q1	0.32	0.50	0.02	0.06
Q2	0.06	0.10	0.06	0.03
Q3	0.46	0.29	0.03	0.06
Q4	0.16	0.11	0.06	0.04
Total	1	1		

Note that firms that increase in employment share and also have skill upgrading (quadrant 1) account for most of the change in the aggregate long-run change in skill mix with 75% of that change. The second biggest contribution to the long-run aggregate change (51%) comes from firms that upgraded their skill mix, while simultaneously cutting their employment (quadrant 3) –which almost certainly explains why they contribute less to the aggregate change than quadrant 1 (employment increasing) firms (see Table 3 to see employment and skilled-labor shares)–. Taken together, the firms in quadrants 1 and 3 account for more than 100% of the total change in skill mix between 1990 and 1998. However, their contribution is offset by the negative contribution of firms in quadrants 2 and 4.

Net Entry

While DHT found that net entry made a substantial contribution to aggregate skill mix change, my results indicate that in Spain the net entry term is positive although relatively small in the long difference. The two four year changes show that the positive long difference is the result of a strongly positive skill change between 1994-1998 that compensates the negative net entry term during Spain's recessionary period. Since the net entry term accounts for both entering and exiting firms, it is not immediately clear if the negative sign during the 1990-1994 period is caused by entrants having a lower than average skill mix or by exiting firms having higher than average skill mixes or both. Table 4 below helps sort out the two different effects by isolating the individual effects of the two net entry terms on aggregate skill mix change. In general, Table 4 shows the share of the aggregate skill-mix change for which entering and exiting firms are accountable.

Table 4

Simple Breakdown of Net Entry's Contribution to Skill Mix Changes				
Years	**Aggregate Change In Skill Mix**	**Net Entry Share**	**Entering Firms Share**	**Exiting Firms Share**
1990-1994	0.005	-0.10	-0.20	-0.10
1994-1998	0.012	0.09	0.06	-0.03
1990-1998	0.016	0.07	0.05	-0.02

When interpreting Table 4, it is important to keep in mind that in this decomposition, the exiting term is subtracted from the entry term. That is, exiting firms contribute positively to aggregate skill mix change when they are below the average skill mix (negative term). By contrast, entrants contribute positively to aggregate skill mix change when they are relatively more skill intensive than average (positive term). An interesting pattern emerges in Table 4: entrants are more skill intensive than average in the long difference because the effects of the low-skill entrants during the recession are compensated by the high-skill entrants during the recovery. By contrast, exiting firms in all time periods had lower than average skill mixes. Table 4 also shows that exiting firms are less skill intensive than entrants –except during the recession when entering firms had a lower skill mix than either continuing or exiting firms.

This same information can be perhaps more clearly seen in Table 5a where I have directly measured the percentages of skilled laborers at each type of firm during each year. For example, entering firms in 1990-1994 had a particularly low share of skilled workers in their labor force, only compared to 3.1% for firms that exited during that period and 3.9% for continuing firms that same year (in *t*). In this time period, the firms that exit look more like continuing firms [in *(t-1)]* than do entrants. On the other hand, it is clear that the new firms in the 1994-1998 period were more skill intensive (4.2%) than both exiting firms and also previous periods entrants; in addition, they were only slightly less skill intensive than continuing firms (4.9%) during that same year (*t*).

Table 5a

Skilled Labor Shares				
	Exiting	**Entering**	**Continuing Firms**	
Period	**(t-1)**	**(t)**	**(t-1)**	**(t)**
1990-1994	0.031	0.022	0.033	0.039
1994-1998	0.034	0.042	0.037	0.049
1990-1998	0.033	0.037	0.034	0.053

The finding that entering firms have lower skilled-labor shares[6] than continuing firms seems at odds with creative destruction models where new technologies can only be adopted by new firms. These models imply that the new firms would implant the

6**.** Skilled-labor shares are defined as number of skilled labor at time *t* [or *(t-1)]* divided by employment at time *t* [or *(t-1)]* for each firm type.

latest technologies, and thus, should have the highest skill mixes of any type of firm; on the other hand, exiting firms would have outdated technologies, and therefore, the lowest skill mixes, but this is not what these results indicate. DHT also confronted this dilemma and they argued –supported by the long-standing empirical literature on the subject– that size has an important role in determining the technology intensity of an entrant vs. a continuing firm. They find evidence that controlling for size as well as industry and location, entrants have a higher skill mix than continuing firms. Unfortunately, data constraints bar me from replicating this exercise.

