Cohort Wage Profiles in an Internal Labour Market

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Abstract

This paper investigates the movement of cohort wages in an internal labour market of a large British financial institution. The main objective of the analysis is to establish whether movements of cohort wages over time in this particular institution are consistent with the theoretical notion of an internal labour market as defined in the literature. The influential work by Doeringer and Piore on internal labour markets and manpower analysis has most certainly produced a definition of internal labour markets, which is still widely quoted. That is to what extent internal and external market forces impact on an employees wage. Additionally the question of what kind of inferences can be made with regards to the wage policy of this particular firm is posed.

The paper follows closely the analysis of aggregate mean cohort wages as outlined in Baker, Gibbs and Holmstrom (1994b)[1]. They analyse the wage policy of a firm empirically using data on management employees of a large financial firm in the USA over the period 1969 to 1988 in order to test theories that could rationalize observed wages. Baker, Gibbs and Holmstrom are in fact using the term 'administered wages' rather than observed wages. This derives from Doeringer's and Priore's definition of internal labour markets. One of the questions asked in the BGH paper is how changes in external market conditions impact on wages within the organisation. The question is analysed in the framework of a cohort analysis, and the results suggest a clear cohort effect that gives evidence of the existence of an internal labour market for the financial institution under consideration. The rationale for following BGH's analysis derives from the fact that at present the analysis and understanding of internal labour markets, its hierarchical structure, organisation, promotion procedures and above all its wage structure have received great attention in theoretical work but still lag considerably in the empirical testing of these established theoretical predictions. The reason for this boils down to the difficulty of obtaining personnel and payroll data of internal labour markets. Replicating part of the analysis as outlined in BGH's above paper will aid greatly in establishing whether the evidence they find only applies to that particular firm or whether their results in terms of wage policy can be generalised not only across firms in the same sector but also (as it is in this case) across countries.

JEL Codes: J31, J41, M5

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[1] Baker, G., Gibbs, M., Holmstrom, B. (1994b) *Quarterly Journal of Economics,"The wage policy of a firm"* **109,** 921-955.

I. Introduction

One of the main ideas of internal labour market theory is that the structure of wages within large firms is not as responsive to changes in external supply and demand conditions as spot market wages (or as neoclassical theory suggests). This suggests that firstly, pay within an internal labour market is not governed by supply and demand but by other factors such as predetermined rules regarding the wage structure and as we will see the structure of jobs. Secondly, that employees of an internal labour market are to some extent shielded from external market conditions which would otherwise impact on their wages and consequently, that employees of an internal labour market are to a certain degree cut off from competition from the external market. Of course, interaction is taking place between the two markets as well. In internal labour market theory the two markets touch at so called ports of entry and exit into and out of the internal labour market. Ports of entry are usually placed at the bottom of the job hierarchy within an internal labour market and once entry is successful, the 'insiders' can compete for gaining entry into better jobs within the hierarchy. Naturally, if no insider matches the characteristics of the job, outsider competition takes place for that job as well but if insiders are available to fill in a better vacancy within the hierarchy, they are clearly at an advantage compared to outsiders since the firm already has some prior knowledge about the insider's ability and has probably invested into some specific training for the insider as well, a cost the firm does want to keep at a minimum. This is suggestive of two other features characterising internal labour markets which run counter to neoclassical predictions: (i) employees, once they enter the internal labour market have the opportunity to compete for promotions and in that way create careers and job ladders which in turn manifest themselves in long-term employment relationships, and (ii) jobs in internal labour markets have the characteristic of being more desirable than external market jobs not only because the wage may not be determined by marginal product which reduces the risk of high wage variations but also because of the prospect of moving from a good job to a better job. The external labour market is constituted of spot markets and employment contracting occurs through information of an individuals characteristics. That is, the only information about the

employee's marginal product is carried by the person's characteristics and a match will be made on the basis of such information. Once the individual has been with the firm for some time the firm and the employee are more able to produce a better match. This occurs because the firm learns about the individual's ability and can observe her comparative advantages. The employee is also interested to derive at a better match in order to minimise her cost of producing effort. In that sense the concept of the job in an internal labour market changes slightly to that of spot contracting in that to derive at a good quality match the characteristics of the jobs become more important.

Doeringer and Piore define an internal labour market as "an administrative unit, such as a manufacturing plant, within which pricing and allocation of labor is governed by a set of administrative rules and procedures" (1971)[2]. Exactly how these rules of pricing and labour allocation are defined is not explicitly elaborated on in Doeringer's and Piore's writings. The distinctive features discussed so far concerning internal labour markets and the fact that neoclassical theory cannot incorporate them, led to the emergence of a new literature, which is still predominantly theoretical in nature, trying to model pricing and labour allocation in terms of careers in organizations in internal labour markets. These models can be placed in three broad categories, (i) building-block models which include human-capital theory, job assignment, incentive contracting, efficiency wages, and tournaments; (ii) applied human resource management and organization theory including politics, social relations and work practices; and (iii) integrative models which address patterns of evidence rather than a single aspect of careers in organisations.

Baker, Gibbs and Holmstrom in their above paper focus on on-the-job-training, learning and incentives in order to investigate the wage dynamics of an internal labour market. They are specifically interested in three aspects of careers in organizations to infer information about the wage policy of the firm: "the relative importance of job levels versus individual performance in determining an employee's wage", the responsiveness of wages to external market conditions, the progression of wages and whether they are downward rigid. BGH find that there are clear cohort effects implying that a cohort's average entry wage is indicative of that cohort's average wage after years of entry. Real-

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[2] Doeringer, P., Priore, M. (1971) *"Internal labor markets and manpower analysis"*.

wage decreases for their sample are rare but do exist for a small fraction of the sample. Serial correlation is observed in wage increases. Promotions are highly important for wage growth. But although the increase in wages due to promotions are larger than the average wage increase that increase is relatively small when compared to the discrepancy of the average wage between levels of the job ladder. Employees experiencing substantial wage increases within a job level relatively quickly after entry into the firm have a higher probability of promotion to the next level than those employees who did not. It is indeed possible for BGH, given their empirical evidence, to shed some light on the wage policy of their firm. Their firm seems to employ a wage policy that (i) is not as "administratively rigid" as the theories of internal labour markets usually suggest and (ii) the three theories they employ cannot explain all of the above findings. While BGH concentrate in a first step on the behaviour of aggregate wages in terms of a cohort analysis and in a second step on the behaviour of individual wages, we only analyse the behaviour of aggregate wages of our British financial firm in the form of a cohort analysis, and do not discuss in this paper the relative importance of job levels versus individual performance in determining and employees wage. Medoff and Abraham (1980,1981)[3] investigate empirically to what extent the human capital on-the job-training model can account for returns to labour market experience that should be based in productivity growth. They do find a strong relationship between experience and relative earnings within levels but no or even negative relationship between experience and relative performance within job levels. The important implication of their analysis is that the human capital on-the-job training model is unable to fully account for their empirically observed return to labour market experience.

The paper is structured as follow. Section I briefly summarizes the three models BGH use as a benchmark to interpret their empirical evidence with regards to the firm's wage policy. Section II describes the data we use for the empirical analysis in this paper and highlights some of the similarities and dissimilarities to the firm discussed in BGH.

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[3] Medoff, J. L. a. A., Katherine. G. (1980) *Quarterly Journal of Economics,"Experience, performance and earnings"* **95,** 703-36, Medoff, J. L. a. A., Katherine (1981) *Journal of Human Resources,"Are those paid more really more productive? The case of experience"* **16,** 186-216.

Section III presents the findings of our average cohort wage analysis and section IV concludes.

I. Theoretical background

One way of approaching the analysis of wage dynamics within firms is the human-capital model introduced in Becker's seminal work on human capital (1975)[4]. Becker distinguishes two types of human capital investment. In the context of firms this takes the form of training. The first type is referred to as general training. This raises a worker's marginal product in firms across the labour market since the training develops skills of equal value to all firms. The second type is referred to as specific training. It increases the marginal product of a worker only in a single firm since this kind of training develops skills that are only of value to the firm or employer within which the training is undertaken. It is quite obvious from the definitions of general and specific training that in the case of the former the worker bears the cost of training. And in the latter the worker and the firm both contribute to the cost of training. The cost of training is the opportunity cost of reduced productivity during the training period and the benefit is the enhanced productivity in the post-training period. In the case of general training, the worker may be "poached" by firms because a firm who has provided (and paid for) the training will attempt to recoup these costs by paying a wage below the post-training marginal product. However, a firm who has not provided the training will be prepared to pay a wage equal to the post-training marginal product because they have no costs to recoup and can simply take advantage of the higher productivity. Therefore, workers, not firms will have to pay the cost of general training. As a consequence, all workers will be paid a wage according to their marginal product. This implies that the worker bears the entire cost of forgone wages associated with the training and reap the entire benefit. In the case of specific training there is no problem of poaching because the worker's value to another firm is that of an untrained worker. Therefore, when the training is specific the firm bears the costs and reaps the gains. The firm is therefore paying a wage in excess of marginal productivity during the training period, but can pay a wage below marginal product in the

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[4] Becker, G. (1975) *"Human Capital: A theoretical and empirical analysis, with special refernece to education",* University of Chicago Press, Chicago.

post-training period. Whilst the worker does have no incentive to bear the cost of specific training, this would result in the worker receiving the wage of an untrained worker. But we typically see a sharing arrangement, where the firm and the worker share the costs and the rewards of the training. The way in which wage growth is linked to on-the-job training is through accumulation, in this case, of specific human capital via on the job training. This should increase with experience. According to this earnings profiles should be concave and increasing at a decreasing rate. And the wage the employer receives equals his marginal product, which is an increasing function of human capital.

Another way to look at wage growth is through learning. Learning models are a variant of the human capital model. These learning models also derive predictions of how learning impacts on the earning's profile of an individual. The distinctive feature between the learning and human capital models is that in the case of learning models the learning is done by the firm and not the employee. In general, on entry to the firm, the new employee is equipped with a set of personal characteristics. Some of these characteristics, such as schooling, can be directly observed by the employer and the employer can indirectly form believes about an employees innate ability through such a signal although it cannot asses a potential employee's true ability. Once this potential employee enters the firm the employer can observe the employees true ability over time by observing her output. This accumulation of information about the employee's ability will help the firm to not only match her better to a job she may reveal herself to have a comparative or absolute advantage in, but will also increase her expected marginal product and therefore her wage.

