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Initial Wage, Human Capital and Post Wage Differentials

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Initial Wage, Human Capital and Post Wage Differentials

Abstract

Insufficiency in information with which firms judge the productivity of a worker for the first time in the market creates more randomness in initial wages than in later wages. A *lucky* individual is to draw a high initial wage relative to the *unlucky*, but otherwise equivalent worker. This paper examines whether this initial luckiness can motivates the individual to work harder thereafter in his career, and consequently leads to a persistent future high wage. In the model of human capital accumulation, an individual worker adjusts hours worked responding to his initial wage. The amount of accumulated human capital is proportional to the number of hours worked via the learning-by-doing. This model predicts that the initial wage is a persistently important factor having positive effect on future wages. Using data from the National Longitudinal Survey of Youth 79, we find empirical evidence that this effect is indeed positive and persists even after 20 years since the initial entry to labor market. The decomposition of initial wages shows that this effect mainly is contributed by the random component, *luckiness*. It implies that the observed cross-sectional wage variation within group can be accounted for the initial randomness in wages.

Introduction

One of the most robust findings in labor economics is a positive return on time spent in the labor market investigated in the standard log-wage equations. Among various attempts to explain this relationship, the primary model is the general human capital theory, in which the stock of human capital rises with experience in the labor market. There are two main streams to describe how people accumulate their human capital through working. First, Ben-Porath (1967) and many followers (Mincer, 1974; Becker, 1975) suggest that people invest in general human capital at the expense of time or direct pecuniary cost, resulting initially in lower wages and subsequently in higher wages in later periods of working life. This so-called 'On the Job Training' (OJT) theory of post-schooling human capital investment and wage growth predicts that at the individual level, there will be a negative relationship between the initial wage level and wage growth. At the market level, it also predicts that the present values of the investor's lifetime wage (with lower initial wage and faster growth) and of the otherwise equivalent non-investor's lifetime wage (with higher initial wage but slower growth thereafter) equals one. There two predictions are tested to be valid in the empirical study of Neumark and Taubman (1995).

The other hypothesis regarding the general human capital accumulation process, namely 'Learning by Doing' (LBD) theory, holds that people enhance their productivity by learning skills through work without giving up working hours or wages. In the two-period model (Cossa, Heckman, and Lochner, 1999), workers choose optimal consumption and leisure (in hours) to maximize their present value lifetime utility. This gives different predictions from the OJT and the LBD human capital evolution processes

on the relationships among initial wage level, hours worked, and wage growth over time. In the OJT, people reduce hours worked for post-schooling training and receive lower wages initially. Over time, their wages grow faster. Therefore, their wages and hours worked move in opposite directions over time. People who invest on human capital earn lower initial wages and experience higher growth in their future wages. The gap in the initial wages would be compensated by difference in wage growth rates. As age approaches the overtaking point, two wage profiles (one flatter than the other) may converge to each other (Mincer, 1974).

By contrast, in the LBD process, there is no explicit cost for human capital accumulation. Given wage offers, people choose how many hours to work and by working, they enhance their productivity. As wages reflect increases in their stock of human capital, wages increase over time as well, and this increase will be larger for workers who spend more hours at work. Since people adjust their labor supply (measured in hours) responding to wages, the patterns of wage and hours worked would move in parallel with each other; the higher the wages, the more hours they work. Moreover, assuming no costly training and flexible choice in hours worked, a difference in initial wages may cause different choices of hours worked, and so, different amount of accumulated human capital. Eventually, the small gap in initial wages is transmitted to a huge wage differential in the later working years.

Empirical evidence such as Neumark and Taubman (1995) has limitations for verifying that their findings indeed prove the OJT hypothesis because they have not considered the endogenous training participation decisions of workers explicitly. When they find a negative relationship between wage level and wage growth, it is simply

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argued to be evidence for the OJT. The separate identification and reconciliation between the OJT and LBD models are little examined.

Aiming to provide evidence for the LBD model, our study considers the initial wage effect on post wage differentials. Variation in initial wages is derived from two factors; a worker-specific permanent factor and random transitory components. The fact that people with higher initial wages earn more later than their counterparts with lower initial wages may be attributed to the possibility that people with higher initial wages are smarter (endowed with more human capital). Then, differences in post initial wages are consequences in their difference in innate ability before working. If the growth rate of human capital accumulation does (not) depend on individual endowed or prior-to-working ability, the gap in initial wages will remain as the same extent (increase in the magnitude) in future wages without any slope effect (with positive slope effect). This implies that the permanent components of initial wages are mostly responsible for future wage differentials.