Beside the share of skilled laborers at new firms, the other relevant factor in determining net entry's importance is the firms' shares of overall employment as displayed in Table 5b below.

Table 5b

Employment Shares				
	Exiting	**Entering**	**Continuing Firms**	
Period	**(t-1)**	**(t)**	**(t-1)**	**(t)**
1990-1994	0.328	0.090	0.672	0.910
1994-1998	0.136	0.126	0.864	0.874
1990-1898	0.417	0.200	0.583	0.800

Several points are worth noticing. First, the employment shares of exiting and entering firms vary quite a bit depending on whether the period under examination is a recession or a recovery. In the recessionary period the employment share of exiting firms (33%) is almost 4 times the one of the entering plants (9%). On the other hand, during the recovery, the employment share of both entering and exiting firms tends to be the same (around 13%). In the long difference, 1990-1998 period, the employment share of exiting firms (42%) is approximately double that of entering firms (20%).

Second, also notice that even over the long difference, new firms account for only 20% of all firms while exiting firms account for almost half. This low total labor share, together with the similarity of exiting and continuing firms' skill shares and the low skill shares of new firms during the recessionary period explain why net entry had such a low impact on aggregate skill mix in my sample.

Finally, the role that net entry plays in supporting the competing hypotheses of skill-biased technological change and change in demand for technology-intensive products needs to be resolved. With this objective in mind, I run a decomposition at industry level (see industries in sample in Appendix). Results showing a strong positive between component would support the change in demand for technology-intensive products hypothesis. That is, technology intensive industries (with high skill mixes) would be gaining in employment share while low-technology industries (with low skill mixes) would be loosing employment share. On the other hand, if the results show a strong positive within component, they would support the skill-biased technological change hypothesis since this would mean that entrants (which would have higher skill mixes than exiting firms) continue entering the same types of industries. My results indicate that the within-industry component is positive and accounts for most of the net-entry change, thus, supporting the skill-biased technological change hypothesis.

Cyclical Pattern

Finally, it is worth re-visiting the cyclical pattern of the skill mix changes. In the US data, DHT found that there were marked increases in the share of skilled workers during recessions that were only partially offset by mild declines during booms. As a result, almost the entire long-run increase in aggregate skill mix occurred during economic downturns in the US. In Spain, this does not seem to be the case; during the 1990-1994 recession, the skilled-labor-share change was smaller that during the 1994-1998 recovery. Between 1990 and 1994, the aggregate skill mix change was 0.5% while during 1994-1998, was more than double the previous change at 1.2%. These results show that the percentage increase in aggregate skill mix is actually bigger during the recovery phase than during the recessionary period in Spain in the 1990s.

The proportion of skilled workers can increase either through increasing the number of more skilled workers or through the decrease of less-skilled labor. DHT spend considerable time trying to be sure that the observed counter-cyclicality in their data is not simply reflecting the firing of unskilled labor during recessions followed by their re-hiring in the recovery periods. With this in mind, Table 6 shows the percentage change in skilled and unskilled workers in both four-year periods. Interestingly, the growth in skill mix was accomplished somewhat differently during the two time periods. In the 1990-1994 period there was positive growth in the relative number of skilled workers and negative growth in the number of unskilled workers. In 1994-1998 by contrast the (larger) increase in skill mix occurred despite positive growth in the relative number of less-skilled workers. The increase in less-skilled labor share in that period was due to a much larger increase in the number of skilled workers than in less-skilled workers.

Table 6

Percentage Change in Skilled and Less-Skilled Labor

Years	% Change in Skilled Labor	% Change in Less-Skilled Labor
1990-1994	7.1%	-6.6%
1994-1998	45.9%	9.4%

To further explore the cyclicality of the aggregate change in skill mix from 1990 to 1998, I perform an exercise similar to the one performed by DHT that attempts to connect the long change in skill mix, 1990-1998, with the cyclical pattern of the skilled-labor share changes. I use the 1990-1998 *continuing* firms as my sample and try to see how the employment and skilled-labor shares of these firms behave during the recessionary and recovery periods (i.e., the business cycle). As in Table 2, I define the quadrants as follows:

Q1: Firms increasing employment share, upgrading of skill mix
Q2: Firms increasing employment share, downgrading of skill mix
Q3: Firms decreasing employment share, upgrading skill mix
Q4: Firms decreasing employment share, downgrading skill mix.