Faber and Gibbons (1996)[5] formalise a learning model they call public learning model that does not incorporate the possibility of reassignments of tasks and how learning by the firm can be used in promotion decisions. In this model individual wages are equal to expected and not actual output of the employee. The expected wage is formed on the information about the employee and is updated each period. As information becomes more and more refined via a process of updating, believes about the employee's ability

[5] Farber, H., and Gibbons, R., (1996) *Quarterly Journal of Economics,"Learning and wage dynamics"* **8,** 1007-1047.

change and wage innovations take place. These innovations are independent and serially uncorrelated. In this model wages are allowed to increase and decrease over time due to the expectation of wage innovations to be zero. This means that observed negative changes in real wages must be a consequence of changes in marginal product. This can be attributed to either changes in product markets or an employee's knowledge must have become dated. The important implication of this is that it affects jobs, not the worker. Observed real wage declines become specific to the individual. Job reassignments can also be introduced into the model. These job reassignments usually take place in the form of promotions of workers within the hierarchy. In this case, the firm updates its believes about a workers performance in each period and wage increases are linked to observed increases in performance. Although the pure learning model does not incorporate job mobility and human capital is only added in a simple way, one can easily look at consequences of a workers ability affecting the speed at which human capital may accumulate. For those who display high levels of ability, human capital acquisition will result in a higher return to investment compared to the returns of those who display low levels of ability. Therefore, a consequence of the information updating should be that high level ability workers are experiencing on average faster growth of wages than low ability workers. Secondly, individual wage increments in adjacent years should be positively correlated. At the same time wages of high ability workers in separate cohorts should converge to one over time and so should the wages of low ability workers in separate cohorts because believes about the worker's ability will become more and more precise over time and wages should converge.

Firms do not only employ learning but also incentive mechanisms, which are also important for a worker's wage growth over his career with the firm. Ideally the firm would like to structure an employee's contract with the aim to induce the employee to maximise her effort. For example, it can structure the employee's contract in a way that she initially earns less than her marginal product and later on more than her marginal product. The employee being aware of this will therefore accommodate her perspective by realising that the rewards of continuously exerting high effort can be enjoyed in terms of higher wages that are above her marginal product at a later day. The firm by initially paying the worker a wage below her marginal product tries to avoid a situation where the

worker takes an action that cannot be observed by the firm and results in productivity of that worker below his ability level.

Baker Gibbs and Holmstrom point out a crucial difference which bears important implications not only for their but also our analysis between the learning and incentive models. In learning models without an element of insurance, external market conditions do not have an effect on wages. The insurance in the incentive contract between the worker and the firm does not need to be renegotiated in the event of the worker threatening to quit when mobility costs are high. Therefore wage growth must be independent of future market conditions. This allows wages to be different for workers who are initially the same on entering if they entered the firm in separate years. This average difference in wages on entry should persist between cohorts in the future. Therefore in incentive models the wage does not need to equal expected marginal product as it does in the learning model.

II. Data Description

Baker, Gibbs and Holmstrom analyse data on all the firm's managerial employees who constitute roughly 20% of the total labour force of that particular firm over the period 1969-1988. In contrast our data covers the period January 1989 to November 2001 allowing for a total of 154 monthly observations on each worker employed in the firm. The total labour force of the firm described by BGH excluding foreign employees gives a total number of 62,957 observations and is similar to the size of the labour force in our firm which employs on average 57,494 employees in each year of which on average 20% are employed part-time and 80% are employed full-time. Each employee is given an identification number in the dataset and amongst other, information on sex, marital status, age, level, bank equivalent grade, ethnic origin, job code, work unit code, salary, bonus, territorial allowance, performance rating, spells of employment, average weekly contracted hours, type of contract and qualification are also available. This analysis does not make use of all the data but concentrates strongly on the available data on salary. In this paper only full-time employees are included in the analysis where full-time employment is defined as a working week of 30 hours and above. Table 1 shows the

aggregate gender composition of those employed full-time between 1989 and 2001. Over the period 1989-2001 more women than men were employed full-time in any given year. On average the composition of the workforce of full-time employees by gender over the whole period consists of 45% full-time male employees and 55% full-time female employees. On a year-to-year basis, table 1 shows that the percentage of men employed by this firm is very stable and that it only increases slightly over the period, employing 47.67% men in 2001 as compared to 43.95% in 1989. The change in the gender composition of the all full-time employees is also reflected in the ratio of women to men in full-time employment, which declines towards the end of the period although never reaching a balanced workforce in terms of gender. In this paper we focus our attention on the movement of cohort wages in this particular firm over time. Unlike in BGH's analysis we are not restricting our sample to managerial employees but include all individuals working full-time to achieve a better understanding of salary movements across the whole spectrum of the internal labour market.

Table 1   **Gender composition of full-time employed workforce**

	All	Men	Women	Ratio Women/Men
1989	49853	21917 (43.95%)	27936 (56.05%)	1.275
1990	49438	21404 (43.29%)	28034 (56.71%)	1.310
1991	45164	19667 (43.53%)	25497 (56.47%)	1.297
1992	42615	18631 (43.72%)	23984 (56.28%)	1.287
1993	41804	18704 (44.75%)	23100 (55.25%)	1.235
1994	42548	19161 (45.06%)	23387 (54.94%)	1.219
1995	42268	19028 (45.03%)	23240 (54.97%)	1.222
1996	41753	18471 (44.23%)	23282 (55.77%)	1.261
1997	46600	21199 (45.50%)	25401 (54.5%)	1.198
1998	48721	22626 (46.40%)	26095 (53.6%)	1.155
1999	50225	23412 (46.60%)	26813 (53.4%)	1.146
2000	52198	24618 (47.17%)	27580 (52.83%)	1.120
2001	52866	25199 (47.67%)	27667 (52.33%)	1.10

We are therefore dealing with a much more heterogeneous workforce than BGH and should consequently expect a slightly different pattern of cohort wage growth over time. This in turn should manifest itself in earnings distributions of not only cohorts but also of the workforce as a whole to be different to a certain degree over time than those analysed in the BGH paper. The internal hierarchy of this firm as discussed in Treble, Gameren, Bridges, and Barmby (2001)[6] is described by a well defined structure of 12 levels that can be divided into four broad categories comprised of training levels, clerical levels, middle managers and senior managers. In our dataset some employees are not graded by the firm and appear as either un-graded staff or un-graded managers. The analysis in this paper where composition of workforce is considered in terms of levels is based on 14 rather than 12 levels. These are discussed later. Altogether we observe 13 yearly cohorts (cohort 1989 to cohort 2001) over the period 1989-2001; unlike BGH we are fortunate to have information on the entry month and the entry year of each individual in the dataset and therefore do not have to exclude our starting cohort in any analysis that requires the use of tenure. Baker, Gibbs and Holmstrom have to do this since they do not know whether those individuals who make up their starting cohort (1969) have either entered in 1969 or have already been employed by the firm before 1969. Accordingly, in our analysis each cohort is comprised of those employees, working on a full-time basis, whose entry date falls into any month in that particular year. The number of individuals accounted for in cohort 2001 may be a slight underestimation of the true cohort size since data for December 2001 is not available. The average age on entry across cohorts lies between 24 and 27 years. Cohort size on entry to the firm varies from a minimum of 1499 (cohort91) individuals to a maximum of 8484 (cohort2000) individuals. These figures can be translated into cohorts on entry having a total share of 4.1% to 12.9% of the total full-time workforce in the firm in the corresponding year. Especially towards the end of the period, between 1997 and 2001, the firm recruits more employees on a yearly basis.

On entry we observe that more women than men in each cohort enter the firm. Men seem to be especially underrepresented in cohort 89 but are recruited in higher numbers in

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[6] Treble, J., Van Gameren, E., Bridges, S., Barmby, T. (2001) *Labour Economics,"The internal economics of the firm: further evidence from personnel data"* **8,** 531-552.

subsequent years. Comparing the percentage of men and women who are still employed by the firm in 2001 as a percentage of the number of men and women on entry to each cohort shows that for some cohorts more women have left by the end of the period as a percentage of women on entry and for other cohorts the same holds true for the percentage of men who have left by the end of the period as a percentage of men on entry to the firm. The comparison of these percentages serves to summarize a censoring effect. Obviously, employees in cohort 89 have had a longer time horizon over which to leave the firm than employees in, for example, 2000. Therefore, the increase in the percentage of employees in each cohort continuing employment with the firm as observed from cohort 89 onwards, does not come as a surprise. Exit rates of men and women on a year-to year basis for each cohort point to an interesting pattern: with the exception of men in cohort 92 the highest proportion of men and women exiting occurs after two years of entry.   The most obvious way of explaining this interesting pattern is found in the existence of job specific human capital. The cost of separation in the presence of job specific human capital is lower after a short period of employment and higher after longer periods of employment. The pattern in the exit rates across cohorts clearly suggests that the bulk of employment separation, may it be voluntary or involuntary, takes place two years after entry into the firm after which exit rates decline. Another argument for this pattern can be formalised in the existence of an 'up our out' policy employed by the firm or can give an indication of a two-year training period, which in case of unsuccessful completion results in the termination of the contract and in case of success guarantees promotion or at least continuity of employment. We know that our firm followed a policy by which all non-managerial employees had a six month probationary period after which their performance and suitability were assessed and they were either confirmed to the permanent staff or were exited either as "resigned unsuited" or "terminated unsuccessful probation" depending on whether there was mutual agreement that the probationer should leave or not. This policy was pursued until the mid 1990s and did not apply to people who were returning to work after a career break. During the mid 90's there was a general change of practice, not policy, with many businesses hiring people on what some call a try and buy basis. Recruits would join on a fixed term contract usually for three month, which would sometimes be extended for another three month. The best people would be

retained, and the worst allowed to leave at the end of their contract. Both of these internal arrangements concerning probationary practices cannot explain the high rates of exit after two years of employment observed across all of the cohorts and do not offer support for an up or out policy.

