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Abstract

Traditional measures of labour quality might have the shortcoming of missing some features of the very important increase in labour utilization within European countries. In particular, we explore the case of Spain. Despite showing one of the most important increases in labour quality in the EU according to standard methods, it also offers a negative increase in TFP growth. This paper computes an index of labour quality in Spain between 1988 and 2006 using microdata from the Labour Force Survey and the Structural Earnings Survey–2002 that allows the introduction of all possible interactions in a semi-parametric fashion between gender, age, education, experience in the current job and nationality. Considering those observable characteristics, the index still shows a notable growth at an average annual rate of 0.42 pp. After a period of slight decline (between 1988 and 1992) the index grows continuously until 2006 when it fell again. This is the case because education is, even by considering all possible interactions with other demographic variables, the highest contributor to the quality index's growth. However, the paper shows the importance of considering changes in average productivities of different socio-demographic groups over time. We include in the analysis two usually omitted variables that help explaining the recent productivity slowdown in Spain: type of occupation held by the individual and unobserved heterogeneity of workers. Both the inclusion of occupation and especially the entry of individuals with below-average productivity levels compared to precedent periods decrease the labour quality growth to an average annual rate of 0.20 pp. Indeed with the addition of these two factors labour quality slightly decreases from 1997 onwards.

JEL classification: C4, J1, J3, O4.

Keywords: Index number, labour quality, productivity slowdown, unobserved heterogeneity

1 Introduction

On the 16th of January of 2008, the president of the European Central Bank Jean-Claude Trichet suggested that the recent low productivity growth in Spain was not surprising given the important number of new jobs that were created during the last decade. Indeed, an important percentage of those new jobs have been filled by a massive inflow of low-qualified immigrants [El País, 17-01-2008]. This argument could have been generalized in the case of Spain to the enormous amount of new entrants into the labour force, especially women and unemployed, which are expected to have a lower productivity because they had less experience than previous participants in the labour market.

Underlying these words, there is the idea that the composition of the labour force in Spain has changed enormously in the recent years and this has had an important effect on aggregate productivity. However, in addition to the abovementioned factors —that would tend to decrease aggregate productivity in the economy— there has also been an important increase in the educational attainment of the labour force which would tend to have the opposite effect. The combination of all those factors together makes it fairly difficult to conclude whether compositional changes in the labour force might explain what happened with labour productivity in the last decade.

It is nowadays well established the important role of cognitive skills in promoting economic well being and income per capita [Barro (1991), Castelló and Domenech (2002), and Hanushek and Woessmann (2008)]. One way of considering labour heterogeneity in macroeconomic models is by incorporating a variable proxying human capital in the labour input. This means generating a quality index that multiplies the number of hours worked in the economy in a particular year. Mulligan and Sala-i-Martin (1997 and 2000) proposed a "labour income based index" to map differences in educational attainment across time and countries into differences in productivitiy, Aaronson and Sullivan (2001) and Schwerdt and Turunen (2007) incorporate into the analysis other potentially relevant characteristics of the labour force such as gender and age in addition to educational attainment. Education and age —which in this literature is considered as a proxy for experience in the labour market— are the two main variables to concretize the idea of human capital [Becker (1993)]. Differences in gender express a different labour behaviour of males and females during their life cycles. Each cell is considered an isolated island within which all hours worked have the same productivity but facing different productivities when compared with each other.

The main difficulty of the approach is to get a proxy for the productivity of a particular island. The question is how the productivity of a 20 years old male with primary education compares with a 30 years old female with secondary education. The idea underlying the "labour income based index" first proposed by Mulligan and Sala-i-Martin (1997) is using wage differentials. Economic theory tells us than in a competitive market wage differentials should represent productivity differentials. This is the way most of the literature computed productivity differentials[1]. Ho and Jorgenson (1999) used the average compensation share

1. There are other methodologies that have been used to obtain quality indexes, many of them focused on only one variable: education. For example Barro and Lee (1996) used actual years of schooling to compare the human capital stock of different countries. Puente y Pérez (2006) incorporated data on schooling grades in a comparable exam for different countries to adjust for educational quality. However, in these studies, the way in which labour quality and productivity are linked is assumed, rather than estimated.

attributable to a particular cell. The Bureau of Labor Statistics (1993) and Schwerdt and Turunen (2007) used a regression approach to predict the compensation for each particular cell. The regression approach allows the researcher to increase the dimensionality of factors in the quality adjustment with fewer observations at the cost of loosing some flexibility since the wage regressions do not usually incorporate all possible interactions of variables.

By using this approach Schwerdt and Turunen (2007) show that the quality of labour increased an average of 0.47% per year between 1983 and 2005. Using their methodology and data sets, Ward-Warmedinger et al. (2008) pp. 42-43 show the labour quality index by country of origin, and Spain appears as the country showing the highest increase in labour quality between 1992 and 2005 (close to 0.9% per year). This is the case because of the enormous educational upgrading of the latest Spanish generations. As it is also shown in the same article, education is the highest contributor to the index growth.

There are other articles constructing an index of labour quality in Spain but following similar strategies. Moral and Hurtado (2003) follow the approach of Ho and Jorgenson to build a labour quality index for the Spanish economy from the second quarter of 1987 to the first quarter of 2003. They consider gender, age, educational attainment and sector of activity. The Structural Earnings Survey (SES-1995) was used to obtain information on wages for those particular demographic groups. They incorporated some assumptions in the analysis to solve the absence of microdata on total number of hours and salaries, for all the relevant cells. They found that adding quality on the total number of hours increases the labour input by an average of 0.38 pp per year, being slightly bigger in the last years. Among the components of quality, they also confirm that educational attainment was the main positive factor.

Our paper builds on this previous research incorporating some potentially omitted variables despite being certainly relevant in the recent past. First, as it will be shown in section 3, we incorporate microdata from the Labour Force Survey (LFS) and the SES-2002. Compared to the work of Schwerdt and Turunen (2007) this data set allows the proper treatment of the factors in an isolated fashion. We will take into consideration almost all possible interactions within these dimensions. This is especially interesting for Spain since the observed educational upgrading is a generational phenomenon. In this country, we observe young educated workers replacing less educated old ones. Not considering this interaction might increase artificially the importance of education in the estimation. Moreover, by using the SES instead of other data sets with fewer observations, we are also able to incorporate actual tenure and immigration on top of gender, age and educational attainment[2]. Tenure is certainly important from the point of view of human capital since there is some learning that is acquired by repeating a particular action. In the Spanish case, the inclusion of this variable appears to be crucial given the enormous job creation during the last decade. Additionally, immigration has increased a lot from 1998 onwards contributing with more than half of the total employment growth, and the works by Amuedo-Dorantes and de la Rica (2007) and

2. We decided not to include sector since theoretically this is not a characteristic of the individual that makes him more or less productive. In principle, agents should move among sectors, equalizing wages for a particular skill regardless the sector the worker is in. However, in practice, there would be reasons to incorporate sector in the analysis, for example, the existence of any unobserved component of the individual's ability that is correlated with the sectoral allocation. In this case, it would be appropriate to control for sector in wages and hours. However, we justify our exclusion because in the case of Moral and Hurtado (who control for that dimension), this variable did not play a direct role. Moreover, we would be loosing many degrees of freedom which, in our opinion, are better spent studying properly the other variables, that are expected to affect quality in a direct way.

Fernández and Ortega (2006) show that the skills of immigrants in Spain are not completely comparable to those of natives, at least in the short run.

One of the main interests of the paper is to analyze whether those additions affect the contributions of the main demographic variables in the labour quality. This is done in section 4. In our framework, it is very easy to decompose the quality index growth into different components in different periods of time. It will be noted that although educational attainment is the most relevant component of the quality index, the decrease in tenure and the increase in immigration drain at the beginning and at the end of the period respectively an important part of the potential quality growth.

As it has been noted by Izquierdo and Lacuesta (2006), Goerlich and Mas (1999), Arellano et al. (2001), and Pijoan-Mas and Sánchez-Marcos (2008), the wage structure has changed a lot in the recent years. In particular, the wage distribution appears to have compressed lately invalidating the usage of a constant measure of quality along the period of analysis. In section 5, using wage information from the SES-1995 and the SES-2002, we analyze whether the results are robust to important changes in the relative productivities over time. Indeed, it is found that changes in relative returns to education and age have been compressed a lot over time and the growth of quality would have been much smaller using both data sets.