By decomposing initial level wages into their permanent and transitory components (Baker, 1997), the relative accountability of these two components for post wage differentials can be investigated. It is expected that the determination of initial wage is quite different from that of later wages because when a firm decides to hire someone who enters the market for the first time, the firm usually does not have enough information to accurately judge the productivity of the individual. Therefore, there is more randomness in assigning an initial wage compared with later wages. We define that an individual is *lucky* if he obtains a relatively high wage (relative to others who have similar productivity). Whether this initial luck can motivate the individual to work harder

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thereafter (say, in order to keep a well-paid job) in his career and this consequently leads to a persistent future high wage is examined in this paper.

In sum, there are two possible ways in which initial level wages may influence future wage: 1. higher initial wages increase hours worked and 2. higher initial wages cause faster wage growth (slope effect). Whether any of these effects is attributed to a permanent factor or to random shock (luck) in the initial wages is the last question we try to answer.

This paper focuses on the slope effect of initial wages on future wages. It is found that the initial wage is indeed an important factor in determining future wages both in the theoretical framework and in the empirical studies. In the LBD framework of human capital accumulation, an individual worker is endowed with innate ability. She adjusts labor supply decisions on hours worked responding to her initial wage. With the LBD, she accumulates her productivity proportional to hours worked. If the level of the starting wage is high, she works for more hours in the next period. This leads her to obtain more human capital during working. Her future wage is likely to be high, directly reflecting her enhanced productivity.

Using a simple regression model, we estimate the effects of initial -level wage and its random component with data from the National Longitudinal Survey of Youth 79. The main finding is that the initial wage has a positive effect on future wages and that it persists over time. This effect is found to be attributable to the *random* component of the initial wages, not the component based on observed factors for an individual. This supports the positive relationship between wage level and wage growth predicted by the LBD model.

Theoretical Framework

Let a representative worker endowed with innate ability α_0, which is not fully observed by firms. We assume that once a worker is actually employed, then her ability becomes public information both to her employer and to the firm that she works for. A worker accumulates her human capital through her working experience in the LBD process. The wage paid by the firm to this representative worker is, on the average, equal to the observed output of a worker. The observed output can be decomposed into two parts: worker's productivity, and a random component due to the firm's inability to observe the individual's true ability before hiring her.

Then, wages at time t are determined by the firm's expectation about the marginal product of a worker, α_t^e, plus a random noise ε_t:

$$w_t = \alpha_t^e + \varepsilon_t. \tag{1}$$

We let expected the marginal product of a worker at t be the marginal product of the worker at the end of t-1:

$$\alpha_t^e = \alpha_{t-1}. \tag{2}$$

Following a typical labor supply model, We let a worker adjust her working hours, h_t, responding to her wage as follows:

$$h_t = h_0 + \beta\left(w_t - \alpha_{t-1}\right) = h_0 + \beta\varepsilon_t. \tag{3}$$

Equation (3) says that working hours (or effort input at work) is positively correlated with the difference between the wage and the marginal productivity ($\beta > 0$) If a worker enjoys positive random shock in her productivity at work, she will invest more time on working in response to higher wage than her actual human capital.

Similar to the LBD human capital theory (Cossa, Heckman, and Lochner, 1999), our benchmark model of the accumulation process of a worker's ability depends on working hours as follows:

$$\alpha_t = \rho \alpha_{t-1} + \eta h_{t-1} . \tag{4}$$

If $\rho = 1$, then Equation (4) implies that the accumulation of human capital is never depreciated. Then through a lifetime, the productivity of a worker keeps increasing. η measures the rate of learning from the last period working.

Simple deduction from Equations (3) and (4) leads us to:

$$\alpha_t = \rho^t \alpha_0 + \frac{1-\rho^t}{1-\rho} \eta h_0 + \eta \beta \rho^{t-1} \varepsilon_0 + \eta \beta \sum_{j=1}^{t-1} \rho^{t-1-j} \varepsilon_j . \tag{5}$$

The first term on the right-hand-side (RHS) of (5) is the initial human capital of the worker. It is constructed from time-invariant characteristics such as years of schooling, sex, and race. The second term at the RHS of (5) is a time-varying component of the obtained productivity from experience in the workplace. It includes working experience and tenure with a specific employer. The third term, ε_0, is a random component of the initial wage, which is our main concern.