 For subsequent years, exit rates decline for both men and women in each cohort and again, whether exit is voluntary or involuntary we are not able to say. If separation from the firm takes place voluntarily, it may be the case that leavers are able to earn higher rewards for their work elsewhere although, as we will shortly see, external wages are on average lower than internal wages. This could potentially point to a reward and promotion structure that only favours individuals with certain characteristics or jobs occupied by certain individuals, making it rather difficult for those who do not have these characteristics or are excluded from these jobs to move up in the hierarchy and therefore reap the rewards from promotion. Women in each cohort leave the firm' s labour force as well. What we do not know in this case is whether women leave because of career breaks in order to commit to family formations or because they are trying to guarantee themselves, as men might do, a position elsewhere in the external labour market. Or phrased differently, women may be more likely to stay with this firm since the working environment suits their personal tastes and guarantees them stability. In short, there are lots of potential explanations for any exit rates observed in the data. Again, in the light of the analysis focusing on earnings and growth in earnings of employees over time, all the points mentioned above bear highly important implications for explaining changes in the earnings distribution of cohorts and the workforce as a whole.

As we have already mentioned, the number of employees recruited into a cohort is not stable over time but varies quite considerably. This seems to be a natural consequence of manpower planning within the internal labour market, which in our firm is determined by future projections. These projections determine by analysing historical promotion rates for each level within the hierarchy how many employees should be promoted within or out of their current employment level and how many new employees need to be recruited from the external labour market after internal labour market promotions have been made. This form of projection procedure serving to minimise the risk of running into projected

shortages very much resembles the traditional idea of manpower analysis within an internal labour market as outlined by Doeringer and Priore (1971)[7] although Doeringer and Priore outline more instruments by which to adjust within the firm which also seem to be more sophisticated. What we do not know so far is whether the firm under consideration also employs more modern ideas for workforce adjustments such as incentive mechanisms that should alter the behaviour of employees within the firm and in turn should drive the adjustment processes such as promotions, salary adjustments and recruitment from outside the internal labour market, just to name a few.

Table 2 describes the composition of each cohort on entry in terms of levels and gender whereas table 3 describes the composition of each cohort in terms of levels and gender in 2001. Table 2 therefore not only reveals insights into the demand of labour at each level of the hierarchy over the period but at the same time is a good source to look for ports of entry into the firm which is one of the defining characteristics of an internal labour market distinguishing it from the external market. Doeringer and Piore formulate as follows: "…and movement between them occurs at certain job classifications which constitute ports of entry and exit to and from the internal labor market". Comparing table 2 and 3 shows how the hierarchical composition of each cohort has changed between two points in time but does not indicate whether the increases and decreases in the percentages of cohort individuals employed in each level in 2001 is a consequence of cohort individuals leaving the firm or getting promoted within the internal hierarchy. Consequently this comparison cannot be used to establish ports of exit but gives evidence on ports of entry. Each table contains 14 levels. S00 and M00 refer to un-graded employees in staff, non-managerial, (S) and managerial (M) levels respectively meaning that these employees have not been classified within the staff- and management levels. S01 is the induction level, S02-S03 are junior staff levels, S04-S05 are senior staff levels, M93-M94 are junior management levels, M95 is the middle management level, M96 is the senior management level, and M97-M99 is the executive management level. We have chosen to name the levels in table 2 and 3 according to how they are classified by the firm.

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[7] Doeringer, P., Priore, M. (1971) *"Internal labor markets and manpower analysis"*.

Table 2 reveals the recruitment patterns of the firm for cohorts 1989-2001. In any of these years the firm recruits outsiders across the whole spectrum of levels in the organisation although the percentages of new entrants into these levels varies considerably across levels. Managerial levels are defined by a much smaller percentage of new recruits than are staff levels and for some cohorts entrance into the two top executive levels (M98 and M99) is completely blocked for outsiders. This is particularly true for new female hires. Not one of the new female hires in any cohort are recruited into the top two executive levels and although men across cohorts are recruited into the lowest executive level (M97) in some cohorts on entry, this is not the case for women at all. At the same time, the percentage of cohort individuals in any given year who do get a job into these levels on entry is only a very small fraction of the overall cohort size. And this is true for both, men and women. Although new entrants are recruited into many levels of the internal hierarchy, it is still possible to define levels at which a large proportion of entrants, either male or female, enter the firm. This predominantly takes place at the staff levels, and in particular at the induction (S01) and junior staff levels (S02-S03) for cohorts 89 and 90 and from then onwards concentrates strongly on S03, the higher junior staff level and S04, the lower senior staff level. But there are exceptions. Nevertheless, these levels can, in our view, be defined as ports of entry. But we are, of course, aware that it is a much more relaxed definition of ports of entry than Doeringer and Priore established. On the grounds of their specific ports of entry definition, our firm would fail to qualify as an internal labour market. As a consequence of their definition the particular labour market this firm constitutes cannot to a certain degree be shielded from the external labour market given that even at high levels in the hierarchy outsiders, and may they only be a few, have access to entry. Also, we should not expect to see recruitments into that many levels but recruitment should only be concentrated at a small number of levels. Again, this phenomenon is not unique to our internal labour market. Holmstrom (1994a)[8] and Treble, Gameren, Bridges and Barmny (2001)[9] have also found evidence of this.

[8] Baker, G., Gibbs, M., Holmstrom, B. (1994a) *Quarterly Journal of Economics,"The internal Economics of the firm: evidence from personnel data"* **109,** 881-919.
[9] Treble, J., Van Gameren, E., Bridges, S., Barmby, T. (2001) *Labour Economics,"The internal economics of the firm: further evidence from personnel data"* **8,** 531-552.

Table 2: Composition of cohorts on entry in terms of levels and gender (%)

	S00	S01	S02	S03	S04	S05	M00	M93	M94	M95	M96	M97	M98	M99
Men														
Cohort89	2.98	26.07	21.15	8.17	5.55	6.13	0.10	15.81	7.70	4.35	1.41	0.58	-	-
Cohort90	1.19	19.84	27.99	11.76	7.62	9.46	0.13	9.92	5.65	4.40	0.92	0.33	0.07	-
Cohort91	3.07	9.21	13.57	13.57	16.16	12.44	-	15.51	6.79	6.64	2.75	0.48	-	-
Cohort92	3.41	8.70	7.87	15.57	19.51	8.93	-	25.73	5.17	3.53	1.76	0.59	0.12	0.12
Cohort93	3.44	4.30	6.34	6.89	18.78	7.20	12.91	31.92	4.23	2.11	1.64	0.23	-	-
Cohort94	2.33	8.14	11.22	15.60	14.46	9.23	7.00	20.16	5.58	3.87	1.65	0.51	0.17	0.06
Cohort95	2.54	9.63	16.57	19.70	9.85	9.10	3.58	15.75	5.67	3.96	2.01	1.42	0.07	0.15
Cohort96	3.79	6.38	14.71	40.67	6.87	6.76	2.33	11.57	3.08	1.57	1.57	0.54	-	0.16
Cohort97	5.26	3.75	14.56	38.37	10.59	7.25	1.47	8.72	4.78	2.83	1.36	0.55	0.15	-
Cohort98	5.38	2.31	10.51	30.00	16.17	8.17	1.12	14.60	5.48	3.28	2.03	0.80	0.07	0.07
Cohort99	9.81	0.66	12.24	32.27	10.88	8.61	1.17	14.89	5.05	2.46	1.45	0.47	0.03	-
Cohort00	11.30	0.24	8.63	30.67	13.17	9.92	0.95	10.27	8.26	3.51	2.22	0.79	0.08	-
Cohort01	11.64	0.37	4.72	31.74	14.30	9.34	1.80	9.56	8.25	4.25	2.82	1.02	0.16	0.03
Women														
Cohort89	3.02	29.60	27.45	20.56	9.63	3.80	-	3.93	1.28	0.59	0.16	-	-	-
Cohort90	1.15	19.18	30.43	28.00	10.82	5.64	0.07	3.15	0.92	0.59	0.03	0.03	-	-
Cohort91	2.05	8.55	17.35	23.98	26.02	12.05	-	6.14	2.29	1.57	-	-	-	-
Cohort92	2.51	8.83	10.62	26.26	32.01	10.37	-	6.89	1.38	0.89	0.24	-	-	-
Cohort93	5.25	5.48	9.06	20.19	36.25	8.03	6.12	7.47	1.51	0.56	0.08	-	-	-
Cohort94	2.69	7.93	11.97	34.52	26.54	5.91	2.50	5.82	1.39	0.58	0.10	0.05	-	-
Cohort95	2.55	8.25	23.41	30.60	17.87	8.08	2.49	4.87	1.11	0.50	0.11	0.17	-	-
Cohort96	4.25	4.72	13.22	57.36	9.77	4.65	0.36	3.78	1.20	0.54	0.11	0.04	-	-
Cohort97	7.08	2.84	12.82	53.91	12.95	4.64	0.43	3.46	0.88	0.75	0.19	0.05	-	-
Cohort98	6.73	2.44	9.36	46.67	18.56	5.64	0.31	7.54	1.95	0.55	0.23	-	-	-
Cohort99	10.31	1.07	9.67	50.61	15.42	5.08	0.33	5.00	1.68	0.61	0.18	0.03	-	-
Cohort00	8.82	0.24	7.96	51.05	17.18	6.56	0.45	4.63	2.22	0.54	0.30	0.04	-	-
Cohort01	9.82	0.11	5.93	49.74	17.77	6.50	0.87	5.12	2.78	0.95	0.38	0.03	-	-