Table 7

Quadrant Employment and Skilled-Labor Shares of 1990-1998 Continuing Firms					
Period		**Q1**	**Q2**	**Q3**	**Q4**
1990	Employment Share	0.317	0.062	0.460	0.161
1994	Employment Share	0.422	0.081	0.373	0.124
	Difference 1990-94	0.106	0.019	-0.088	-0.037
1990	Skilled-Labor Share	0.023	0.062	0.029	0.056
1994	Skilled-Labor Share	0.035	0.038	0.036	0.044
	Difference 1990-94	0.011	-0.024	0.007	-0.012
1994	Employment Share	0.422	0.081	0.373	0.124
1998	Employment Share	0.500	0.100	0.291	0.110
	Difference 1994-98	0.077	0.019	-0.082	-0.014
1994	Skilled-Labor Share	0.035	0.038	0.036	0.044
1998	Skilled-Labor Share	0.056	0.035	0.060	0.037
	Difference 1994-98	0.021	-0.003	0.023	-0.007

Several patterns of interest emerge from Table 7. For example, firms in Q1 (expanding employment and upgrading skill mix) show increases in their skill shares in both the recessionary period and the recovery. However, the increase in skilled-labor is higher during the recovery period (1994-1998), a pro-cyclical pattern, which contrasts with DHT's finding of counter-cyclicality in skilled-labor share changes in the US.

Also, firms in Q2 and Q4 (those continuing firms with decreases in skilled-labor shares from 1990 to 1998), show decreases in skilled-labor shares in both the recession and recovery periods. However, during the recovery the decrease is a lot smaller than during the recession for both quadrants. Finally, firms in Q3 experience an increase in both periods, but this increase is much larger during the recovery period.

4.2 Sub-Decompositions

As mentioned earlier, Spain's labor market has a number of unique features. In this section I explore the effects of these characteristics on aggregate skill mix change by drilling down and further decomposing the change by firm types that are particularly relevant to the characteristics of the Spanish labor market. For example, I separate firms with a relatively high percentage of permanent labor contracts from firms that rely more heavily on temporary contracts. These types of sub-decompositions could help inform discussions of Spanish labor market liberalization by identifying and quantifying the relative contribution of different types of employers to aggregate labor skill mix.

Permanent vs. Temporary Labor Contracts Sub-decomposition

As indicated earlier, a unique feature of the Spanish labor market is its rigidity. This rigidity arises from the pervasiveness of binding employment contracts carrying high separation costs. The effects of these contracts have been well documented in papers such as Bentolila and Saint-Paul (1992). In response to these contracts' negative effect on employment trends, in 1984 the Spanish government created alternative types of temporary employment of workers with little or no separation costs (legal or pecuniary) upon contract termination. These flexible contracts have allowed larger employment responses over the course of business cycles, particularly in the downward direction, but their effect on skill mix changes is unclear. As already mentioned in the Introduction, they also created a "dual" labor market where on one hand, there are workers hired on permanent contracts, who enjoy strong employment protection legislation and bargaining power through labor unions, and on the other hand, there are workers employed under temporary contracts who lack employment protection and bargaining power, and have much higher turnover rates and generally lower salaries.

Therefore, an interesting question to ask in the context of this paper is: how are the skill-labor shares being accomplished? That is, what types of firms are accounting for most of the change in the aggregate skill mix, those hiring temporary or permanent-contract labor? Firms are classified as "High-permanent" worker firms if their average share (over the beginning and ending periods) of permanent-contract employees is 80 percent or more of their workforce. While any threshold is somewhat arbitrary, the 80 percent cutoff was selected because it is the median share of permanent workers for the firms in my sample.

A clearly related issue is whether or not the changes in skilled and less-skilled workers come about due to changes in the shares of permanent or temporary workers. Finally, it would be interesting to know how are these dynamics affected by the business cycle. To begin to examine these issues, Table 8 presents a sub-decomposition of aggregate skill mix, which shows the proportion that each firm type accounts for by time period.