To predict the sign and trend of the initial wage effect, we consider four cases where different distributional assumptions on the random component of initial wages and variation from the benchmark process of human capital accumulation are considered. In particular,

Case 1. $\rho = 1$, and $\{\varepsilon_t\}$ is *i.i.d.* with mean zero and finite variance σ^2 for t=1,…,T, ε_0 can have a much larger variation than σ^2. The human capital accumulation process

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follows Equation (4). Random shock in initial wage reflects the luck of an individual.
With $\rho = 1$, Equation (5) becomes

$$\alpha_t = \alpha_0 + t\eta h_0 + \eta\beta\varepsilon_0 + \eta\beta\sum_{j=1}^{t-1}\varepsilon_j . \tag{6}$$

We find that the initial random shock in wages has a permanent and positive impact on future human capital for all future time periods. This marginal effect is *constant* $(\eta\beta)$ for all t.

In this case, we can interpret the error component in the initial wage as the quality of matching between a worker and an employer (or a workplace environment). In general, each worker only has limited access to information about job openings. A worker could afford to search and gather employment opportunity information only when she manages to be employed during the searching process or support herself while unemployed. So her matching with a job would occur at a time when she can not afford the searching process any more and she would choose a job from the offers available to her then. At any moment, it is not practically possible that a worker searches the best match using the entire information about the job market.

In the other case where a worker does not try to change her employer, her workplace environment with the same employer can still change randomly in the sense that many economy-wide factors that a worker is unable to control may affect her working environment relevant to her productivity. In either case, it is reasonable to assume that the matching quality is random (has a random component) over time.

Case 2. $0 < \rho < 1$, i.e. α_t follows a stationary *AR (1)* process,

$$\alpha_t = \rho\alpha_{t-1} + \eta h_0 + \eta\beta\varepsilon_{t-1} \text{ where } 0 < \rho < 1 . \tag{7}$$

Equation (7) allows the possibility of human capital depreciation over time. It is reasonable that as they get older, workers may forget part of their knowledge accumulated in the past. If they switch jobs and work in different tasks, part of the specific human capital obtained in previous jobs may be lost in their productivity in the next period. In either case, workers' human capital may depreciate for a given time period. Direct deduction from Equation (7) leads to:

$$\alpha_t = \rho^t \alpha_0 + \frac{1-\rho^t}{1-\rho} \eta h_0 + \eta\beta\rho^{t-1}\varepsilon_0 + \eta\beta\sum_{j=1}^{t-1} \rho^{t-1-j}\varepsilon_j \ . \qquad (8)$$

The effect (coefficient) of initial shock, $\eta\beta\rho^{t-1}$, is positive but *monotonically decreasing* over time. Eventually, it dies out to zero. Initial wage differentials caused by uneven random luck among workers will not have a persistent significant effect on future wage differentials.

Case 3. $\rho = 1$, and $\{\varepsilon_t\}$ is a stationary *AR (1)* process, i.e.

$$\varepsilon_t = \delta\varepsilon_{t-1} + u_t \text{ where } 0 < \delta < 1 \ . \qquad (9)$$

We assume that the human capital accumulation process is Equation (4) with $\rho = 1$.

Equation (9) indicates that any kind of random luck in the labor market of an individual worker is correlated over time. Once a worker gets lucky, she is more likely to remain lucky in the next period while an unlucky worker is more likely to suffer from her continuous unluckiness in her later working career. We may consider random luck as some unobserved individual heteroskedastic characteristic that helps a worker get a high-paying job or give a good signal to employers. Either directly or indirectly, these factors enable a worker to maintain her luck with employers and keep high wages over time. Since these factors are likely to be related with a worker's personality and attitude

towards relationships, work, and risk, they produce a positive correlation with luck over time.

To figure out the effect of temporally correlated random shock on future wages, we combine Equations (4) and (9) to obtain the following:

$$\alpha_t = \alpha_0 + t\eta\beta h_0 + \eta\beta\left(\frac{1-\delta^t}{1-\delta}\right)\varepsilon_0 + \eta\beta\sum_{j=1}^{t-1}\sum_{s=1}^{j}\delta^{j-s}u_s \ . \tag{10}$$

The initial shock produces a positive effect on future productivity and wage. This effect *monotonically increases* over time with an upper bound of $\eta\beta\left(\dfrac{1}{1-\delta}\right)$. Due to the positive and persistent impact of initial luck on future productivity and wages, given that other factors are fixed, the wage differential between lucky workers and unlucky workers in the first period at work does not disappear. This implies that the wage differential among experienced workers is a consequence of the variation of initial luck they receive when starting to work.