Table 3: Composition of cohorts in terms of level and gender (%) in 2001

	S00	S01	S02	S03	S04	S05	M00	M93	M94	M95	M96	M97	M98	M99
Men														
Cohort89	0.7	-	0.23	7.49	14.29	14.05	0.23	26.93	21.55	9.60	3.75	0.94	0.23	-
Cohort90	0.62	-	-	5.23	11.08	20.00	-	31.69	16.31	10.15	3.69	1.23	-	-
Cohort91	-	-	-	2.15	3.23	10.75	1.08	18.28	29.03	20.43	6.45	5.38	3.23	-
Cohort92	-	-	-	4.02	12.06	12.06	0.50	26.13	29.65	12.62	1.10	-	-	-
Cohort93	2.69	-	0.30	2.69	6.57	11.04	-	18.81	30.45	16.42	7.16	3.28	0.60	-
Cohort94	1.31	-	0.44	5.01	13.51	13.29	-	22.00	22.88	8.93	6.10	4.36	1.31	0.87
Cohort95	3.86	-	-	7.20	11.83	17.48	-	18.51	23.39	9.25	5.40	2.57	0.26	0.26
Cohort96	1.03	-	1.38	15.52	17.07	20.52	0.52	21.03	14.83	5.52	1.90	0.69	-	-
Cohort97	4.10	0.11	1.93	15.59	25.48	15.24	1.71	16.38	9.56	5.80	2.39	1.37	0.34	-
Cohort98	7.87	0.19	1.12	13.31	21.65	11.62	1.31	20.15	11.25	5.72	3.56	1.97	0.19	0.09
Cohort99	6.82	0.07	2.70	20.74	19.32	7.84	0.95	25.54	8.31	3.85	3.11	0.61	0.14	-
Cohort00	9.45	-	4.66	25.67	16.22	10.21	1.31	13.68	10.25	4.53	3.01	0.93	0.08	-
Women														
Cohort89	1.05	-	-	7.49	37.63	25.96	0.52	18.99	6.27	1.57	0.35	0.17	-	-
Cohort90	0.50	-	0.50	7.06	40.34	26.22	-	16.64	6.72	1.85	0.17	-	-	-
Cohort91	1.42	-	-	6.38	24.82	29.79	-	20.57	9.93	4.26	2.13	0.71	-	-
Cohort92	1.25	-	0.31	13.40	26.48	29.28	-	19.00	8.10	1.56	0.62	-	-	-
Cohort93	5.06	-	0.60	11.90	25.30	29.76	-	14.29	9.82	2.08	0.89	0.30	-	-
Cohort94	0.68	0.17	-	8.86	37.31	26.58	-	15.67	7.16	2.56	0.51	0.51	-	-
Cohort95	4.80	0.18	0.53	15.10	32.33	26.11	0.36	11.90	6.57	1.60	0.36	0.18	-	-
Cohort96	1.44	0.12	2.28	19.78	35.13	26.02	-	9.47	4.08	1.56	0.12	-	-	-
Cohort97	4.68	-	2.54	24.20	35.36	18.54	0.41	8.53	3.53	1.80	0.41	-	-	-
Cohort98	6.04	-	1.01	24.53	36.33	14.60	0.29	11.80	3.38	1.58	0.43	-	-	-
Cohort99	5.82	-	1.44	36.03	32.25	10.31	0.36	8.93	2.82	1.44	0.48	0.06	-	0.06
Cohort00	7.89	-	3.89	46.45	22.54	8.27	0.59	6.34	3.03	0.59	0.41	-	-	-

Especially women in cohort 91 to 94 bring with them the necessary characteristics to enter at the senior staff level.

Quite interestingly, as from 1996 onwards, nearly half or more than half of the newly recruited women enter at level S03 which is a much higher concentration than that for their male counterparts. Especially in 1992 about 32% new male entrants to the firm start their career at this level. Compared to the percentage of men entering at the management level, the percentage of women into managerial positions is considerably small.

In summary table 2 shows that the firm does recruit into all levels in the hierarchy but that the bulk of new hires enters at the junior and lower senior staff levels although men are also recruited into the lower junior staff management. Our hypothesis is that the firm after it has carried out it's recruitment projections does have to employ outsiders as well as promoting insiders in order to meet the projections. And this takes place at all levels of the hierarchy. Since recruitment takes place at all levels of the hierarchy, recruitment considerations should be very much affected by the number of employees who in any given year leave the firm but also by how much the firm expands its production processes.

Table 3 shows the composition of cohorts in terms of levels and genders in 2001. We know that for any given cohort, cohort individuals will have left the cohort over time. However, the information in table 3 reveals that by 2001 the composition of the cohorts in terms of their position within the hierarchy has changed considerably. Obviously this change is more pronounced for the earlier cohorts since cohort individuals had more time to move up (or down) the hierarchy. For both, men and women the distribution across levels shifts into the direction of higher levels. The fraction of those remaining in the induction level is very small for some cohorts and non-existing for other cohorts for men and women. The same is true for the lower junior staff level. In 2001 a substantial number of men across cohorts is employed in management levels indicating that movements up the hierarchy must have occurred throughout the period. Women also gain a higher percentage of positions in the management levels across cohorts in 2001 especially in the junior management level (M93). But again, the percentages for higher

management levels do not come close to those held by their male cohort members. A large proportion of women in each cohort are employed in senior staff grades and comparing these figures with that of their male counterparts, we can say that the men who are still remaining with a cohort in 2001, must have been able to move quicker up the hierarchy than the women unless they stay in the same position throughout their employment span. This is particularly evident when looking at the change in percentages for executive management. Men in most cases have gained access to these positions although in some cohorts men in executive management levels must have left the firm as well and still other cohorts do not have a male representative in specifically the top two executive management levels. For women virtually nothing has changed at the top end of the hierarchy except for cohort 99 where 0.06% of women are in the top executive management level. And one or two women in other cohorts have moved to a low executive management position (M97). But again at this level women in cohorts 90, 93, 96, 97, and 2000 have left the firm and were not replaced. But overall the composition for both men and women in terms of levels has changed in 2001 and the biggest changes can be seen for the earlier cohorts.

III. Average and Cohort wages

In this section real average wage movements of cohorts are analysed in comparison to the real average wage structure as a whole and the behaviour of entrant real average wages over the period 1989-2001. This is used as another device to establish evidence of an internal labour market in this firm. It has long been recognised that the existence of internal labour markets generates a different wage structure than that predicted by competitive theory. Particularly, the structure of wages in an internal labour market does not move in accordance with supply and demand changes in the external market but remains more stable. It is in this sense that employees of an internal labour market enjoy protection from external market influences that impact on their marginal product. Baker, Gibbs and Holmstrom do indeed find strong evidence of an internal labour market for the American financial firm they analyse in the form of clear cohort effects. The movement of insider wages in their firm follows a common pattern that stands in stark contrast to a more idiosyncratic movement of entrant wages over time. We have produced the graphic

impression of cohort, entrant and organisational level average salary movements as presented in figure II of their paper for our firm in figure I.

We go a step further in that we are also decomposing the overall movement of cohort salary by gender, graphically presented for men and women also in figure I.

Figure I not only plots real average annual cohort salary but also real average annual salary of all employees and real average annual entrant salary against time. In the separate graphs form men and women real average annual salary of all male and female employees are also plotted respectively. Since the data is collected on a monthly basis, our measure of real average salary is a yearly average constructed on the basis of the nominal monthly salary of each individual as reported in the dataset. The retail price index is rebased to 1989 and used to adjust nominal salary for inflation. The first thing to note looking at all employees in figure I is the small variation in real average earnings over time represented by the solid dashed line. The evolution of earnings for the firm as a whole can therefore be characterised by almost constant earnings growth. On a year to year basis organisational level average earnings growth, although of small magnitude, is positive except for year 1995 to 1996 where on average percentage growth in real salary is zero and for 1996 to 1997 in which employees experienced real negative salary growth of –0.2%. Averaging over the 12-year period, real salary growth per year is about 2%. The path of the average real salary of this firm over time is dissimilar to that observed by BGH for the American financial firm. Their firm's average salary path for all employees does show more variation over time and more importantly exhibits real salary declines of a rather large magnitude over the first half of the period (1972 to 1981), followed by real average salary gains over the later part of the period (1982-1988) which fail to bring real average salary back to its starting level in 1970. Quite contrary, in our British financial firm, apart from the discussed predominantly positive and rather stable salary growth, mean salary for all employees in 2001 is certainly higher than that observed in 1989. Therefore what we find, comparing the two financial firms, is the contrasting evolution of real average salary for the two firms as a whole; the American firm described by large variations in average salary for all employees over time as compared to the British firm described by rather small variations in mean salary for all employees over time.

The second important feature of figure I is the movement of new entrant's average real salary as depicted by the solid line. It follows, as in BGH, a more idiosyncratic path than either mean salary for the entire firm or cohort mean salaries. But this is what we should expect to see given that new entrant salary is determined by external rather than internal market forces and therefore reflecting changes in external market conditions. Entrant average salary either goes up or declines on a yearly basis with entrants in 1991 starting on a 23% higher average salary than entrants in 1990 whereas entrants to the firm in 1996 starting on an average salary 14.4% less than that for entrants in 1995. Of course this may not only reflect external market conditions but may also be attributed to either higher/lower quality of the entrants themselves or the nature of the job they move into depending on the job's position within the hierarchy of the firm.
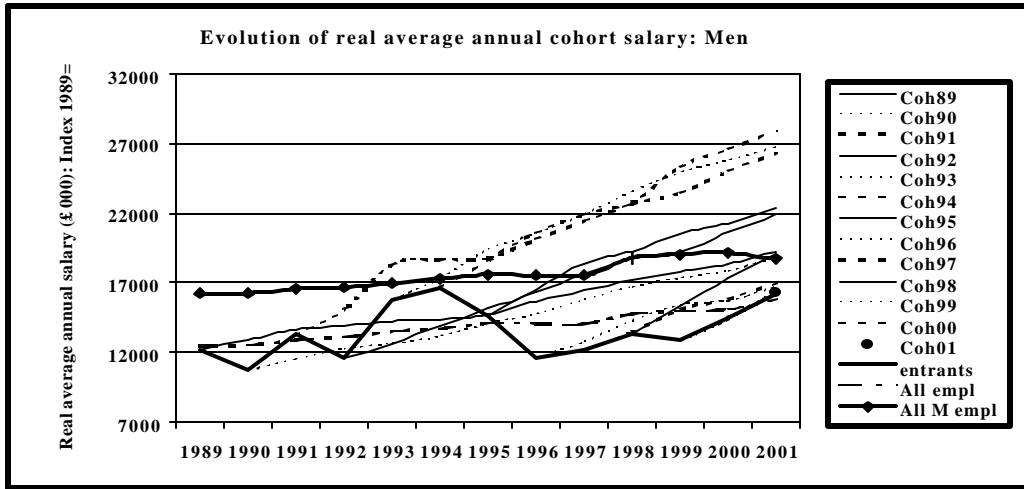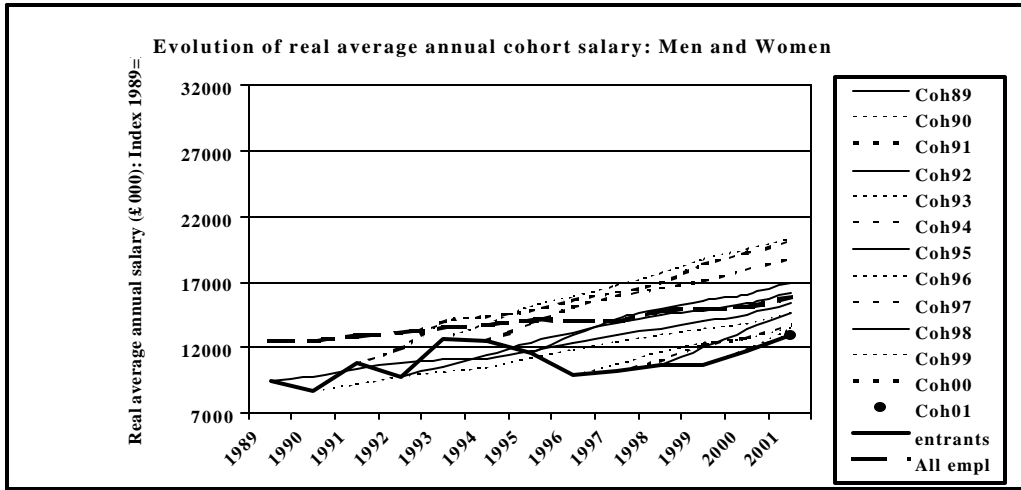
In the light of the evidence on average salary growth of cohorts over time, discussed in more detail below, we also find evidence that entrants starting on high entrant salaries relative to that observed by entrants in years characterised by relatively low entrant salaries, usually maintain their salary position or experience high salary growth in subsequent years. Entrants to this firm's labour market experience an average increase in income of 47% over ten years. This is 7% higher than the average increase in income for the entrants of the American financial firm in BGH. But the entrants in our sample are also on average eight years younger than those in BGH and also come from the whole range of levels within the hierarchy as opposed to just managerial grades. Still, our entrants do not experience a doubling in their income in 10 years as described by Topel and Ward (1992)[10] although the mean entrant ages are slightly similar.