In order to have a better approximation to the real quality index year by year, we are going to enlarge the wage equation in two directions. The first one is adding occupations. From the beginning of the 80s [Del Rio and Ruiz-Castillo (2001), Abadie (1997), and Febrer and Mora (2005)], the increase in the supply of university degree-holders has not been offset by an increase in the demand of high skilled workers. This fact made many high educated workers to accept low-qualified jobs. Therefore, adding different types of occupation into the regression should clearly modify the productivities of every socio-demographic group.

The second enlargement is a mechanism of selection into the labour force. The motivation comes from the recent enormous employment increase in Spain. In 1988 the employment rate between the ages of 16 and 64 was 48.6% and nowadays is 66.6%. It is very likely that those who participated in the labour market at the beginning of the 90's, were different in many aspects to those who decide to participate nowadays on top of education, age or tenure. Indeed, it is likely that they were more favorably selected since only half of them decided to enter the labour force, and now working is a more widespread option. If this is the case, the quality of labour, as it happened with the addition of occupation, should be modified downward.

Section 6 in the paper incorporates the different quality adjusted labour inputs into a Cobb-Douglas production function for the aggregate Spanish economy. Moral and Hurtado estimated that approximately 46% of the Solow residual in the aggregate economy —when estimated without quality adjustment— could be attributed to this factor[3]. Our empirical results obtain similar contributions and when adding occupations and the selection mechanism into the labour force the negative growth of the TFP in the latest years is reduced notably.

3. See López Salido et al. (2006) for a deep discussion on this issue.

2 Empirical Model

The problem of obtaining a measure of labour quality is essentially a problem of aggregating either different types of workers or different types of working hours. This problem encompasses two different, related questions. First, the assessment of the productivity level of a worker or an hour and second the way in which these individual productivities are aggregated.

The first question is usually addressed making the assumption that relative wages correspond to relative productivity levels, something which we are also going to assume. Clearly, this is not always true. An unfair wage scheme, possibly resulting from a poor wage setting mechanism, might not reflect productivity differentials. Moreover, different endowments of other factors, like capital, could affect labour productivity through complementarities. However, wages are often the most objective way of assessing productivity reducing enormously the dimensionality of the problem.

Concerning the aggregation of different productivities, the most general framework would be an unconstrained function that maps the amount of each type of worker into a quality adjusted measure of labour. Unfortunately, this framework is not feasible for two reasons. First, we only observe some workers' characteristics instead of all variables affecting productivity. Second, the shape of the aggregator function is not known and it would be very difficult to estimate it in an unconstrained way.

To solve the first problem we will define several groups of workers according to some observed variables, and we will assume that the productivity of all the workers in a given group is the same.[4] The relative productivity of two different groups, as it was mentioned above, is going to be estimated as the relative average wage, using data from the SES-2002. In order to save degrees of freedom while maintaining some flexibility, continuous variables should be categorized, and the number of variables and categorical groups should be maintained low. Consequently, we are considering 3 educational levels (primary, secondary and university), 5 age levels (16-24, 25-34, 35-44, 45-54, over 55), 3 different experience levels in the firm (less than 2 years, between 2 and 7, over 7) and two sexes.[5] This amounts to a total of 90 different groups when considering all possible interactions. In addition, we would like to incorporate nationality defined by three new categories: native, EU immigrant and non-EU immigrant. Unfortunately, if we want to address all possible interactions, this addition would increase the number of groups up to 270, and some groups, when computing the average wage, have little or no observations. Our approach to solve this problem is to assume that the possible effect of nationality is independent of the effects of other variables. In this way, we only need to estimate two new relative wages, and then we can apply them uniformly to all groups.

In practice, the wage that we are going to impute to every person follows the model:

$$w = \alpha_0 + \sum_{k=1}^{90} \alpha_k I^k + \alpha_{91} F + \alpha_{92} EU15$$

4. We will use H^i to represent hours worked in a given group *i*.
5. See note 2.

Where w represents the individual log wage, I^k represent one of 90 dummy variables corresponding to all the abovementioned combinations between gender, age, education and tenure. Finally, there are two dummies that are not interacted with the other: a dummy variable for foreigner (*F)* and another being equal to 1 when a foreigner does not belong to the EU-15 (*No-EU15).* We use individual data to estimate by OLS the previous equation and we predict the log wage of a particular group of individuals that share certain characteristics of gender, age, education, tenure and nationality.

Regarding the aggregation of all the productivities of different groups into a measure of quality-adjusted labour, one possibility is to estimate relative productivities (using relative wages, as explained above) each period, and then use them to obtain the measure of quality-adjusted labour, which we denote by L_t. For example, using initial period weights, we would have:

$$L_t - L_{t-1} = \sum_i w_{t-1}^i \left(H_t^i - H_{t-1}^i \right)$$

Where w^i_{t-1} denotes the average wage of group i in period t-1, and H^i_t and H^i_{t-1} represent hours worked in group i in periods t and t-1, respectively. This is known as a Divisia Index [Thornquist (1936)]. It can be shown that this aggregation is an approximation (in differences) to *any* aggregator function,[6] the more accurate the shorter is the time interval between t-1 and t. For this reason, this would be the best approach one can use. However, it is very data demanding, because it needs as much wage observations as quantities observations, and this is not the case in Spain, where we use yearly data on hours worked, but only two waves of wage structure data. For this reason, we cannot apply this general methodology, and we need to assume some structure concerning the aggregation function. In particular, we are going to assume that relative productivities across groups are independent and constant over time.[7]

$$L_t - L_{t-1} = \sum_i w^i \left(H_t^i - H_{t-1}^i \right)$$

With this model of labour input we could generate an index of changes in quality that is set to 100 in the initial year[8]:

$$Q_t = \frac{1}{c} \frac{\sum_i w^i H_t^{\ i}}{\sum_i H_t^{\ i}}$$

6. Indeed, Diewert (1976) shows that if the aggregator function is translog, then the approximation is exact.

7. We will assess the importance of this assumption in section 5.

8. The c is the constant that sets $Q_1(c)=100$.

3 Data

In order to estimate a quality adjusted series of labour using the previous methodology, we need data on hours worked per type of worker and wages per hour at the same level of dissagregation. We will use education, gender, age, experience and nationality.

Regarding hours worked we use microdata from the LFS. The periodicity is quarterly and the sample period is from the beginning of 1987 to 2006[9]. The question used to compute hours worked is the number of weekly hours worked in the usual activity[10]. Experience captures the number of months that someone has worked in the current job.[11].

Figure 1 compares the number of workers and the number of hours worked per week per worker that are officially provided by INE and those series computed with our microdata. We show that our numbers reflect very well the evolution of the official figures. On this regard, it is observed that between 1987 and 2006 there has been a big increase in the number of workers facing an average annual growth rate of 2.8 pp. Despite the 1991-1994 recession that ended up with a net loss of 800,000 jobs, after that date there has been an impressive recovery of the total number of workers. Indeed, between 1998 and 2006 the number of workers grew at an annual growth rate of 4.6 pp. On the other hand, during the same period, there has been an important decline of hours worked per week. The series show an annual decline of –0.3 pp. That is the reason why the total number of hours worked has been growing at a lower rate than the number of workers.

Apart from changes in the abovementioned quantities, the Spanish labour force has experienced a noticeable change in terms of its composition. Table 1 and 2, show the changes in this regard (in number of people and hours worked) according to the LFS. Both tables reflect the same compositional change; however, there could be some differences between the typical image of the change in the composition of workers and the change in the composition of hours depending on the intensity of part time jobs held by some particular subgroups of the population. It is noticeable for example, the case of females.