Case 4. Both { α_t } and {ε_t} are stationary *AR (1)* processes. As our most general case, we combine human capital accumulation that allows for partial depreciation and an intertemporal correlation within random luck in wages, i.e., α_t follows Equation (7) and ε_t follows Equation (9). Then it follows that:

$$\alpha_t = \rho^t\alpha_0 + \frac{1-\rho^t}{1-\rho}\eta h_0 + \eta\beta\left(\frac{\rho^t-\delta^t}{\rho-\delta}\right)\varepsilon_0 + \eta\beta\rho^{t-1}\sum_{j=1}^{t-1}\sum_{s=1}^{j}\frac{\delta^{j-s}}{\rho^j}u_s \ . \tag{11}$$

Now, the marginal effect of initial shock on future wages, $\eta\beta\left(\dfrac{\rho^t-\delta^t}{\rho-\delta}\right)$ depends on two AR (1) parameters, ρ and δ. Assuming that both ρ and δ are positive numbers between 0 and 1, regardless of the relative magnitude of the two parameters, the effect of initial

wage will eventually disappear. However, a converging trend of this effect depends on the specific choices of two parameters. In particular, if $\rho = \delta$, then the effect of initial wage will be $\eta\beta\left(t\rho^{t-1}\right)$.

Figure 1 illustrates changes in the initial random shock effect over time. Depending on different choices of ρ and δ, the marginal effect follows different patterns in trends. Even in cases of increasing trend, the trend is reversed to decrease at $t>6$. Intuitively, the reasonable conjecture is that the intertemporal correlation of a worker's productivity is stronger than that of her random shock in wages, say $\rho > \delta$. Figure 2 shows the trend of initial shock when $\rho = \delta$. If ρ is very close to 1, the marginal effect first explodes and then slowly decreases towards zero. As ρ gets smaller toward zero, the exploding trend stabilizes and the initial shock effect converges to zero within a relatively short period of time. Figures 1 and 2 show that changes in the marginal effect of initial shock on post wages are not necessarily monotonic. In Case 4, though the marginal effect of initial wages reduces to zero eventually, it does *not monotonically decrease* and the speed of convergence depends on the values of ρ and δ. Hence, during the early period of a working career, workers with positive initial shock might gain larger and larger benefits from it over certain time. Along with longer experience at work, it starts to decrease and eventually leaves no effect.

Empirical Model

Using Equations (2) and (6), we can rewrite a wage function of Equation (1) according to four possible cases:

Case 1. $\qquad w_t = \alpha_0 + (t-1)\eta h_0 + \eta \beta \varepsilon_0 + v_t$ where $v_t = \eta \beta \sum_{j=1}^{t-2} \varepsilon_j + \varepsilon_t$, $\qquad\qquad$ (12)

Case 2. $\qquad w_t = \rho^{t-1}\alpha_0 + \dfrac{1-\rho^{t-1}}{1-\rho}\eta h_0 + \eta \beta \rho^{t-2}\varepsilon_0 + v_t$ $\qquad\qquad\qquad$ (13)

$\qquad$ where $v_t = \eta \beta \sum_{j=1}^{t-2} \rho^{t-1-j}\varepsilon_j + \varepsilon_t$,

Case 3. $\qquad w_t = \alpha_0 + (t-1)\eta \beta h_0 + \eta \beta \left(\dfrac{1-\delta^{t-1}}{1-\delta}\right)\varepsilon_0 + v_t$ $\qquad\qquad$ (14)

$\qquad$ where $v_t = \eta \beta \sum_{j=1}^{t-2}\sum_{s=1}^{j} \delta^{j-s} u_s + \varepsilon_t$, and

Case 4. $\qquad w_t = \rho^{t-1}\alpha_0 + \dfrac{1-\rho^{t-1}}{1-\rho}\eta h_0 + \eta \beta \left(\dfrac{\rho^{t-1}-\delta^{t-1}}{\rho-\delta}\right)\varepsilon_0 + v_t$, $\qquad\qquad$ (15)

$\qquad$ where $v_t = \eta \beta \rho^{t-2} \sum_{j=1}^{t-2}\sum_{s=1}^{j} \dfrac{\delta^{j-s}}{\rho^j} u_s + \varepsilon_t$.

For the empirical analysis, we use two different wage equation specifications to find out which cases more faithfully reflect the data generating process (i.e. the true effect of initial wages). Given a time period t, for each individual i, we consider two log wage regressions.

$\qquad$ (Regression 1) $\qquad\qquad w_t = \gamma w_0 + X_t \delta_1 + v_t$,

and

$\qquad$ (Regression 2) $\qquad\qquad w_t = \gamma_0 \alpha_0 + \gamma_1 \varepsilon_0 + X_t \delta_2 + v_t$.