Thirdly, turning to cohort salary movements over time, we do find, as BGH, a strong cohort effect. Insider wages in our firm also follow a different growth path than that of entrant wages. But whereas cohort wages in the American firm as described in BGH move in a parallel fashion, in this firm although cohort wages move in the same direction and positively away from the starting wage of each cohort, we graphically observe that the path of growth in wages between cohorts may cross. This surely indicates that some

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[10] Topel, R., and Ward, M. (1992) *Quarterly Journal of Economics,"Job mobility and the careers of young men"* **107,** 439-479.

cohorts do better than others in terms of wage growth. Secondly, some of the cohort wages are very slow in not only reaching subsequent cohorts entry wages but also in adjusting to and crossing over the mean real salary of the entire firm. This stands in contrast to the behaviour of cohort wages in BGH. Cohorts in BGH tend to secure themselves an average salary above subsequent cohort's salaries and move in the direction of the mean salary of the firm on average in five years. In this firm, however, it takes some cohorts a period as long as eight years to do so and therefore especially the later cohorts, 1996-2001, are not able to come near to the firm's mean salary level. In stark contrast to this, cohorts 1991 and 1993 to 1995, seem to be constituted of employees employed at the higher end of the hierarchy, starting with relatively high entrant wages and move to and far beyond the average salary of the entire form in a considerably short period of two years. In essence, as in BGH, the variation in salary between cohorts and the position individual cohort members hold over time within the firm's wage distribution does indeed crucially depend amongst others on starting salary. The findings of cohort wage movements in contrast to the behaviour of entrant wages over time not only suggests a clear cohort effect in that insiders are protected against external market forces but also that the distribution of earnings within the firm changes over time given that some cohorts seem to do much better in terms of earnings than others. Those individuals in cohorts moving to and above the mean salary of the entire firm in a short period of time should consequently move up quickly in the distribution of earnings. Figure I also shows graphs that decompose these findings of average salary movements for cohorts, new entrants and the entire firm for the firm as a whole by gender over the period 1989 to 1991. Of course, the general observations discussed for men and women in the firm taken together do not change a lot but we are nevertheless able to make some interesting inferences. If we compare the growth of entrant wages in the three panels of figure I, we find that the idiosyncratic path of new entrant wages is largely driven by male employees entering the firm year by year.

Figure 1

Evolution of real average annual cohort salary: Men and Women

Evolution of real average annual cohort salary: Men

Evolution of real average annual cohort salary: Women

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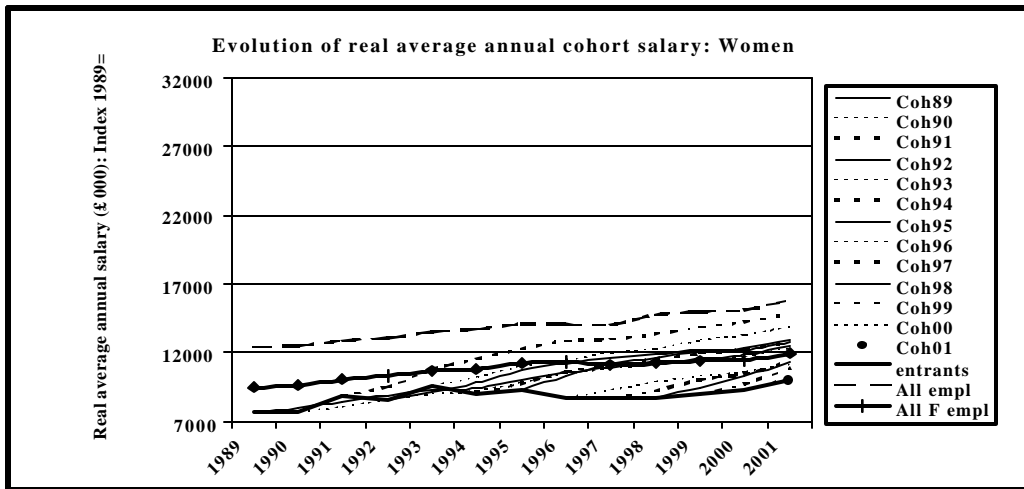
The movement of male entrant salaries obviously moves in the same parallel fashion but is also much more pronounced than that for all entrants or female entrants for which the movement of average new entrant salary is much smoother and more constant over time. Yearly changes in male entrant salary range from –20.5% from 1995 to 1996 up to 43.9% from 1993 to 1994. This compares with a range of –6% for women from 1995 to 1996 up to 15.5% for 1990 to 1991. The gap between female and male new entrant's starting salary in any given year is quite substantial and therefore suggests that women are hired into jobs in the lower ranks of the hierarchy and men into ranks above those occupied by female new entrants. A second very interesting feature that emerges in the gender comparison in the graphs is the position of the average salary of the entire firm in relation to male and female new entrant salaries and the position of the line describing the evolution of all male or all female employees average salary. These last two variables of comparison are added to compare performance of female/male cohort wages in relation to the position of women/men in terms of salary in the entire firm. We find that the position of the graph representing the average salary of all employees is largely driven by the rather low average salaries of the female employees whose average lies well below that of the entire firm whereas the male's average lies far above it.   Adding the growth in average salary of cohorts to this decomposition we obviously observe positive wage growth for the male and female cohorts over time. Female entrants experience an increase in income of 48% over ten years, which is somewhat higher than the 43% increase in income for men over the same period. All men in each cohort are doing exceptionally well in quickly moving towards the average salary of the entire firm. This happens on average after two to three years. Moreover, especially men in cohorts 1991,1993,1994, and 1995, which were already identified as those cohorts characterised by strong growth in salary are also moving beyond the mean salary of all male employees in the firm one to three years after entry into the firm. One thing to note is that between 1993 and 1995 men in cohort 1991 have after a two year period of strong gains in average earnings a flat earnings profile whereas the women in cohort 1991continue to experience positive gains between 1993 to 1995. Nevertheless, none of the female cohorts manages to adjust its average salary to that of the entire firm and only women in the early cohorts enjoy average salaries higher than that of all female employees.

The conclusions to be drawn from the gender decomposition of average salaries in this internal labour market are that first of all, the general picture emerging in figure I, is mostly driven by the 'poorer' position of women in the firm. Secondly, there prevails quite a substantial gap between male and female earnings within the entire firm but female entrant income growth over ten years is higher than that for male entrants. The general movement of cohort salaries are the same for both men and women employed by the firm but given the lower average salaries for women in each cohort, we should find that firstly, women are recruited into lower levels than men on entry; secondly given that female cohorts are unable to adjust to the mean salary of the entire firm and at the same time continuing to experience salary growth, men may either have an advantage of promotion over women or men are placed on a fast track scheme if it exists on entry to the firm. The decomposition is also helpful in deriving inferences for the position of men and women in the distribution of earnings of the firm. Women should be predominantly positioned at the lower half of the distribution and men at the top. But that is not to say that no women are occupied at the top of the hierarchy. We have seen in table 2 and 3 that the composition of men and women on entry and in 2001 shows differences in terms of where they are positioned in the hierarchy and that women are not presented to the extent as men are in managerial levels, especially in the two top levels. This obviously feeds through in the above graphs via the difference in mean salary cohort members receive for the work they do in the firm. But going back to establishing proof of an internal labour market within our firm, the main conclusion drawn from this last section of cohort salary movements over time is the confirmation of the existence of an internal labour market in this British financial firm. The evidence is that cohort individuals are shielded to some extent from external market conditions since they do predominantly show mean salary and salary growth that lies above the new entrants salary.

The next step in the average cohort salary analysis involves taking care of any compositional effects. Table 2 already presented evidence on the position of new hires at nearly all levels of the hierarchy and that entry to the firm is not tied to a few specific levels. Entry into staff levels seems to be the norm but women and even more men in each of the thirteen cohorts are also recruited into management levels. The percentage of men the firms allows into management levels on entry has been shown to be considerably higher than that for women. And although these percentages are

not outrageously high, the evidence is that recruitment takes place at all levels except some of the executive management levels. Given the high concentration in staff levels for new employees we reproduce the evolution of real average annual cohort salaries as presented in figure I conditioned for cohort individuals either being in staff- or management levels on entry but allowing for progression from then on. There are several good reasons for proceeding in this manner. First of all, any outliers in terms of salary are eliminated which may drive the processes described in figure I. Secondly, and as a consequence of this, we not only make the two new samples more homogeneous but, and more importantly, we may observe the earnings evolution of cohort individuals who started employment within staff- or management levels to become more similar. We are therefore looking at the evolution of average salary of individuals who are roughly the same on entering the firm. Thirdly, this analysis will go beyond figure I in that it derives a more detailed graphical presentation aiding to understand more fully the complexities of real average annual cohort salary movements of all cohort members. Fourth, since this paper is in most parts aimed to reproduce analysis carried out in the BGH paper whose analysis rests on a sample of employees in managerial positions in a specific firm, we can, by conditioning for being recruited into a management levels on entry, make more inferences about possible generalisation of evidence between firms. And in particular this can be achieved by specifically analysing the evolution of earnings of cohorts who we know are working in management.