Table 8

Share of Aggregate Skill Mix Change By Firm Type and Time Period		
	Firm Type	
Period	**High-Permanent**	**Low-Permanent**
1990-1994	49%	51%
1994-1998	67	33
1990-1998	77	23

Interestingly, Table 8 shows that during the recessionary period, the "low-permanent" firms account for slightly more of the aggregate skill-mix change, while the "high permanent" firms account for most of the increase during the recovery period. Although it is impossible to be certain of the cause of this pattern given these data, at first glance, one explanation for this could be that the "high-permanent" firms would be more reluctant to hire more (likely permanent-contract) workers during uncertain times. On the other hand, firms with a relatively higher percentage of temporary contracts, to the extent that they continue hiring predominantly temporary-contract workers, are more flexible and more able to adapt to changes in demand due to the business cycle.

Continuing the exploration of how these changes in skill mix occur, I now examine whether the percentage changes in skilled and unskilled workers come about due to changes in the shares of permanent or temporary workers and how these dynamics are affected by the business cycle. Table 8a displays the percent changes in skilled and less-skilled workers by time period and firm type: "permanent" or "temporary" contract firms.

Table 8a

Changes in Skilled Labor by Firm Type: 1990-1994 and 1994-1998				
	1990-1994		1994-1998	
Firm Type	% Change in Skilled Labor	% Change in Less-Skilled Labor	% Change in Skilled Labor	% Change in Less-Skilled Labor
High Permanent	1.5%	-8.1%	36.0%	1.8%
Low Permanent	21.8%	-4.3%	75.1%	22.0%

Several interesting patterns are evident in Table 8a. First, note that the hiring of skilled workers continues during the recession (1990-1994), but in firms with high shares of permanent-contract employees, skilled labor increases just 1.5%. By contrast, in firms with lower ratios of workers with permanent contracts, skilled workers increase by about 22%.

Second, both types of firms not only continued to hire skilled workers during the recession (1990-1994), they both decreased their low skilled work force at the same time, particularly the firms with high proportions of permanent contract workers. This finding may not be what one would expect a priori, but it corresponds to the evidence collected by Toharia (1998) and Malo and Toharia (1994)[7]. It would be interesting to see if this finding would hold in other recessionary periods.

During the recovery period (1994-1998), other patterns emerge. First, notice that this is the period during which low permanent-contract firms seem to make their largest employment changes –both of skilled and unskilled workers–. It is also interesting that the percentage increase in skilled workers is higher than that of the less-skilled, resulting in another increase in the skill mix (ratio), but it is achieved in a different way than it was during the recession. Second, compared to the recession period, the percentage changes, in levels and absolute value, in employment are much bigger than during the recession, particularly for skilled workers.

Third, also note that the firms with a lower share of permanent contracts have greater sensitivity to the business cycle. That is, their workforce changes are greater than that of the "high-permanent" firms, particularly during the recession, when they had roughly twice the percentage change in less-skilled labor and almost seven times the change in less-skilled labor as did the "high-permanent" firms. This pattern supports the expectation that temporary labor contracts may be lending firms more flexibility as the reforms intended. It may be that "low-permanent" firms are playing an important part in introducing flexibility into the labor market that previously would not have been possible.

Finally, I should note that although they had lower percentage increases of skilled labor, "high-permanent" firms account for most of the change in skill mix because they account for a much larger share of employment than do the "low-permanent" firms. (See Table 8b below.)

7. It seems that during the recessionary period, in particular 1993, firings of permanent-contract workers was exceptionally high due to structural adjustments in the manufacturing sector.

Table 8b

Shares of Employment by Firm Type and Time Period				
		Period		
Firm Type		**1990-1994**	**1994-1998**	**1990-1998**
High-Permanent	Employment share	0.59	0.63	0.62
	Employment share	0.58	0.59	0.61
Low-Permanent	Employment share	0.41	0.37	0.38
	Employment share	0.42	0.41	0.39

Technology Sub-Decomposition

The evidence presented from the main decomposition (large within and small between effects and the role of net entry) seems to validate the skill-biased technological change hypothesis. If this is the case, then we should expect that firms with more technology or higher rates of technology adoption/innovations will also be the ones that have higher workforce skill upgrades.