X includes several demographic and labor force characteristics of a worker, for example, age, years of schooling, sex, race, marital status, years of experience, and AFQT score. In

Regression 2, since both initial ability (α_0) and random shock are unobserved, we need the first-step estimation of the initial wage equation given as:

$$w_0 = Z_0 \delta_0 + \varepsilon_0, \tag{16}$$

where Z needs to contain additional variables not contained in X to avoid multicollinearity in Regression 2. Thus, we approximate α_0 based on observables Z. In Regression 2, we decompose the initial wage effects into a systematic part and a random shock (luck) part separately. We let Z satisfy the exclusion condition by including some explanatory variables in Z which are excluded in X, such as education squared, an interaction term of education and AFQT score. Also, some family variables such as father's educational attainment, mother's educational attainment, the closest sibling's gender, and educational attainment are used as additional explanatory variables responsible for the determination of initial wage. In particular, we try to control innate ability using these family related variables.

Using obtained initial wages and residuals from Equation (16) as

$w_0 = Z_0 \hat{\delta} + \hat{\varepsilon}_0 \equiv \hat{w}_0 + \hat{\varepsilon}_0$, Regression 2 is estimated as follows:

$$w_t = \gamma_0 \hat{w}_0 + \gamma_1 \hat{\varepsilon}_0 + X_t \delta_2 + v_t. \tag{17}$$

In Regression 1, we obtain a preliminary measure of initial effects. Then, whether the source of these effects is systematic or random components of the initial wage is investigated in Regression 2. The questions we pursue are whether there *exists* an effect of initial wage on future wage, how persistent is this effect over time, and what are the effects and trends in its persistence as a random component of the initial wage on future wages.

Data

For the empirical analysis described above, we employ the National Longitudinal Survey of Youth 79. Our sample includes only a cross-sectional sample of 6,111 individuals aged 14-21 as of December 31, 1978. Based on the information about employment status over survey years 1979-2000, we track down when they started to work and years of experience. Then, we limit the time periods for each individual to only *after* all schooling is completed, leaving the number of cross-sectional observations at 752.[1] Then initial wages are defined as the first wage observed *after* years of education completed stop increasing. This allows us to exclude cases where people start work during schooling or return to school after they start working.

For each year during 1980-2000, the current wage, our dependent variable, is the wage observed after 1 to 21 years later from the year of starting to work for each worker. For example, if the number of years since starting to work is equal to 3, the current wages are wages in 1982 for people who started to work in 1979, or wages in 1985 for those started to work in 1982, and so on. All wages are converted to the wages for compatibility using the Consumer Price Index. The distributions of years of starting work both overall and within a fixed number of years since the starting year are reported in Table A1.

Estimation Results

We implement a simple OLS estimation to find out which theoretical cases described in Section II are indeed consistent with the data. Results are presented in Tables 1 and 2. Table 1 reports the results of Regression 1 where we estimate the effect of initial wages

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on future wages without decomposing initial wages. It is noteworthy that the effect of initial wage is persistent even after 20 years since workers started to work. On average, one percentage increase in initial wages raises all future wages by 0.28%. In this specification, we are unable to differentiate the effect of explained components of initial wage from that of random shock in initial wages.

Before we interpret this result as a *true* effect of initial wage, we pay attention to the possibility of an endogeneity problem. An endogeneity problem happens if any individual unobserved characteristic makes workers relatively more productive and raises both their initial wage and future wages. Innate ability is the common suspect considered responsible for this endogeneity bias. Our data provide a proxy variable for individual innate ability, AFQT scores measure in quantiles. By controlling AFQT scores explicitly, we try to avoid the possibility that the observed persistence of effects of initial wage over time reflects the persistent feature of workers' unobserved ability. Also, some information about family members is included, assuming that these variables may be correlated with an individual's unobserved ability. NLSY79 provides father's and mother's educational attainment reported in 1979, and the closest sibling's gender and years of schooling reported in 1993. Combining these variables in different ways, we decompose initial wages into systemically predicted part and unobserved random (luck) part. Table 2 presents the results of the initial wage decomposition. The systematic part of initial wage has a large and highly significant effect on future wages during the first 3 years since the year of starting to work. Afterwards, the effect becomes insignificant.