Women had entered the labour force pushing up its percentage in the total number of hours worked. This increase in the percentage has been pretty constant over the whole period of time. In terms of age, both very young individuals and elderly have decreased their importance, while individuals between 35 and 55 have been gaining weight in the number of hours worked. Additionally, the educational level of the workforce has increased at a

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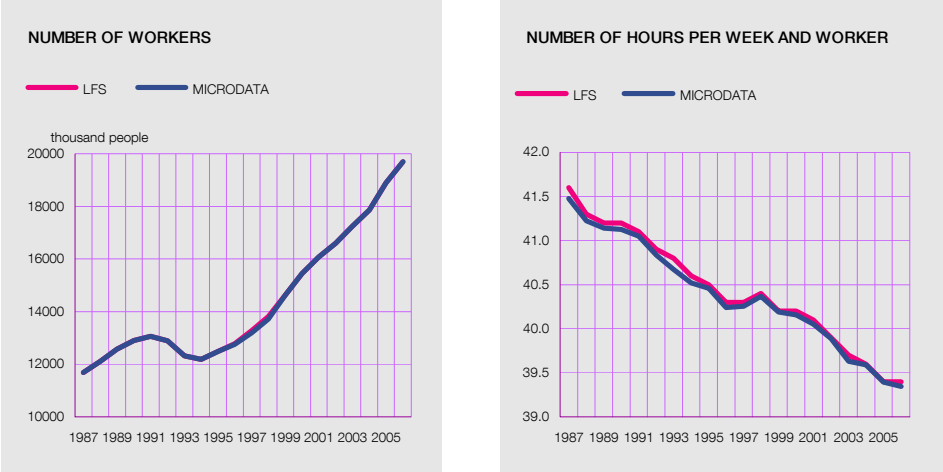
9. From 2005 the LFS have sample weights that are compatible with the population figures coming from the 2001 census and the "padrón continuo". These new weights were necessary due to the massive entry of immigrants in the late 90's. In addition to that change, INE revised all official results from 1995 onwards in order to account for the past population change that was not taken into account in previous waves. However, INE only provides microdata with weights consistent with this methodology from 1999 onwards. Before that date we use the old data sets (methodology LFS-2002), however; this break is not very important for the years 1996-1998 as it could be seen in the Bank of Spain *Economic Bulletin,* April- 2005, pp. 12-14.

10. There are other alternatives as the number of effective weekly hours which could recover better the period of vacations, sickness leave or extraordinary hours. We have chosen the first alternative because we believe those particular periods should not be taken into account in the measurement and because INE publishes usual hours as the measure of hours worked per worker.

11. Whereas everybody has answered the nationality, gender, age and education, there are some missing values for hours worked and experience. We impute those variables using several covariates without missing observation in the whole sample. In particular we use for each year the gender, age, educational attainment, sector and occupation. We restrict the estimation to have a number of hours worked between 0 and 80 and experience between 0 and 70.

continuous and fast pace during the whole period of analysis. In terms of experience within the firm, between 1988 and 1992 and in the last period over 2002 there has been an important reduction of the tenure of the workforce. Instead, between 1992 and 2002, the distribution of years worked in the firm is pretty constant. Finally, the number of immigrants has increased disproportionately after 1997, especially in the recent years.

LABOUR INPUT FIGURE 1
Number of workers and hours per week and worker



SOURCES: INE and Banco de España.

All these abovementioned changes and their interactions will affect the quality of labour depending on the relative number of efficiency units that we impute to a particular group. As it was suggested in the previous section, we are going to do that with the information on earnings that comes from the SES-2002. This survey only includes workers who were on the payroll of a firm on 31st October of the 2002. The firm should be made up of at least 10 workers[12] and the sample contains only workers whose main source of income is their salary and where working in all sectors but agriculture, fishing, public administration and housekeeping[13]. In terms of characteristics of the worker the survey provides information about gender, age, nationality, educational attainment[14] and the number of months that the worker has been working for the current firm.

The information on payments is quite precise in the survey and we include as wages the gross ordinary salary plus the extraordinary payments made by the firm on an annual basis. It does not include non-monetary payments, arrears, indemnifications or other expenses. We will study the worker's hourly wage so we need information about working time. We have data about the agreed regular schedule and the hours that someone worked in a non-regular fashion. Since we only have information about non-regular hours of work in October, we extrapolate the number in that particular month to the rest of the year[15]. It is important to note that a large fraction of the sample did not work the whole year in the

12. The absence of small firms should be taken into account when we draw conclusions from our analysis.
13. In particular, they have information on workers corresponding to the sectors between C and K and M , N and O.
14. The codification of educational attainment in 2002 corresponds to the same codification of the EPA since 2000. The codification in 1995 corresponded to the one used in the EPA between 1992 and 1999.
15. We must assume that October is a regular month in order to perform the extrapolation correctly.

firm[16]. In order to compute the hourly wage for those workers, we divide the payments by the actual time at work for that person.

CHANGES IN THE PERCENTAGES OF THE GROUPS IN THE TOTAL NUMBER OF WORKERS TABLE 1

PERCENTAGE OF WORKERS	1988	1992	1997	2002	2006
GENDER					
Males	69.6	67.3	64.9	62.4	59.4
Females	30.4	32.7	35.1	37.6	40.6
AGE					
Between 16 and 24 years old	15.2	14.9	11.5	11.4	10.3
Between 25 and 34 years old	28.1	29.2	30.0	30.3	29.7
Between 35 and 44 years old	23.8	24.6	27.0	27.8	27.9
Between 45 and 54 years old	18.9	18.3	20.5	20.0	20.8
55 yeras old and more	14.0	13.0	11.0	10.5	11.2
EDUCATION					
Low	55.5	45.7	34.4	22.8	16.0
Medium	33.1	41.2	48.2	56.8	61.8
High	11.3	13.2	17.4	20.4	22.1
EXPERIENCE					
Less than 2 years	23.9	31.8	34.1	30.9	32.2
Between 2 and 7 years	23.9	22.4	18.7	24.6	26.2
7 yeras and more	52.2	45.8	47.2	44.5	41.6
NATIONALITY					
Spanish	99.7	99.4	99.2	94.4	87.7
Foreign from EU-15	0.1	0.2	0.4	1.1	1.4
Rest of foreigns	0.2	0.3	0.5	4.5	10.9

SOURCES: INE and Banco de España.

CHANGES IN THE PERCENTAGES OF THE GROUPS IN THE TOTAL NUMBER OF HOURS TABLE 2

PERCENTAGE OF HOURS WORKED	1988	1992	1997	2002	2006
GENDER					
Males	71,6	69,6	67,8	65,4	63,5
Females	28,4	30,4	32,2	34,6	36,5
AGE					
Between 16 and 24 years old	14,8	14,5	11,0	10,8	9,6
Between 25 and 34 years old	27,8	28,9	29,6	30,0	29,8
Between 35 and 44 years old	23,9	24,7	27,1	28,0	28,2
Between 45 and 54 years old	19,2	18,6	20,9	20,3	21,1
55 years old and more	14,2	13,3	11,3	10,9	11,3
EDUCATION					
Low	56,5	46,8	35,4	23,4	16,3
Medium	32,9	40,9	48,2	56,9	62,3
High	10,6	12,3	16,4	19,6	21,5
EXPERIENCE					
Less than 2 years	22,9	30,6	32,5	29,4	30,9
Between 2 and 7 years	23,7	22,3	18,7	24,6	26,3
7 yeras and more	53,3	47,0	48,8	46,0	42,8
NATIONALITY					
Spanish	99,7	99,4	99,2	94,4	87,6
Foreign from EU-15	0,1	0,2	0,4	1,0	1,4
Rest of foreigns	0,2	0,3	0,5	4,6	11,0

SOURCES: INE and Banco de España.

16. At least one-third of workers did not work the whole year. There are various reasons: either they were hired or fired in the course of the year, injured or required a maternity break.