Although we do condition for either being in a staff- or management level on entry to the firm, we do allow cohort individuals to freely progress in the hierarchy thereafter. The simple reason for this is that firstly our samples particularly for those who entered at a staff level would potentially become smaller as cohort individuals progress into management levels. But more importantly by unnecessarily cutting out employees if we were to condition on being in a staff level or managerial level throughout the employment period, we are also allowing the variation in salary to be cut down. And this we effectively avoid by introducing this element of progression.

Figure II

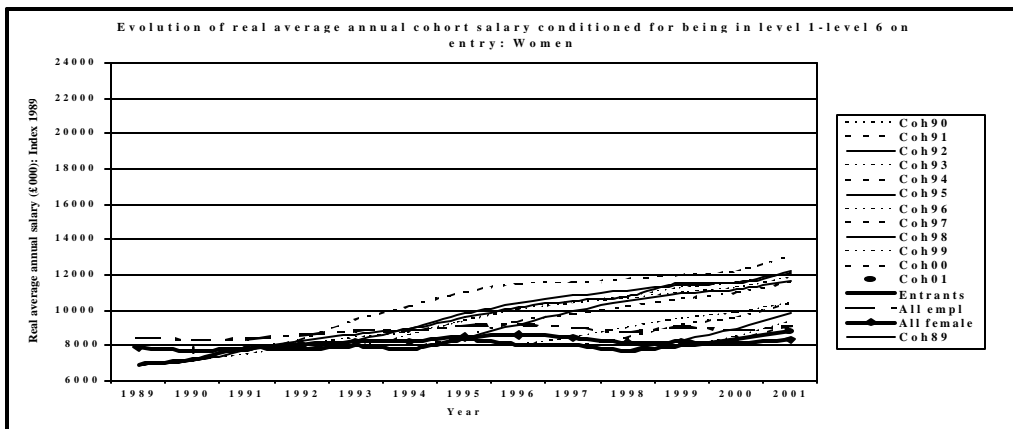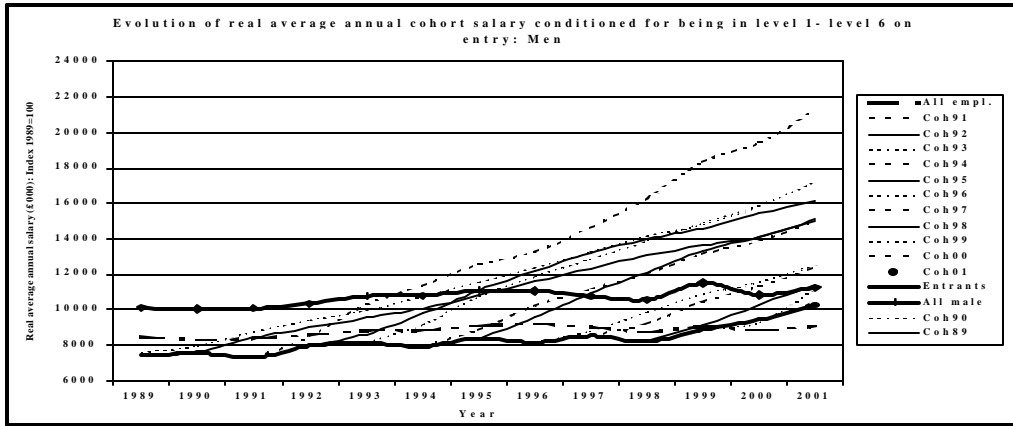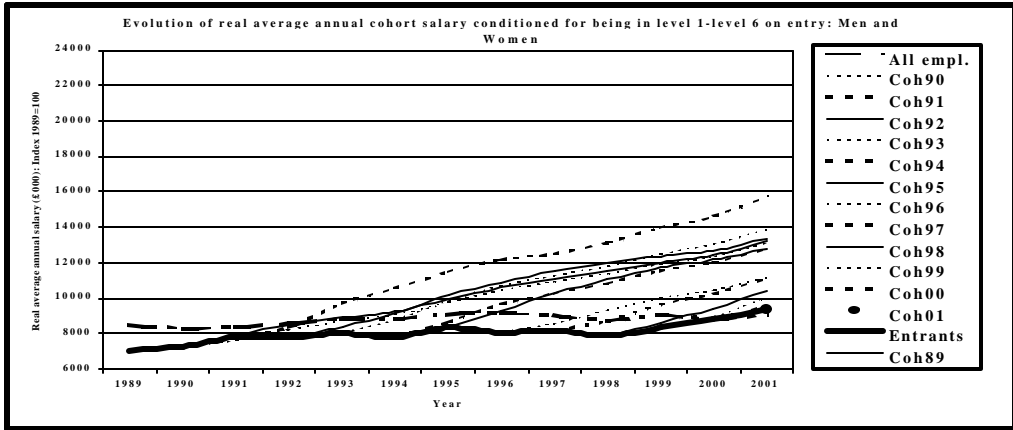**Evolution of real average annual cohort salary conditioned for being in level 1-level 6 on entry**

Evolution of real average annual cohort salary conditioned for being in level 1-level 6 on entry: Men and Women

Evolution of real average annual cohort salary conditioned for being in level 1- level 6 on entry: Men

Evolution of real average annual cohort salary conditioned for being in level 1-level 6 on entry: Women

Figure III

Evolution of real average annual cohort salary conditioned for being in level 7-level 14 on entry

Evolution of real average annual cohort salary conditioned on being in level 7-level 14 on entry: Men and Women

Evolution of real average annual cohort salary conditioned for being in level 7-level 14 on entry: Men
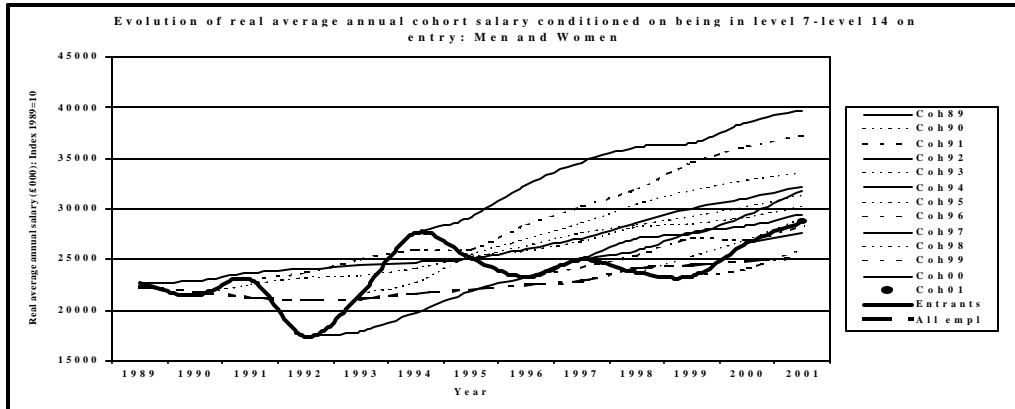

Evolution of real average annual cohort salary conditioned for being in level 7- level 14 on entry: Women

27
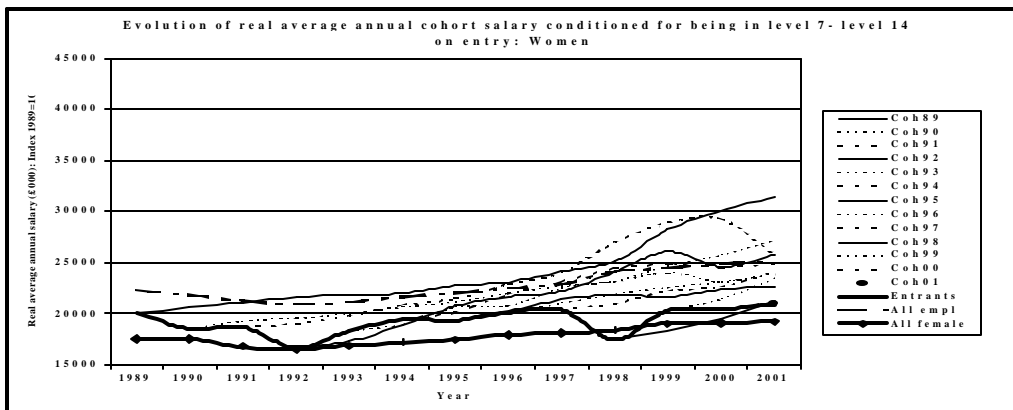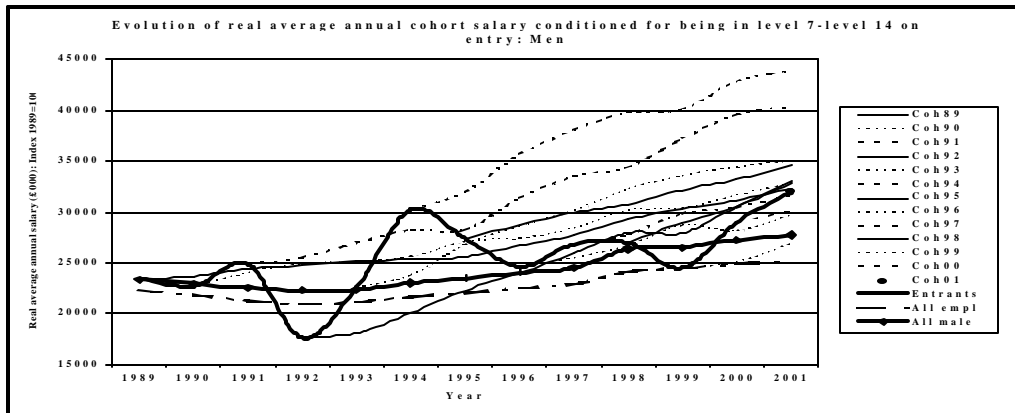
Obviously, there are employees who do leave the firm and one should expect these employees to be on relatively low salaries, probably without the ability to move up the career ladder in the hierarchy, or maybe bound by their contract to leave after a specified period. Therefore attrition is not random. Conditioning in this way, we derive salary growth path for those who do progress and at the same time allowing the distribution of salary to shift. The new graphs are represented in figure II for those who are recruited at staff level and in figure III for those who are recruited into managerial levels.