By contrast, the unexplained random component of initial wages (Table 2, Column 3) is consistently positive and highly significant in its impact on future wage up to the

most recent data available (year 2000). There is a slight fluctuation in the extent of the effects extent of the effect across time periods. The average effect of one percentage increase in initial wages is a 0.274% increase in future wages up to 21 years after having started work. This result provides supporting evidence for our theoretical hypothesis, which held that the positive random shock (luck) in initial wage increases future wages permanently through a worker's human capital accumulation (via working harder). Figure 3 plots the estimates of initial random component effects. Certainly, there are fluctuations in magnitude over time. For the first 3 years, the coefficients are remarkable higher than for the later years. Whatever the causal relationship between initial wages and post wages may be, it is reasonable to assume that initial wages should have a strong relationship with post wages over a short time period. Over a 3-9 year period, the effect of initial random shocks fluctuates across years with a slightly decreasing trend. Over time, the extent of the fluctuation in the initial random shock effect stabilizes. After 10 years, it settles down to around 0.25, not likely to converge to zero.[2]

It is important to integrate our empirical results with one of the theoretical predictions. As shown in Figure 3, the effect of random shock as part of initial wages is decreasing during only a short period time and it does not disappear toward zero even 21 years later. This supports the prediction of Case 1 where we assume the *i.i.d.* random shocks and no human capital depreciation. Given that our sample only contains relatively young workers (aged 14 to 21 in 1979, and aged 35 to 56 in 2000), no human capital depreciation assumption seems not a restrictive assumption. Our empirical results support the proposition that if a worker's luck in job matching and in her performance at work is purely random unrelated with any other direct factors which determine her productivity at

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a given time, it functions as an incentive for her to spend more time in working and to invest more effort in work. This leads to a permanent increase in her human capital level. Therefore, after over 20 years later, her post wages benefit from the good luck in her initial wage.

An interesting explanation of wage differential within groups is provided. Given the same innate ability, educational attainment and other demographic conditions, workers benefit or suffer from wage inequality, which is caused by differences in their initial luck at work. Once lucky, she is more likely to remain lucky in wages only because she gets lucky in the beginning. Once unlucky, it is difficult to overtake her lucky counterpart. Hence, we observe a persistent wage differential, and this will not be eliminated simply by equalizing systematic determinants of wages across workers.

Conclusion

The standard Mincer wage regression developed by Mincer (1974) and its numerous successors do not explicitly explain what are unobserved factors in wage determination and what causes wage differentials across individuals. Among all possible unobserved factors, we examine the role of initial wage in understanding the determination of future wages. We present a human capital accumulation model showing the theoretical predictions of initial wage effects on future wages. We estimate the future wage equation as a function of initial wage which is decomposed as a systemically explained part and an unexplained random part. Our finding is consistent with the model assuming that luck is random and independent over time and that there is no human capital depreciation (for relatively young workers). Then a *positive constant* effect from initial luck is predicted

and supported by the estimation results. This suggests that the level of initial wage, specifically its random luck portion rather than the actual productivity portion related to observables, provides an additional incentive for workers to invest more effort at work and maintain their wages high throughout their working life.

Some issues call for further research. One may argue that the random component of initial wage may be related to an individual's ability not observed by economists but (partially) observed by firms who made a hiring. If this is true, then the initial wage effects may reflect unobserved individual heterogeneity rather than luck. To address this concern, one needs some instrumental variables that are (i) correlated with the initial wage, (ii) not correlated with an individual's future wage, and (iii) not perfectly correlated with the X variables used in Regressions 1 and 2. These three conditions are difficult to satisfy simultaneously. The data from NLSY79 provides only an individual's parents' education, siblings' education and siblings' gender, which can be considered legitimate instruments that satisfy (ii) and (iii). However, these variables have poor explanatory power for individual's initial wage. Regression of initial wages on these variables gives an adjusted R^2 of 0.021. Thus, (i) is violated. In fact the only variables that are (relatively strongly) correlated with initial wages are an individual's own AFQT score, education, and sex, but all these variables are part of the X variable and therefore cannot be used as instruments. Information about family members such as siblings' initial wages and their AFQT score may serve as good candidates for legitimate instruments. However, the NLSY data does not contain this information. We are left with a `weak' instrumental variable problem. Unless we encounter some `strong' instruments correlated with innate ability but not part of the X variable (own IQ score and education level), any

attempt to rely on instruments fails to properly control unobserved ability in initial wages. Given that it is unlikely that firms can observe all individuals' heterogeneity (ability), it seems fair to say that the random components of initial wage is at least partially attributable to luck. Further research is needed to examine exactly what percentage of the initial wage can be attributable to luck.