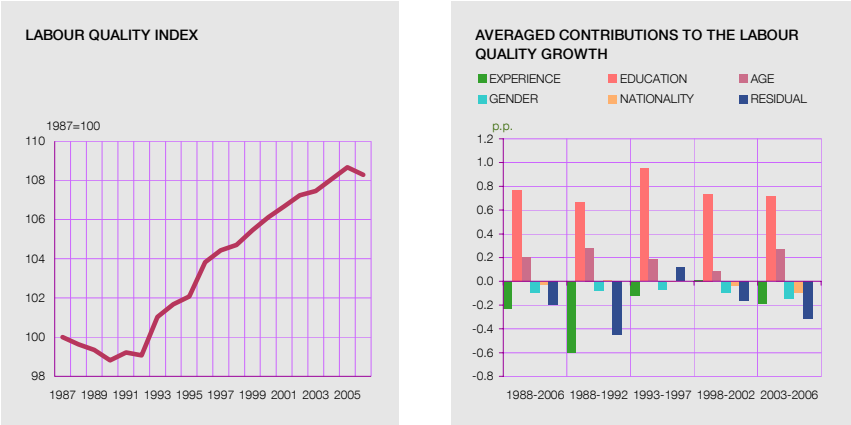
One advantage of using the SES instead of other Spanish data sets with information about salaries, as the European Community Household Panel (ECHP), is the sample size. The number of observations in this data set is 186,763 (as opposed to around 10,000 in the ECHP) which allows for treating all the possible interactions among variables with a sizeable number of observations per cell[17], according to the abovementioned methodology.

17. Only two groups: males and females between 16 and 24 with high education and more than 7 years of experience present 1 observation. All the other groups have at least 15 in the 2002 sample and 12 in the 1995.

4 Labour quality and its contributors

Figure 2 shows the estimation of the labour quality index for the whole economy[18]. Overall the index grows at an average annual rate of 0.42%. Only between 1988 and 1992 the index declines with a negative growth of –0.19%. After that moment, there is a period of stable and very dynamic growth of the quality of labour with an average annual growth rate of 1.06% between 1993 and 1997. Finally, the index starts moderating its rhythm with a growth rate of 0.53% between 1998 and 2002 and 0.24% between 2003 and 2006. Indeed, 2006 is the first year during the last 15 that presents a negative growth rate.

LABOUR QUALITY INPUT FOR THE WHOLE ECONOMY FIGURE 2



SOURCES: INE and Banco de España.

Overall, the results are very similar to the ones obtained by Hurtado and Moral (2003) with aggregate data (and without interactions) and the 1995 wage structure. Indeed they found a quality growth rate of 0.38% per year during the period 1987-2003 with the decline in labour quality in the first part of the sample. The main qualitative difference comes from the period 1996-2001 where Hurtado and Moral obtained a stagnation of the index whereas we observe a permanent growth.

In terms of contributions, Figure 2 shows also the contribution of education, age, experience, gender and nationality to the overall growth of the index in several sampling periods. Education is the factor that has influenced the most to the positive evolution of the index. During the whole period of time it contributed 0.77% to the quality growth. This is the counterpart of the important and continuous educational upgrading of the Spanish labour force. Although in the last years the contribution has been decelerating respect to the period 1993-1997 when it contributed with 0.95 pp, the positive impact of education is still relevant and it is expected to be relevant in the near future while the new generations with high levels of education keep replacing the older ones. However, the contribution should be decreasing over time.

18. In the appendix we provide the index normalized to 100 in 1988.

On the other hand, the age of an individual is a proxy for the stock of general experience that is embodied in a person. In principle, we expect individuals to increase their abilities the more years they spend in the labour force independently on whether they stay at the same firm or they switch to another. In that sense, aging should increase the abilities of the population via more experience and that is the reason why it is not surprising to see a positive contribution of aging in the quality index during the whole period. The contribution is 0.20 pp and it is pretty constant over the whole period[19]. As long as population gets older in the future, the contribution of aging might become smaller because of the typical concavity of wage profiles over the life cycle.

The age distribution does not fully characterize the way productivity varies with the years on the labour market. Indeed, the more years someone works in a particular job, the more productive he is respect to another worker that has spent the same number of years in the labour market but in other firms. This is what we capture with the variable years within a firm. Indeed, this factor is the second in terms of quantitative importance after education. The big reduction of tenure contributed negatively to the job quality with –0.23 pp. Indeed, during the period 1988-1992 this factor is the maximum responsible of the decline in labour quality. After that date, the negative contribution moderates and even becomes positive between 1998 and 2002. However, in the last period (2003-2006), tenure decreases again contributing negatively to the index (–0.19 pp). Notice that the contribution of this factor is much more volatile than the contribution of education. Variations of tenure are difficult to predict since this is a factor that is affected by the cycle.

Because of earnings differentials are assumed to be an image of relative productivities, and women earn less than males even when controlling for all the other relevant characteristics, it is not surprising that the increase in female participation produce a negative effect on the quality index. Its contribution is small and pretty constant around –0.10 pp.

Concerning the effects of migration, the big inflow of immigrants in Spain has impacted the labour quality with a negative contribution of –0.03 over the whole period. However, since the phenomenon is quite recent it is not surprising that the impact starts beginning important in 1998 and especially since 2003.

Finally, it is worth noting that the residual (the part of the variation in quality that cannot be accounted by univariate changes) is quite important, especially at the beginning and at the end of the sample. The residual is capturing some interactions between variables, both in wages (an example would be that an educated worker has more experience premium than a non educated) and in quantities (another example would be that women tend to have less experience). A closer look at these interactions reveals that most of the residual can be accounted by interactions between experience and other variables. This means that the importance of experience is larger than its univariate contribution suggests.

Summarizing, current wage differentials generate an increasing quality of labour during the last 15 years even with the inclusion of all possible interactions between different socio-demographic characteristics. This issue contrasts with the recent stagnation in the productivity growth.

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19. Only between 1998 and 2002 the contribution is slightly smaller and that is because the age distribution does not change much within this period compared to the others.

5 The importance of changes in average productivities over time

As it was suggested in section 2, the more wage information we have, the better the approximation to any aggregator function that maps individual characteristics to aggregate production. However, our previous computations fix the salary in 2002, and it is well known that there have been in the recent past many changes in the returns to different characteristics [see Izquierdo and Lacuesta (2006)] that might end up changing the estimation of individual productivities and consequently the quality index.

In order to show how those changes in returns affect the quality index we redo the previous exercise using earnings from the SES-1995. The sample of 1995 is slightly different to the 2002. In particular, in 2002 there is information on the nationality of the worker that is absent in the 1995 wave. Apart from that issue, the codification of education is different and in 2002 the coverage of the survey was extended to some non-market services (education, health and social services sectors). In order to do a fair comparison we homogenize the information on education, and we drop the observations regarding the abovementioned sub-sectors from the 2002 sample. Moreover, we do not consider nationality in the regressions.

Figure 3 shows the two quality indexes starting at the same level (100) in 1987.[20] Notice that this assumption does not need to hold if there are aggregate changes in the average productivity of all groups and not only in the relative productivities. In a sense the following figure only allows for relative productivities to change, and in the following two sub-sections we will allow for aggregate changes on top of relative. The average annual growth rate for the quality index given the earnings structure in 1995 is 0.6% whereas using the 2002 the growth rate is 0.42%. This higher index growth when 1995 relative wages are used is apparent during the whole period but the difference is especially important between 1998 and 2005. During the first years both indexes present a similar growth.

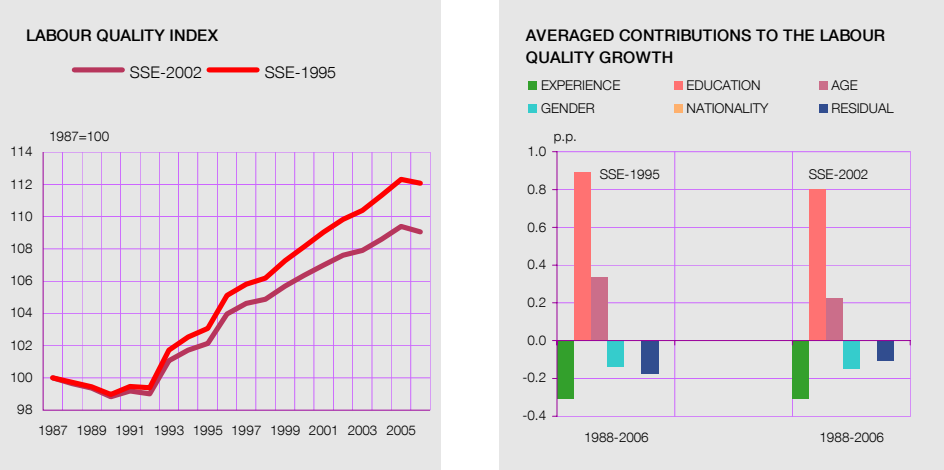
Given this discrepancy, if we believe equation (1), our best estimation for the real index of quality for the period 1988-2006 would be a combination of the two quality indexes. Indeed it would be similar to the index using the 1995 information at the beginning of the sampling period and similar to the index using the 2002 information at the end of the period. In a sense, the real average annual growth rate for the index during the whole period would have been in the range [0.42 ; 0.6]. This means that the slowdown of the index after 1997 would have been much more pronounced than what was evident using only one wave.