The next sub-decomposition will test precisely that and will look at whether the firms with more technology innovations also account for the highest proportion of the increase in the aggregate skill mix. I will refer to the firms with a higher number of process/product innovations as “high technology” firms; those with a lower number of technology innovations as “low technology” firms and those with no technology innovations as “no technology” firms[8].

Given these definitions, I conduct three aggregate skill-mix sub-decompositions by firm technology-type for the same three time periods.

Table 9

Proportion of Aggregate Skill Mix Changes by Firm Type and Time Period			
	Firm Type		
Period	**High Technology**	**Low Technology**	**No Technology**
1990-1994	1.03	0.05	- 0.08
1994-1998	0.68	0.20	0.12
1990-1998	0.79	0.22	- 0.01

Table 9 shows what proportion of the aggregate change in skill mix is accounted for by “high technology”, “low technology” or “no technology” firms. The results appear consistent with the skill-biased technological change hypothesis. That is, firms with high rates of technology adoption account for more of the change in aggregate skill mix, particularly during the recessionary period where “high technology” firms accounted for over 100% of the change in aggregate skill mix. During the other 4-year change and the long

8. My technology measure is calculated by dividing the number of process or product innovations adopted by a firm during (t-1) and t by the number of years that firm exists during that period.

difference, “high technology” firms accounted for more than half of the total change in skill mix. On the other hand, firms with low or no technology adoption accounted for considerably less of the change in skill mix than “high technology” firms. In particular, the “no-technology” firms accounted for a negative 8% and only 12% of the aggregate change in skill mix in the 1990-1994 and 1994-1998 periods respectively. In the long difference, 1990-1998, “no-technology” firms actually “contribute” by reducing the aggregate skill mix by 1%.

However, we must also consider what share of overall employment these firms account for. That is, if high technology firms account for 60% of the increase in aggregate skill mix but 90% of employment, then they may actually be under-contributing to aggregate skill mix change. Table 10 below shows the employment share at each type of firm as well as each category’s change of skilled and unskilled workers.

During the recession, “high-technology” firms clearly over-accounted for their share of aggregate skill mix change. They contributed most of the change in aggregate skill mix change, but only about ½ of aggregate employment. Meanwhile, “low” and “no technology” firms under-accounted for their shares of aggregate skill mix change. This is particularly clear in the case of the “no-technology” firms who, although they simultaneously reduced their skilled and unskilled workforce, cut their skilled labor force disproportionately more. On the other hand, the “high” and “low technology” firms show a similar percentage change increase in skilled workers. Each showed a clear pattern of increasing both types of employment, but also a disproportionately large increase in skilled workers.

During the recovery period, a slightly different pattern emerges. While the “high technology” firms again accounted for most of the change in aggregate skill mix, their contribution is relatively small compared to their share of employment in either time period. “Low-technology” firms accounted for more of the aggregate skill mix than “no-technology” firms; and the first ones over-accounted for their share of skill mix change relative to employment. It is also interesting that all three types of firms increased their skill mixes by increasing their skilled employment more than their unskilled workforce.

Finally, in the long difference we see that the “high technology” firms account for most of the change in aggregate skill mix, followed by “low technology” firms and lastly by “no technology” firms. “Low technology” firms disproportionately contributed to aggregate skill mix change, although “high technology” firms accounted for most of the overall change. “No-technology” firms had a decrease in the share of skilled labor; these firms lost more skilled than less-skilled workers.

Perhaps most interestingly, the table also shows how the ranking of employment share has changed from 1990 to 1998. In 1990, the ranking in employment share was: “High-Technology”, (followed closely by) “No-Technology” and “Low-Technology” firms. In 1998, the ranking is: “High-Technology” firms, “Low-Technology” firms and lastly “No-Technology” firms. “High-Technology” firms experienced the largest increases in employment share in all periods while “Low-Technology” firms also had increases in employment share in all periods, but of a lower magnitude. By contrast, “No-Technology” firms did not increase their employment share in any of the periods.