Another question is what exactly this *luck* in initial wage means. Obviously, educational attainment, experience, and other well-accepted determinants of wages do not explain it. It can be a matching quality in job searching or at work. It can be an economic-wide factor such as an unbalanced technology advance favoring some subgroup of workers. It may represent the signaling about how good a worker is, which is perceived by her first employer. In the sense that initial wage is an outcome of both the observed and unobserved productivity of a worker, the random component of initial wage, which we call 'luck,' can be used as an alternative proxy variable for unobserved ability. However, more investigation is necessary to verify which is responsible for the persistent impact of initial luck on post wages.
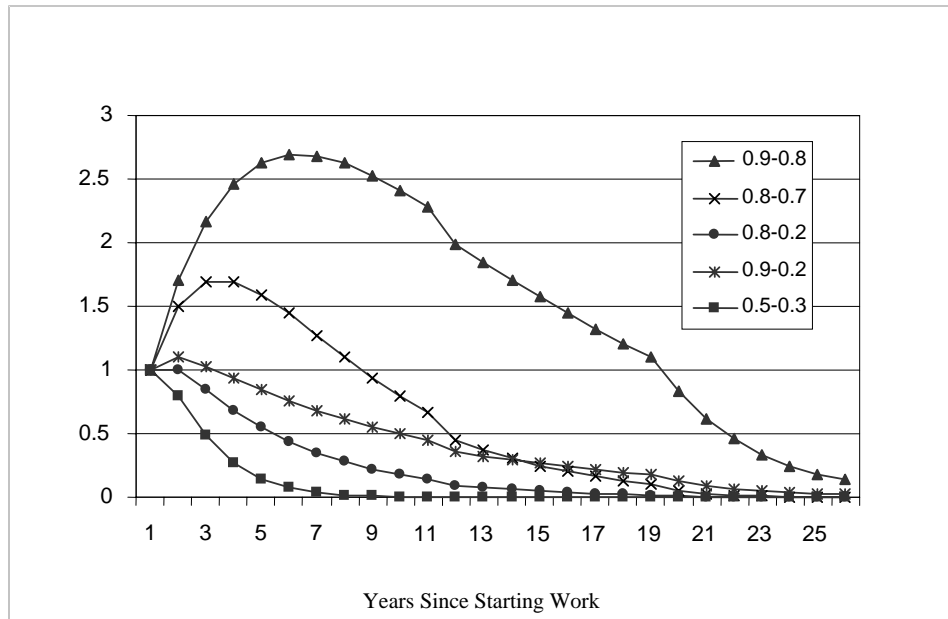
Figure 1. Changes in Initial Wage Effects (Case 4)
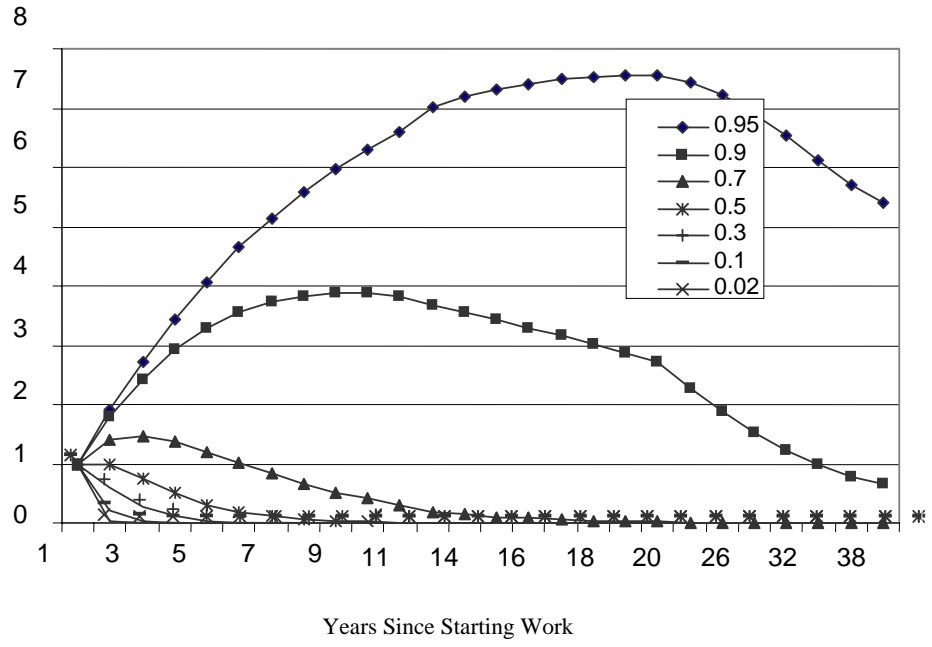
Figure 2. Changes in Initial Wage Effects (Case 4, $\rho = \delta$)