We could attribute the gap of the two series to the direct effect of two components: education and age (especially the first one). This could be observed in Figure 3 where it is represented also the contribution of each variable to both indexes. As it is evident in the graph, education and age are the components that are more different in terms of contributions. This is not surprising since, as it was already pointed out in Izquierdo and Lacuesta (2006), returns to education and age have decreased significantly when

20. Please note that the figure only depicts the effect of changes in relative productivities. In other words, a general increase in productivities between 1995 and 2002 affecting all groups (reflected in a general increase in real wages) is not taken into account.

comparing the two waves of data. In that paper, it was also shown that returns to tenure and gender did not change that much between the two waves[21].

EFFECT OF CHANGES IN RELATIVE RETURNS TO THE LABOUR QUALITY FIGURE 3



SOURCES: INE and Banco de España.

If we had information on yearly wages we would perform the whole exercise changing the wages year by year[22]. This is impossible in the Spanish case because there is no longitudinal microdata describing wages with the precision of the ESS. We might have used the European Community Household Panel (ECHP) for some years (1994-2001), but on the one hand we are left with very few observations to consider all possible interactions and on the other, we would still need to treat the years outside the sample.

Even in the case we had perfect information on yearly wages we might think that our model generating the prediction of the average productivity within a particular cell is not capturing correctly the characteristics of the Spanish market. For instance, we might want to enlarge the wage equation in such a way we could control for specific changes in the Spanish labour market that might have affected relative returns. First, adding occupations and second adding a mechanism of selection into the labour force. Since the 80s [Del Rio and Ruiz-Castillo (2001), Abadie (2002), and Febrer and Mora (2005)], the increase in the supply of university degree-holders has not been offset by an increase in the demand. This fact made many high educated workers to accept low-qualified jobs. Indeed the change in the educational distribution over time has not been accordingly matched by changes in the distribution of occupations. Therefore, adding different types of occupation into the regression should clearly modify the results downward. On the other hand, there has been an enormous net creation of employment. In 1988 the employment rate between the ages of 16 and 64 was 48.6% and nowadays is 66.6%. It is very likely that those who participated in the labour market at the beginning of the 90's, were different in many aspects to those who decide to

21. Actually, returns to tenure change in different parts of the distribution of earnings, but in the average those differences cancel out.

22. Notice that it is not enough to change relative wages, but one also need to have an estimator of the absolute real wage change within the reference group in order to compare the productivity of each cell from one year to another.

participate nowadays on top of education, age or tenure. Indeed, it is likely that they were more favourably selected since only half of them worked, and now working is a more general option. If this is the case, the quality of labour, as it happened with the addition of occupation, should be modified downward.

5.1 The effect of adding the type of occupation

At the beginning we decided not to include occupation into the measure of human capital because theoretically this should not be a characteristic of the individual that makes him more or less productive. Instead, the occupation held is something that is chosen by the individual and it is clearly endogenous. However, in practice, there would be reasons to incorporate occupations into the empirical analysis, for example, if individual's education does not fully reflect someone's ability and it is just a signal of his potential ability. In that case, occupation might be a better proxy of the skill of the worker. It is also possible that the model underlying the formation of wages departs from the simpler human capital accumulation model specified in section 2. For example, let's imagine an assignment model [Sattinger (1993)] were particular individuals with identical characteristics are assigned to available occupations. Apart from the individual's human capital, his productivity will depend on the type of job he has. In that case and given the fact that occupations in reality are heterogeneous, better individuals are assigned to better occupations[23]. In that model, we need to control for the type of occupations because someone's productivity will depend on the type of job that someone's has. We enlarge our wage regressions with four types of occupations[24]:

$$w_i = \alpha_0 + \alpha_1 Gender_i + \alpha_2 Age_i + \alpha_3 Educ_i + \alpha_4 Tenure_i + \alpha_5 F_i + \alpha_6 EU15_i + \alpha_7 Ocup_i$$

Table 3 shows the way occupation has changed over time[25]. There has been a polarization of occupations increasing the weight of qualified non-manual occupations and non-qualified manual occupations:

23. Better occupations, meaning more suitable to someone's skills, in such a way that if someone with the required skills matches with a suitable occupation he is more productive.

24. Note that we have removed all the interactions between variables. This is because with the addition of occupations, there are no observations for several groups if we consider all interactions. We have, however, tried to include some interactions separately (in particular, the interaction between education and occupation, which is of special importance given the change in coefficients in table 4), and the results are very similar.

25. Notice we only have occupations from 1994 onwards because of a change in the definition of occupation (CNO-94).

CHANGES IN THE PERCENTAGES OF THE GROUPS IN THE TOTAL NUMBER OF HOURS TABLE 3

PERCENTAGE OF HOURS WORKED	1988	1992	1997	2002	2006
GENDER					
Males	71,6	69,6	67,8	65,4	63,5
Females	28,4	30,4	32,2	34,6	36,5
AGE					
Between 16 and 24 years old	14,8	14,5	11,0	10,8	9,6
Between 25 and 34 years old	27,8	28,9	29,6	30,0	29,8
Between 35 and 44 years old	23,9	24,7	27,1	28,0	28,2
Between 45 and 54 years old	19,2	18,6	20,9	20,3	21,1
55 years old and more	14,2	13,3	11,3	10,9	11,3
EDUCATION					
Low	56,5	46,8	35,4	23,4	16,3
Medium	32,9	40,9	48,2	56,9	62,3
High	10,6	12,3	16,4	19,6	21,5
EXPERIENCE					
Less than 2 years	22,9	30,6	32,5	29,4	30,9
Between 2 and 7 years	23,7	22,3	18,7	24,6	26,3
7 yeras and more	53,3	47,0	48,8	46,0	42,8
NATIONALITY					
Spanish	99,7	99,4	99,2	94,4	87,6
Foreign from EU-15	0,1	0,2	0,4	1,0	1,4
Rest of foreigns	0,2	0,3	0,5	4,6	11,0
OCCUPATION					
Qualified non-manual			29,1	30,1	31,2
Non-qualified non-manual			23,1	23,2	23,9
Qualified manual			34,9	32,9	30,7
Non-qualified manual			12,9	13,7	14,1

SOURCES: INE and Banco de España.

However, relative productivities will also change since the addition of occupation changes the coefficients of the wage regression notably (Table 4). For instance, the wage differential by education is decreased enormously:

EFFECT OF ADDING THE OCCUPATION TO THE LABOUR QUALITY ESTIMATION TABLE 4

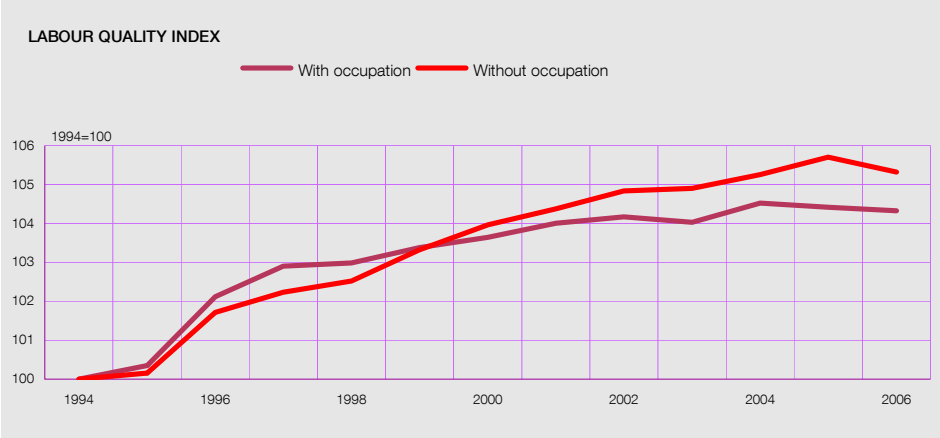
ESTIMATED COEFICIENTS	WITH OCCUPATION	WITHOUT OCCUPATION
FOREIGN	-0.03 (0.0059) ***	-0.06 (0.0063) ***
FOREIGN FROM EU-15	0.11 (0.0115) ***	0.20 (0.0124) ***
FEMALE GENDER	-0.24 (0.0020) ***	-0.25 (0.0020) ***
AGE BETWEEN 16 AND 34 YEARS OLD	-0.19 (0.0036) ***	-0.20 (0.0039) ***
AGE BETWEEN 35 AND 54 YEARS OLD	-0.06 (0.0033) ***	-0.06 (0.0036) ***
MEDIUM EDUCATION	0.06 (0.0022) ***	0.14 (0.0023) ***
HIGH EDUCATION	0.32 (0.0035) ***	0.68 (0.0029) ***
LESS THAN 2 YEARS OF EXPERIENCE	-0.42 (0.0025) ***	-0.49 (0.0026) ***
BETWEEN 2 AND 7 YEARS OF EXPERIENCE	-0.23 (0.0023) ***	-0.28 (0.0025) ***
QUALIFIED NON-MANUAL	0.55 (0.0035) ***	
NON-QUALIFIED NON-MANUAL	0.16 (0.0031) ***	
QUALIFIED MANUAL	0.14 (0.0029) ***	
CONSTANT	2.31 (0.0040) ***	2.48 (0.0036) ***
Number of observations	186,763	186,763
R-squared	0.52	0.44

Standard errors in parentheses
Signigicant at: * (10%); ** (5%; ***(1%).

SOURCES: INE and Banco de España.

Figure 4 describes the way the quality of labour changes with this addition. It is clear from the graph that the quality of labour decreases the average growth from 1997 onwards (notice that in this figure the level in 1994 is 100). Without occupations the index grew between 1997 and 2006 0.35% per year in average while with occupations it grows 0.21%. This is the case because the contribution of occupation is negative and the contribution of education is decreased enormously.

EFFECT OF ADDING THE OCCUPATION TO THE LABOUR QUALITY ESTIMATION FIGURE 4



SOURCES: INE and Banco de España.

5.2 Measuring selection in the labour market

Our first equation in section 2 was defined in terms of variables that were fully observable (*X*) by the econometrician. Let's assume that every individual has some characteristics that affect his own productivity and it is unobserved by the econometrician (ε). The usual way of understanding this variable is by labelling as ability for example. In that case, wages are defined as:

$$w_i = \alpha_0 + \alpha_1 Gender_i + \alpha_2 Age_i + \alpha_3 Educ_i + \alpha_4 Tenure_i + \alpha_5 F_i + \alpha_6 EU15_i + \varepsilon_i = w(X_i) + \varepsilon_i$$

A person decides to participate in the labour force if the wage offered is bigger than a reservation wage $w_i^R = w^R(X_i, u_i) = w^R(X_i) + u_i$. Since we only observe those individuals whose wage is above the reservation wage, the expected wage in the labour market is:

$$E(w_i \mid X_i, w_i > w^r{}_i) = \alpha_0 + \alpha_1 Gender_i + \alpha_2 Age_i + \alpha_3 Educ_i + \alpha_4 Tenure_i + \alpha_5 F_i + \alpha_6 EU15_i + E(\varepsilon_i \mid w_i > w^R{}_i)$$

Let's assume that $(\varepsilon_i, u_i) \sim N\left[\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\sigma^{\varepsilon} & \sigma^{\varepsilon u}\\ & \sigma^{u}\end{pmatrix}\right]$, then, the participation equation is such that[26]:

$$P(w_i > w^r{}_i) = P\left(\frac{u_i - \varepsilon_i}{\sqrt{\sigma^{\varepsilon} + \sigma^{u} - 2\sigma^{\varepsilon u}}} < \frac{w(X_i) - w^r(X_i)}{\sqrt{\sigma^{\varepsilon} + \sigma^{u} - 2\sigma^{\varepsilon u}}}\right) = \Phi(\gamma(X_i))$$

In this case, only those for whom the offered wage is higher than their reservation wage decide to participate. Therefore, the average ability in the economy is a function of the proportion of individuals who decide to participate:

26. Φ and ϕ refer, respectively, to the cumulative distribution function and density function of a normal distribution N(0,1).

$$E\left(\varepsilon_i \mid w_i > w^r{}_i\right) = \frac{\sigma^{\varepsilon} - \sigma^{\varepsilon u}}{\sqrt{\sigma^{\varepsilon} + \sigma^{u} - 2\sigma^{\varepsilon u}}} \frac{\phi\left(\gamma(X_i)\right)}{\Phi\left(\gamma(X_i)\right)}$$

In practical terms this issue generates an estimation problem since we only observe wages for those who participate and not controlling for this extra-term would bias all coefficients. The correct empirical model is:

$$E\left(w_i \mid X_i, w_i > w^r{}_i\right) = \alpha_0 + \alpha_1 Gender_i + \alpha_2 Age_i + \alpha_3 Educ_i + \alpha_4 Tenure_i + \alpha_5 F_i + \alpha_6 EU15_i + \alpha_7 \frac{\phi\left(\gamma(X_i)\right)}{\Phi\left(\gamma(X_i)\right)}$$

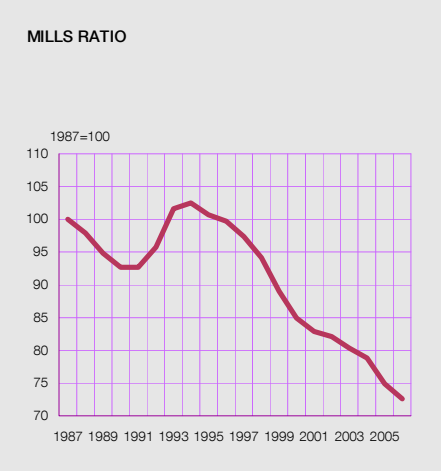
The good news is that we could estimate the extra-parameter (called mills ratio) by assuming a probit model for the probability of being working [Heckman (1979)].[27,28]

$$P\left(working_i \mid X\right) = \overline{\Phi\left(\gamma(X_i)\right)}$$

Once we add the mills ratio into the wage equation we estimate α_7 . A negative sign in front of the mills ratio means that those with high reservation wages are more productive, whereas a positive sign is coherent with both unobserved terms going in opposite directions.

Figure 5 shows the way the average mills ratio for workers has changed over time. The pattern follows inversely the evolution of occupation rates. Between 1987 and 1991 the mills ratio decreases because of the increase in the labour participation but between 1992 and 1995 that particular increase is compensated by an increase in unemployment and that is the reason why the mills ratio increases. After that moment the mills ratio decreases notably. Therefore, the mills ratio will be fundamental from 1996 onwards:

EVOLUTION OF THE MILLS RATIO SELECTION PARAMETER IN SPAIN FIGURE 5



SOURCES: INE and Banco de España.

27. The dependent variable takes the value 1 if employed and 0 if unemployed or inactive. The independent variables are gender, age, education and nationality.

28. The exact procedure is the following. First we estimate the probit for 2002 using data from the LFS (second quarter). Second, we estimate α_7 in the previous equation, with information from SES-2002, and with the predicted values from the probit previously estimated. Finally, we re-estimate the probit for each year, holding constant its effect on wages, α_7.