The first visual feeling that springs to the eye comparing figure II and III is how well behaved the evolution of average annual cohort salary appears for those who entered the firm at the staff levels. Real average salary growth does move in a nice parallel fashion across cohorts and incidences of one cohort 'overtaking' another are rare. And this holds true not only for all who entered at staff level but also once the sample is split up by gender. We have already seen that men in each cohort in the internal labour market tend to make much higher mean salary gains during the period than women and this is also confirmed by the two conditioned samples in figure II and III. If one were to take cohort 89 as a benchmark case for all other cohorts, then, over a 12-year period those who entered at staff levels should see an average increase in their average salary of 87%. Women should experience an increase of 75% and men an average increase of 105%. These figures are much higher than those for entrants into management levels. Again, taking the experience of cohort 89 as a benchmark, men and women pooled together should experience an average salary increase over a 12-year period of 43%, women of 57% and men of 38%. But we need to bear in mind that the cohorts change over time in terms of their composition and that the cohort mean salary is derived as the mean of all cohort individuals mean salary in the given sample. So obviously there is some sample selection effect going on at the same time. Mean annual cohort salary growth for those entering at managerial levels is much more variable over time than for those in a cohort entering at staff levels. The former start employment at a real mean cohort salary above the average of all employees in the firm except for men in cohort 92 and 99 and progress above and beyond it very quickly. This is not the case for women starting at managerial levels. Although average salary progression for this group does take place over time, it takes place mostly below the mean of all employees employed in any given year. And if gains are

made in terms of salary towards or beyond the mean of the entire workforce, it can be characterised to be rather slow. This is something we have already pointed out in figure I but we are now able to say that even though women do not make salary gains above the mean of all employees in the pooled sample, this finding is largely driven by the experience of women who entered at staff levels and suppresses the gains women make above the mean salary of all employees if they entered at the managerial levels.

One thing evident from figure II and III is that cohort individuals do move up in terms of salaries within the internal labour market which could either be a consequence of promotions within levels or promotions to a higher level. And these progressions drive the movements in average annual cohort salary in figure I where we have looked at real average annual cohort salary growth without conditioning for entry level. What we do observe specifically in figure I looking at all cohort individuals should be largely driven by the salary gains of men in the cohorts. So if you are a male new entrant you do make salary gains no matter if you start out at staff or management levels. So men seem to be at an advantage and should therefore find it easier to climb up the hierarchy. Whereas women do tend to struggle a bit especially if they are recruited into staff levels. Another distinguishing feature in figure II is the growth path of entrant mean salaries. Surprisingly for those who entered into a staff level, entrant salaries are less idiosyncratic than for those who entered the firm at the managerial level. The mean entrant salary of men who enter the firm at the management level can now graphically be held responsible for the idiosyncratic entrant mean salary growth path as observed in figure I for all cohort individuals and especially men. And we can also confirm that this constitutes a very clear similarity between managerial employers in the BGH paper and our sample of managerial employees. But there remains an important dissimilarity in the evolution of real average annual cohort salary between the American and the British financial firm. That is the observed real decline in real mean annual salary of cohort individuals in the American financial firm over part of the period. Effectively this means that the theory of on the job training cannot explain this pattern whereas for our British firm the observed and continuous upward movement of real salary of cohorts over time can be explained on the grounds of on the job training.

So far we have paid great attention to a descriptive visualisation of the earnings evolution of our cohorts. Although such an analysis greatly helps to get an idea of the direction and the extent to which earnings of different cohorts move over time, it does not give us any insight into what forces drive the earning's growth observed. Quite naturally we would now like to move on from the descriptive visualisation of earnings growth of cohorts as presented in figure I to empirically investigate the cohort effects we observe. We are specifically interested in disentangling the underlying cohort, year and tenure effects. Baker, Gibbs and Holmstrom consider three models, which disentangle the cohort, year and tenure effects on earnings, to test if all cohort effects are equal to zero or positive. Hence, the model they would like to estimate determines average earnings in year t of a cohort entering in year i (E_{it}) as a function of tenure (Tenure$_{t-i}$), year (Year$_t$), and cohort (Cohort$_i$) as expressed in equation (1):

$$E_{it} = a_0 + a_1 \text{Tenure}_{t-i} + a_2 \text{Year}_t + a_3 \text{Cohort}_i \qquad (1)$$

Of course, model one represents an identification problem due to the linear dependencies amongst the explanatory variables and cannot be estimated. But this is not to say that one cannot make any empirical inferences about the cohort effect presented in figure I. Baker, Gibbs and Holmstrom proceed by estimating equation 2 which excludes the cohort dummies and allows the effect of tenure on a cohort's earnings to be general by estimating the effect of tenure dummies.

$$E_{it} = a_0 + a_1 \text{Tenure}_{t-i} + a_2 \text{Year}_t \qquad (2)$$

Secondly, they estimate (2) again but impose a linear restriction on the effect of tenure in order to test if the tenure effect is linear. A cohort's average earnings E_{it} as expressed in equation 1 and used by BGH is defined as the mean earnings of a cohort in year t which is a subset of all the individual mean earnings of each member in a cohort in year t. Although we have followed suit in estimating the same functional forms for the British financial firm, we have also estimated the same regression from a panel of all individuals in each cohort given the vast number of individual observations on mean salary. The differences in results are therefore a consequence of data organisation. The regression results in table 3 derive from cohort earnings regressions based on individual mean salary data rather than aggregated mean cohort salary data. Unless otherwise stated, the following discussion of results is based on

table 4 which reports regression results obtained from individual observations in cohorts and not aggregated cohort data. Obviously, the reason for not aggregating across cohorts is that the estimates of the coefficients in the regressions will be more precise but more importantly should reduce the standard errors of the coefficients estimated due to the larger sample size available from individual observations. We are also very much aware of the problem of heteroscedasticity in earnings over time which arises once we use individual panel data on earnings for our estimations. There are several reasons why we encounter heteroscedasticity in the context of earnings evolution in any internal labour market over time. A strong candidate for explanation is the ability of employers to learn about their employees ability over time which is not revealed on entry to the firm since workers will be pooled initially. Once the employer learns about the employees ability through, for example, observing the employee's output, the employer is able to match a workers salary more closely to her ability. Consequently, those employees who reveal high levels of ability will be rewarded by salary increases compared to those employees who are observed to reveal comparatively lower levels of ability. Therefore, one should expect to see an increase in the variance of earnings over time. But there maybe other explanations as well and since we are not able to specify the nature heteroscedasticity takes in these models, we are not adopting a proceedure sensitive to the forces that drive heteroscedasticity in earnings but instead use White corrected standard errors.

The regression results of the general and linear tenure model for the american financial firm in BGH's paper indicate, by use of an F-test that, "the tenure effect is almost exactly linear". This observation does not hold true for the British financial firm. The regression results of the aggregated mean cohort salary data only marginally reject the general tenure model thereby only marginally confirming linearity. The F-statistic in this case is 1.924 (the critical F equals 1.95). Running the same regressions with data on earnings of all individuals in a cohort shows that the coefficients on tenure under specification 1 in table three clearly suggest a nonlinear tenure effect and that all the estimated betas do have a significant effect on average earnings of a cohort.

Table 4   **Cohort salary regressions**

Dependent variable	Specification 1 Individual mean cohort salary		Specification 2 Individual mean cohort salary		Specification 3 Individual adjusted mean cohort salary	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Intercept	9398.062	107.44	9398.062	107.437	9398.062	107.44
Tenure			468.04	9.00		
Tenure dummies			No		No	
1990	584.15	63.90				
1991	1654.43	78.37				
1992	2314.78	90.86				
1993	2703.42	101.96				
1994	3325.17	120.48				
1995	3827.87	138.35				
1996	4084.76	147.56				
1997	4148.58	168.91				
1998	3870.99	202.01				
1999	3562.49	194.56				
2000	3588.46	230.39				
2001	4207.37	377.91				
Year dummies						
1990	-361.81	134.18	-302.41	131.46	33.93	138.05
1991	-324.57	144.56	32.65	135.55	-348.62	142.21
1992	-350.05	148.14	220.19	139.52	-759.26	147.22
1993	417.25	158.24	974.01	148.64	-303.45	153.96
1994	433.73	150.18	966.36	144.25	-475.93	156.53
1995	675.32	148.12	1251.65	141.97	-325.08	154.06
1996	660.43	137.34	1192.74	133.90	-194.76	148.15
1997	824.32	129.78	1258.34	126.49	57.44	144.46
1998	2015.64	135.71	2381.80	132.35	1407.51	150.47
1999	2327.67	132.79	2625.19	130.20	2010.70	150.45
2000	2575.35	131.16	2820.18	128.19	2366.38	152.50
2001	3323.05	137.60	3564.57	133.27	3025.28	162.37
Cohort dummies						
1990					-810.33	74041
1991					2222.61	142.45
1992					1886.32	146.87
1993					2041.02	120.69
1994					1644.00	117.69
1995					1531.53	140.39
1996					528.80	107.53
1997					491.59	111.11
1998					45.37	119.99
1999					-626.20	120.62
2000					-194.95	134.37
2001					466.74	189.99

Sum of squared errors	26,871,000,000,000	26,929,000,000,000	26,690,000,000,000
R^2	0.0331	0.0310	0.0184
Degrees of freedom	224590	224601	224590
N	224615	224615	224615
	F-statistic for		F-statistic for

We have also estimated the linear tenure model including a squared term for tenure. The p-values on tenure and tenure squared in this case provide strong evidence in favour of nonlinearity in the effect of tenure on mean cohort earnings. Testing specification 2 against specification 1, the F-statistic for difference from specification 2 is 40.4, again emphasizing that the general tenure model fits the data for the British financial firm much better than the linear tenure model, ruling out linearity in tenure. The authors have already pointed out in the graphical presentation of earnings evolution of cohorts that average earnings of cohorts of the British firm do not tend to conform to the almost parallel average growth path of cohorts observed by BGH for the American firm.

Rejecting the linear restriction on tenure in specification 2 should therefore not come as a surprise. The effects of the tenure dummies on average earnings of cohort individuals are all positive, significant and the relationship of the two variables is concave. Therefore, the first result in the empirical analysis of cohort effects is the nonlinearity in the effect of tenure on individual average cohort earnings for the British financial institution in contrast to the American counterpart.