Table 10

Aggregate Skill Mix % Changes by Firm Type Proportion of Aggregate Change in Skill Mix by Firm Type				
	Period			
Firm Type		**1990-1994**	**1994-1998**	**1990-1998**
High Technology	% change in skilled labor	0.266	0.664	0.820
	% change in unskilled labor	0.153	0.276	0.264
	Employment share in beginning year	0.500	0.496	0.507
	Employment share In end year	0.616	0.579	0.627
Low Technology	% change in skilled labor	0.267	0.654	1.184
	% change in unskilled labor	0.117	0.143	0.364
	Employment share in beginning year	0.103	0.141	0.172
	Employment share in end year	0.123	0.148	0.229
No Technology	% change in skilled labor	-0.143	0.330	-0.349
	% change in unskilled labor	-0.104	0.103	-0.262
	Employment share in beginning year	0.273	0.273	0.202
	Employment share in end year	0.260	0.273	0.143

5 Conclusions

As in other developed countries, Spanish firms' skill mix has increased during the 1990s. This paper has attempted to examine whether this change in the Spanish labor market can be attributed to demand shifts towards more skill-intensive products or to skill biased technological change and has found, just as in the US, that skill biased technological change is a more likely explanation. Specifically, my decompositions showed that the largest component of the aggregate skill change is the within component. That is, the increase in aggregate skill mix mainly comes from continuing firms increasing their individual labor skill mixes presumably in response to the re-tooling or upgrades in technology in these firms.

Furthermore, the increase or upgrade in skill mix seems to be procyclical in Spain. During the 1990-1994 recession the increase in skill mix is smaller than during the recovery period (1994-1998). This finding is different to the one found in the US, where increases in skill mix are found to be counter-cyclical. It will be interesting to explore this topic with data that covers more than one business cycle. This would help establish the pro-cyclicality or counter-cyclicality of aggregate skill-mix changes in Spain.

Given the unique nature of Spain's labor market, I performed a series of sub-decompositions to see how firms' use of permanent or temporary contracts was related to skill mix change. The results from this sub-decomposition show that during the recessionary period, firms with a lower percentage of permanent contracts account slightly more for the increase in aggregate skill mix, but during the recovery period, the "high permanent-contract" firms account for most of the change.

Drilling a bit more into this dimension, I found that "low permanent-contract" firms are the ones that experience the biggest percentage changes of skilled and less-skilled labor. However, due to the larger employment share of "high permanent-contract" firms, this type of firm accounts for most of the aggregate increase in skill mix during the recovery period. Nevertheless, the evidence presented indicates that "low-permanent-contract" firms may lend flexibility to changes in the labor market.

Finally, I performed an additional sub-decomposition based on the technological "intensity" or rate of innovations of firms. The results again seem to support the skill-biased technological change hypothesis. They show that firms that innovate or adopt more technologies are also the ones that account for most of the increase in skill mix during the 1990s in Spain. It is also worth pointing out that the ranking of employment share of High, Low and No-Technology firms has changed from 1990 to 1998. In 1990, the ranking in employment share was: High-Technology, (followed closely by) No-Technology and Low-Technology. In 1998, the ranking is: High-Technology firms, Low-Technology firms and No-Technology firms. High-Technology firms experienced the largest increases in employment share in all periods while Low-Technology firms also had increases in employment share in all periods, but of a lower magnitude. By contrast, No-Technology firms did not gain employment share in any of the periods.

APPENDIX

Manufacturing Industries covered by the ESEE

Code	Industry
1.	Metals – Metales férreos y no férreos
2.	Non-metal Mineral Products – Productos minerales no metálicos
3.	Chemical Products – Productos químicos
4.	Metallic Products – Productos metálicos
5.	Agricultural and industrial machinery – Máquinas agrícolas e industriales
6.	Office machinery, computers, etc. – Máquinas oficina, proceso datos, etc.
7.	Electronics – Material y accesorios electrónicos
8.	Vehicles and engines – Vehículos automóviles y motores
9.	Other transportation equipment – Otro material de transporte
10.	Meat, processed food and canned goods – Carne, preparados y conservas
11.	Food products and tobacco – Productos alimenticios y tabaco
12.	Drinks – Bebidas
13.	Textiles and clothing – Textiles y vestido
14.	Leather and Shoes – Cuero, piel y calzado
15.	Wood and wood products – Madera y muebles de madera
16.	Paper, paper articles, printing – Papel, artículos de papel, impresión
17.	Plastic and rubber products – Productos de caucho y plástico
18.	Other manufactured products – Otros productos manufacturados

To run decomposition at industry level, the following industries are grouped

Codes 8 and 9
Codes 10, 11 and 12
Codes 13 and 14
Codes 17 and 18

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