Table 5 shows the effect of adding the mills ratio to the second regression in table 4. The coefficient in front of the mills ratio is positive, meaning that the incorporation of new workers in the economy decreases the average productivity. The other coefficients do not change much, meaning that mostly the changes in the quality of labour come from the addition of the new regressor instead of changes in the relative productivities:

EFFECT OF ADDING A SELECTION MODEL TO THE LABOUR QUALITY ESTIMATION TABLE 5

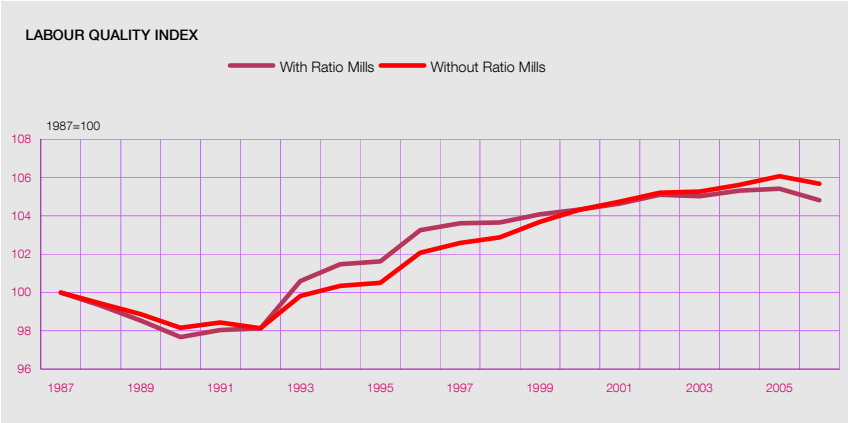
ESTIMATED COEFICIENTS	WITH MILLS RATIO	WITHOUT MILLS RATIO
FOREIGN	-0.03 (0.0070) ***	-0.06 (0.0063) ***
FOREIGN FROM EU-15	0.16 (0.0130) ***	0.20 (0.0124) ***
FEMALE GENDER	-0.31 (0.0083) ***	-0.25 (0.0020) ***
AGE BETWEEN 16 AND 34 YEARS OLD	-0.12 (0.0111) ***	-0.20 (0.0039) ***
AGE BETWEEN 35 AND 54 YEARS OLD	0.07 (0.0164) ***	-0.06 (0.0036) ***
MEDIUM EDUCATION	0.17 (0.0053) ***	0.14 (0.0023) ***
HIGH EDUCATION	0.76 (0.0098) ***	0.68 (0.0029) ***
LESS THAN 2 YEARS OF EXPERIENCE	-0.49 (0.0026) ***	-0.49 (0.0026) ***
BETWEEN 2 AND 7 YEARS OF EXPERIENCE	-0.28 (0.0025) ***	-0.28 (0.0025) ***
MILLS RATIO	0.15 (0.0186) ***	
CONSTANT	2.27 (0.0260) ***	2.48 (0.0036) ***
Number of observations	186,763	186,763
R-squared	0.44	0.44
Standard errors in parentheses		
Signigicant at: * (10%); ** (5%; ***(1%).		

SOURCES: INE and Banco de España.

Figure 6 describes the way the quality of labour changes. In this case, the level is 100 in 1987.

FIGURE 6

EFFECT OF ADDING A SELECTION MODEL TO THE LABOUR QUALITY ESTIMATION



SOURCES: INE and Banco de España.

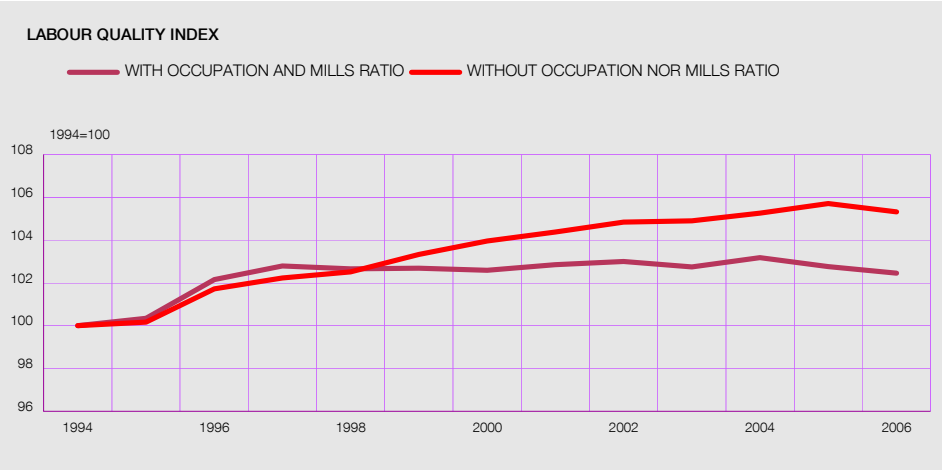
The incorporation of the mills ratio increases the quality index between 1991 and 1996 and decreases the slope from that moment on. Therefore, it has an important impact on the average growth of the latter period. Without the mills ratio the average yearly growth between 1997 and 2007 of the quality index was 0.35% and including the mills ratio this number decreases to 0.15%. Indeed, this factor has a higher impact than occupations in the latter period.

5.3 Adding occupations and the selection mechanism together

The incorporation of occupations and the mills ratio increases the growth of the quality index between 1994 and 1997, and decelerates it afterwards. In section 5.1 we learnt that the index without any of these two variables was growing between 1997 and 2006 at a yearly average of 0.35%, attaining an accumulated growth of almost 4 pp. However, with the inclusion of the two new dimensions the index decreases at a yearly average of 0.03%, accumulating a decrease of 0.3 pp.

FIGURE 7

EFFECT OF ADDING OCCUPATION AND A SELECTION MODEL TO THE LABOUR QUALITY ESTIMATION



SOURCES: INE and Banco de España.

This evidence suggests that for the case of Spain using the traditional approach to compute the quality of labour index might be misleading. The rapid and continuous incorporation into the labour market of high educated workers, in addition to the current wage differentials by educational level would necessarily make the quality index to grow. However, if we consider the impressive incorporation of workers into the Spanish labour market, as well as the type of jobs that they hold the picture changes abruptly and we observe a stagnation in the quality of labour during the last 10 years.

6 TFP of the market economy after adjusting for the quality of labour

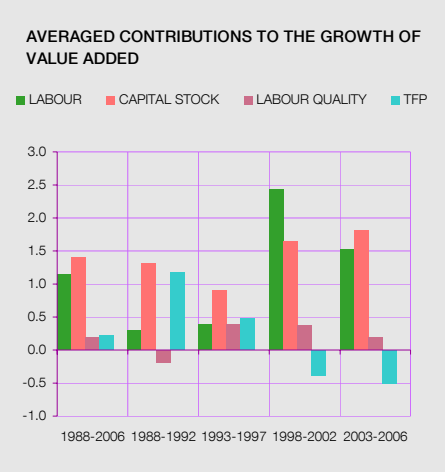
Once we have a quality index that incorporates heterogeneity in the labour force, we could add it to any aggregate production function of the market economy[29]. In particular we use the typical Cobb-Douglas with capital and hours worked augmented with the characteristics of the workers:

$$Y_t = TFP_t F(K_t, H_t, Q_t)$$
$$Y_t = TFP_t K_t^{1-\alpha} (H_t Q_t)^{\alpha}$$

Where *Y* represents the Value Added of the market economy in real terms, *K* is the stock of capital of the market economy, *H* is the total number of hours worked, and *Q* is the quality index of the market economy[30]. On the other hand, α is set to 0.60 in order to approximate the labour share in the GDP in the recent years[31]. With this equation Total Factor Productivity *(TFP)* is the residual of the abovementioned equation.

Given our first estimation of the labour quality, this factor contributes with 0.19 pp to the Value Added growth in annual terms [see figure 8]. Indeed, its contribution is as high as the contribution of the TFP (0.23 pp). This means that the growth of our quality index explains almost one half of a TFP growth calculated without labour quality.

TOTAL FACTOR PRODUCTIVITY OF THE MARKET ECONOMY FIGURE 8



SOURCES: INE and Banco de España.

29. We only have an accurate estimation for the capital in the market economy and that is the reason why we need to exclude non market services. Capital is estimated using the perpetual inventory of the stock of capital.

30. The quality index of the market economy grows slightly less than the quality index of the total economy, as can be seen in the appendix. Indeed it grows at an average of 0.32% between 1988 and 2006, against a 0.42% for the total economy. We cannot use directly the quality index for the whole economy in TFP calculations because we do not have access to measures of capital for the non-market services.

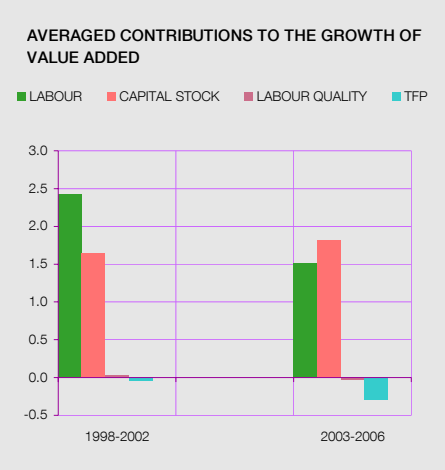
31. This value corresponds to the average share of labour income over total value added. The estimation for the TFP do not change qualitatively even in the case of setting different labour shares over time.