To make inferences about the cohort effect, BGH proceed by estimating equation 3:

$$E_{it} - a_1 (t\text{-}i) = a_0 + a_2 \text{Cohort}_i + a_3 \text{Year}_t \qquad (3)$$

This can only be estimated because the linear tenure model is nested in equation 3. In essence, average cohort earnings are adjusted by the linear tenure effect and by effectively adjusting mean cohort earnings in this particular way, one can now test for the significance of cohort effects with regards to earnings. BGH are indeed able to reject the hypothesis that all the cohort effects in 3 are zero and by testing 3 against 2 in the form of an F-test also conclude that model 3 is an improvement on the linear tenure model.

Our data has already rejected the linear tenure model and we therefore do not proceed by estimating equation 3 adjusting in our case average individual earnings by the linear tenure component. Instead we are adjusting individual average cohort earnings

by the effect of the tenure dummies from the general tenure model (specification 1). The results are presented under specification 3 in table 4. Specification 1 is then tested against specification 3, which includes the cohort dummies. The F-value equals 126.9 presenting evidence that the inclusion of cohort dummies are not only an improvement on the general tenure model but that we can be confident to reject the hypothesis that all cohort dummies are zero in equation 1. It is important to understand why the general tenure model is nested in our specification 3, which adjusts mean earnings by the effect of tenure dummies. It can easily be shown that the total sum of squares in the general tenure model must be the same as the total sum of squares in our model adjusting earnings by the general tenure effect. Consider the following:

The general tenure model is given by

$$E_{it} = a_0 + a_1 \text{Tenure}_{t-i} + a_2 \text{Year}_t$$

The total sum of squares of the general tenure model is given by

$$\text{TSS} = \text{ESS}_1 + \text{RSS}_1, \qquad\qquad (4)$$

where the subscripts identify the explained sum of squares and the residual sum of squares as those of the general tenure model. The ESS_1 derives from two components, ESS_{11}, which comes from the tenure dummies and ESS_{12}, which comes from the year dummies. Our specification of the adjusted average cohort earnings model (specification 3 in table 3) is given by

$$E_{it} - a_1 \text{Tenure}_{t-i} = a_0 + a_2 \text{Year}_t + a_3 \text{Cohort}_i$$

The total sum of squares is given by

$$\text{TSS} = \text{ESS}_2 + \text{RSS}_2 \qquad\qquad (5)$$

In this case the ESS_2 can be attributed to the component derived from the year dummies, ESS_{12} and the component derived from the cohort dummies, ESS_{22}. Since the only restriction we place on the general tenure model is in the cohort dummies, $á_3=0$, it is indeed the case that the general tenure model is nested in the adjusted cohort model:

From the adjusted cohort model we have:

$$\text{TSS-ESS}_{11} = \text{ESS}_{12} + \text{ESS}_{22} + \text{RSS}_2$$

Restricting á$_3$ in the adjusted cohort model to be zero effectively amounts to the general tenure model in terms of total sums of squares. Therefore, we have established proof that the general tenure model is nested in the adjusted cohort salary model and are therefore able to conduct an F-test to establish if the adjusted cohort salary model is superior to the general tenure model which at the same time will also give evidence as to whether the cohort effects are zero or not. Testing specification 1, the general tenure model, against specification 3, the adjusted cohort salary model results in a computed F-statistic of 126.92 which first of all leads to a rejection of the null hypothesis that all cohort effects are zero and secondly shows an improvement on the general tenure model.

The cohort effect in specification 3 is again highly nonlinear. This should not be surprising given the graphical evidence on cohort wage growth in figure I which establishes graphically that the gap in wages of adjacent cohorts is not independent of the year of entry of a cohort meaning that the tenure effect cannot be linear. Quite on the contrary, what figure I does show is a lot of variation between wage differentials of adjacent cohorts. This as we mentioned earlier is attributed to the wage a cohort receives on entry to the firm. Entry wages follow a completely different path than incumbent wages and we suggest that the variation between wage differentials of adjacent cohorts is due to this discrepancy. It is because of this observation that specification 3 fits the data much better and picks up on the wage differential and the different growth patterns in real wages of adjacent cohorts as opposed to the general or linear tenure model because the cohort year model (specification 3) allows for entry wages to move independently of one another plus allowing the growth path of real wages of cohorts over time to move in a parallel fashion.

This following section takes a closer look at the variables included in the three regressions in table 4. The tenure dummies in specification 1 give an indication of how the returns to specific human capital in the internal labour market of our firm evolve and impact on individual mean cohort salary. All the coefficients on the tenure dummies are positive and they are increasing. For example, employees with 12 years

of tenure earn on average £4207.37 more than an employee who just entered the firm, holding everything else constant. Therefore specific human capital acquired while working for the firm is an important aspect of mean salary growth. Baker, Gibbs and Holmstrom do not actually state the coefficients on the tenure dummies for their sample and we are therefore unable to make a comparison. Obviously the effect of tenure is not lost in specification 3, the individual adjusted mean cohort salary model since by adjusting for tenure we have effectively incorporated the tenure effect into the dependent variable. The coefficients on year dummies 90, 96 and 97 in our preferred specification 3 are not significant but all others are. Some of the coefficients on the year dummies are negative but by not as much as those produced by BGH. But the coefficients do confirm that there are differences on entry and that there are dissimilarities between salaries in different years. But overall, the situation seems to be improving in the organisation with especially the later year dummies showing high and positive coefficients. The coefficients on the cohort dummies are mostly positive except for cohort dummies 90, 99 and 2000. Obviously the coefficients on the cohort dummies are derived from a complexity of the state of external market conditions and compositional factors. The cohort effects are nonlinear which they should be since external market conditions are reflected in the highly non-linear path of entrant salary. The returns on earnings for individual cohorts are larger for some than for other cohorts when measured against cohort 89, holding everything else constant. We have already accepted that cohort effects are significant and the coefficients on cohorts only give us an idea of how being in a given cohort affects those cohorts' average annual earnings. A next natural extension of the individual cohort salary models would be to include variables such as level and education dummies in order to see how much of the effect of the cohort dummies is due to these compositional and the personal characteristics of the cohort employees. Also, the regressions should be run by gender and ethnicity as well to get an even more detailed picture of how the discussed effects may potentially vary between the groups.

IV Conclusion

The first conclusion to be drawn from our analysis is the existence of an internal labour market in the British financial firm. We have seen in figure I-III that the firm shields its employees from external labour market conditions once they have entered

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the internal labour market. Throughout the period all cohorts enjoy positive earnings growth above the external market rate. Hence, a clear cohort effect exists in this firm. But the evolution of average earnings of individual cohorts, although moving in the same upward direction, is different in terms of magnitude. Because the cohorts in the British financial firm do not experience real salary declines over the period, which is not the case for the American financial firm, on the job training can account for the earnings growth observed in figure I-III. Without question, future work needs to address in more detail the extent to which the implications of human capital on-the-job-training model account for the observed salary growth. This should be based in productivity growth and hence, empirical work on experience and relative performance of cohort individuals within job levels of the hierarchy needs to be carried out in order to assess to what extent they account for increasing returns to labour market experience.

Another interesting feature of the earnings evolution of cohorts is that the salary on entry seems to determine how earnings evolve thereafter. Cohorts starting on a relatively low entrant salary experience slower and less growth in earnings than cohorts who start on a high entrant salary. Learning theories that are based on the assumption that the expected marginal product of a worker should equal his wage run into difficulties explaining the persistent effect entrant salary exerts on the earnings evolution of a cohort. The updating mechanism firms use to update their believes about the ability of their employees should in the limit lead to the convergence of salaries within the groups of high and low ability workers. As a consequence we would expect salaries within these groups to converge across cohorts. Therefore the wages of workers across cohorts are not solely determined by expected marginal product. The difficulty with this implication of the theory arises only if firms are completely uninformed about new entrants and as a consequence offer a pooled contract on entry. If on the other hand firms have partial information on new hires, low average wages on entry and subsequent lower growth in earnings of a cohort reflects on the lower average ability of a cohort.

The analysis in this paper does not shed much light on the extent to which incentives drive the observed earnings growth of cohorts. If a tournament type model was assumed in which remuneration of an individual's performance is based on the

relative rank the individual holds in the organisational hierarchy and not his output level, wages will differ from realized marginal product. Analysis presented by Audas, Barmby and Treble[11] which actually uses personnel data of the British financial firm discussed in this paper to 'investigate empirically the respective roles of incentives and good fortune in an hierarchical promotion system' in the context of a tournament model as introduced by Lazear and Rosen (1981)[12] offers support for earnings growth being driven by incentives. Their empirical evidence suggests that effort is a positive function of price spread and that effort is a negative function of luck, empirically supporting the two main theoretical predictions of tournament theory as outlined in Lazear and Rosen (1981). The implications for the context of this analysis are that incentives do indeed appear to work and hence, are also a possible explanation for the observed earnings growth of cohorts.

This paper has also shown that the earnings evolution of male and female cohort individuals differs quite substantially although the cohort effect and the general direction of earnings growth are roughly the same. Male cohort individuals are clearly at an advantage in terms of relative salary growth compared to women even though the gender composition of the cohorts in terms of their position within the firm moves in the same direction. A closer inspection of the evolution of earnings of men and women according to at which level they entered the firm indicates that the entrant salaries of men entering at managerial levels is highly idiosyncratic as in BGH sample of managers. This is not the case for women who enter as managers. So the idiosyncracy mainly derives from manager's entrant salary but is not the case for men and women entering into staff levels. This is important to point out because we may not conclude that starting salary has long lasting effects on salary growth once we condition for entrant levels and that this is only true for those entering into managerial levels. Although, salary growth of individuals being recruited as managers is not as well behaved than that of those recruited at staff level. Future work needs to address these findings in a more detailed and regression based framework. Secondly it needs to pay closer attention to the distribution of earnings over time. The cohort effect needs to be broken down into the compositional and external market factors in order

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[11] Audas, R., Barmby, T., Treble, J. *forthcoming in Journal of Labor Economics,"Luck, Effort and Reward in an Organisational Hierarchy"*.

[12] Lazear, E. P., Rosen, S. (1981) *Journal of Political Economy,"Rank-Order Tournaments as Optimal Labor Contracts"* **vol. 89,** 841-864.

to establish if the compositional or the external market factors drive the results in this paper. Also, promotion procedures and job mobility in the hierarchy need to be analysed because they have an important impact on salary growth. In this way one moves away from an aggregate analysis to an emphasis on individual determinants of the evolution of earnings. In such a framework one can then make predictions as to whether incentive mechanisms are also largely at work within the firm's wage setting process.

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