It is clear that the evolution over time of labour quality contribution differs a lot from the evolution of TFP contribution. The latter is pretty high for the first period of the sample and decreases sharply during the last years.[32] On the other hand, labour quality contribution starts at negative rates, increasing afterwards and only decelerating at the very end. This means that accounting for labour quality could help to explain part of the recent drop in unadjusted TFP growth.

Once we take into account occupations and the mills ratio, the contribution of the quality of labour during the period 1998-2002 almost vanishes and it is slightly negative for the period 2003-2006. Note that this should not be interpreted as a low importance of taking into account changes in labour quality. Instead, the correct interpretation is that, although education had a very important contribution to labour quality growth, there are other factors, also very important, that could offset this positive contribution of education at least in the short run.

TOTAL FACTOR PRODUCTIVITY OF THE MARKET ECONOMY FIGURE 9

ESTIMATION ADDING OCCUPATION AND A SELECTION MODEL



SOURCES: INE and Banco de España.

32. There is a very recent acceleration of TFP growth in annual terms.

7 Conclusions

The paper departs from the traditional way of measuring an index of labour quality in order to explain a recent empirical puzzle in the Spanish economy: despite showing one of the most important increases in labour quality in the EU according to standard methods, it also offers a negative increase in TFP growth. The increasing importance of overeducation in Spain as well as the enormous increase in occupation rates makes necessary the addition of a participation mechanism and a variable describing the type of occupation held by the worker. The addition of those variables changes the prediction of the absolute and relative productivities of every demographic sub-group of the population achieving completely different results.

In the estimation of a labour quality index for Spain between 1988 and 2006, we first include the typical human capital variables gender, age, education, experience in the current job and nationality, similarly to what has been done in previous research. In this first stage we include all possible interactions of these variables. This issue is important given the fact that educational attainment has increased generationally. The treatment of all possible interactions would have not been possible without the usage of microdata from the Labour Force Survey and the Structural Earnings Survey–2002. Indeed, the usage of microdata allows the introduction of all possible interactions among those variables. The index consists in disaggregating the total number of hours worked into different cells with particular characteristics and weighting them by the market wage of each particular group. Overall, the index grows at an average annual rate of 0.42%. Only between 1988 and 1992, the index declines with a negative growth of –0.19%. After that moment, there is a period of a very dynamic growth of labour quality with an average annual growth rate of 1.06% between 1993 and 1997. Finally, the index starts moderating its pace with a growth rate of 0.53% between 1998 and 2002 and 0.24% between 2003 and 2006.

The construction of the index enables its disaggregation into different components. Education is the factor that has influenced the most to the positive evolution of the index. However, at the beginning of the sample, the important reduction in tenure pushed the index down more vigorously. During the last years, skill upgrading is not as strong as before, and immigration and tenure depressed the quality of labour to slower growth rates. In the future, the increasing importance of immigrants and the slowdown of education might push down the quality of labour even more. However, during the last year we have observed a decrease in the rate of temporary contracts, partly due to a higher destruction of temporary contracts. This phenomenon might push labour quality up if continues over time.

This labour quality increase is puzzling given the observed slowdown in productivity growth during the last decade. One potential explanation underlying this fact might be that our measure of productivity is not really capturing the recent changes in the composition of the Spanish labour force. Indeed, in order to construct the index we kept relative productivities constant during the whole period. However, the productivity of each characteristic has varied across time as it has been apparent by important changes in the underlying wage structure. In order to check this issue, we computed the index of quality using wage information from the Structural Earnings Survey 1995 and we found that there are notable differences between the two indexes. In particular, the index of quality computed using the 1995 information would have been growing more than the 2002. This is intuitive since wage differentials where higher in 1995 than in 2002. This evidence reinforced the

idea that the usage of time varying wages is more appropriate when incorporating more years into the analysis.

The impossibility of having yearly information on wages makes us think in ways of enlarging the cross section wage equation incorporating some particular features of the Spanish economy that might have changed notably during this recent period. First, we incorporate the type of occupation and second we introduce a selection mechanism into the labour force. There would be reasons to incorporate occupations into the analysis. On the one hand, individual's education might not fully reflect someone's ability and it might be only a signal of it. In that case, occupation might be a better proxy of the skill of the worker. On the other, an assignment model predicts that the individual productivity is a match between certain abilities and some characteristics of the job. Therefore, adding different types of occupation into the regression with the increasing overeducation in the Spanish economy would modify the coefficients of the regressions. The paper shows that this is the case. Moreover, there has been an enormous net employment creation. In 1988 the employment rate between the ages of 16 and 64 was 48,6% and nowadays is 66,6%. It is very likely that those who participated in the labour market at the beginning of the 90's, were different in many aspects to those who decide to participate nowadays on top of education, age or tenure. Indeed, it is likely that they were more favourably selected since only half of them worked, and now working is a more general option. The paper also shows that this factor had a negative effect on the quality of labour in the recent years.

Finally we included labour quality in a standard growth accounting exercise setting for the market economy and for each particular sector. The main result in this respect is that labour quality can account for half of the TFP growth on average. Also, some of the recent slowdown in productivity can be explained by a drop in labour quality growth rates over the last years of the sample. Once we take into account occupations and the mills ratio, the contribution of the quality of labour during the period 1998-2002 almost vanishes, meaning that these two factors had a negative effect on labour quality that could compensate the quality increase from other factors like education. The distinction between the two compensating effects is very important, because it can be expected that the shortage of qualified labour demand mentioned before is a temporary phenomenon. Also, the increase in employment, and hence the inclusion of less productive people into the labour force, is again temporal. Therefore, disentangling a null contribution into a positive and permanent component and a negative and transitory one allows us to expect future improvements in labour quality, and hence in productivity.

8 Appendix: Labour Quality Index

QUALITY LABOUR INDEX FOR THE WHOLE ECONOMY, BY SECTOR AND ALTERNATIVE INDEXES TABLE A-1

1994=100	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
QUALITY LABOUR INDEXES													
MARKET ECONOMY	100,0	100,2	101,5	101,8	102,2	103,1	103,6	104,4	105,1	105,7	106,3	106,5	106,4
Agriculture	100,0	99,6	100,5	101,0	101,7	101,9	102,1	102,1	102,9	102,1	104,1	104,8	106,0
Industry	100,0	99,6	101,0	100,9	100,8	101,1	102,4	102,3	103,9	104,9	105,5	105,7	107,5
Construction	100,0	100,0	101,6	102,8	101,8	101,9	103,1	104,1	103,9	104,8	105,4	105,2	104,1
Market Services	100,0	100,8	102,0	102,5	103,2	105,0	105,0	106,3	107,0	107,6	108,1	108,3	107,7
WHOLE ECONOMY	100,0	100,4	102,1	102,7	103,0	103,7	104,4	104,9	105,5	105,7	106,3	106,9	106,5
Non market services	100,0	100,6	102,8	104,6	104,8	105,1	106,4	106,6	105,8	104,4	105,0	106,3	105,1
ALTERNATIVE QUALITY LABOUR INDEXES													
QUALITY LABOUR INDEX WITHOUT INTERACTIONS (a)	100,0	100,2	101,7	102,2	102,5	103,3	104,0	104,4	104,8	104,9	105,3	105,7	105,3
ADDING OCCUPATION	100,0	100,3	102,1	102,9	103,0	103,4	103,6	104,0	104,2	104,0	104,5	104,4	104,3
ADDING A SELECTION MODEL	100,0	100,2	101,8	102,1	102,2	102,6	102,8	103,1	103,6	103,5	103,8	103,9	103,3
ADDING OCCUPATION AND A SELECTION MODEL	100,0	100,3	102,2	102,8	102,6	102,7	102,6	102,8	103,0	102,7	103,2	102,8	102,5

SOURCES: INE and Banco de España.

a. This index is included only for comparability with alternative quality labour indexes.

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