Years Since Starting Work

Figure 3. Estimated Initial Wage Effects

Table 1. Initial Wage Effects

Years Since Initial Work	Coefficient of Initial wage (t-Ratio)		Std. Dev.	No. Obs.	Adjusted R^2
1	**.460**	**(12.21)**	.0377	541	.386
2	**.504**	**(12.88)**	.0391	521	.412
3	**.393**	**(7.42)**	.0529	506	.244
4	**.237**	**(4.62)**	.0512	498	.235
5	**.318**	**(6.38)**	.0498	487	.301
6	**.418**	**(7.92)**	.0524	498	.317
7	**.247**	**(5.11)**	.0485	514	.297
8	**.226**	**(4.12)**	.0548	514	.261
9	**.332**	**(4.82)**	.0688	501	.191
10	**.270**	**(4.64)**	.0581	508	.230
11	**.219**	**(4.55)**	.0482	516	.326
12	**.308**	**(5.76)**	.0535	500	.344
13	**.296**	**(3.89)**	.0760	487	.223
14	**.228**	**(3.28)**	.0694	492	.252
15	**.210**	**(3.71)**	.0565	501	.268
17	**.308**	**(5.34)**	.0578	529	.251
19	**.251**	**(4.33)**	.0579	507	.282
21	**.245**	**(3.35)**	.0732	447	.200

Table 2. Decomposition of Initial Wage Effects: Specification I

Years Since Initial Work	Coefficient of $\hat{w}_0$ (t-Ratio)		Std. Dev.	Coefficient of $\hat{\varepsilon}_0$ (t-Ratio)		Std. Dev.	Adjusted R^2
1	1.222	(2.81)***	.4343	**.455**	**(12.04)**	.0377	.388
2	.861	(1.99)**	.0392	**.501**	**(12.77)**	.0393	.411
3	1.559	(2.73)***	.5701	**.386**	**(7.29)**	.0529	.249
4	.502	(0.83)	.6043	**.235**	**(4.57)**	.0514	.234
5	.482	(0.81)	.5953	**.316**	**(6.32)**	.0501	.300
6	.129	(0.22)	.5966	**.417**	**(7.92)**	.0526	.316
7	- .029	(-0.05)	.6295	**.249**	**(5.12)**	.0487	.296
8	- .469	(-0.71)	.6562	**.233**	**(4.22)**	.0552	.261
9	- .328	(-0.39)	.8342	**.339**	**(4.88)**	.0695	.191
10	.086	(0.10)	.8447	**.271**	**(4.64)**	.0584	.228
11	.064	(0.11)	.5689	**.221**	**(4.55)**	.0485	.325
12	.121	(0.17)	.7266	**.309**	**(5.76)**	.0537	.342
13	.452	(0.49)	.9135	**.294**	**(3.84)**	.0766	.221
14	- .405	(-0.47)	.8561	**.233**	**(3.34)**	.0698	.251
15	.731	(1.02)	.7183	**.207**	**(3.64)**	.0567	.267
17	- .543	(-0.77)	.7058	**.316**	**(5.44)**	.0581	.252
19	- .862	(-1.32)	.6528	**.255**	**(4.41)**	.0578	.285
21	.152	(0.17)	.8738	**.246**	**(3.35)**	.0734	.198
Average	.151			.279			

[a] The predicted initial wages and residuals are estimated using age, education, education squared, AFQT score, an interaction term of education and AFQT score, race, sex, and marital status as explanatory variables.

[b] Dependent variable: logarithm of real current wages for all years of experience, 1 to 18.

[c] All estimated coefficients for $\hat{\varepsilon}_0$ are significant at 1% level. WE omit *** for concision.

[d] In the first step regression of initial wage, we include age, gender (dummy), marital status (dummy), race (dummy), education, education squared, AFQT score, an interaction term of education and AFQT score, and dummies for 'year of starting work'.

Endnotes

[1]   Among these 752 individuals, we only consider those who have started to work no later than 1985. Then we are left with 716 individuals. All 36 individuals excluded from our final sample are high school graduates or less than high school educated. Unless some kind of interruption in schooling happens, these individuals are supposed to finish all schooling by age 18. If they have not started to work by 1985 (age 20-27), it implies that they spend 2-9 years without working. By restricting our sample to those who started working by 1985, we allow only limited years of job searching or after school training after finishing all education. In this way, we may exclude a possible discontinuous career effect on estimation results.

[2]   The remaining results of the initial wage estimation are in Table A1. Post wage estimations are briefly reported in Table A2. In Table A3, results from different specification of initial wage estimations are presented. In short, the results are consistently similar to Table 2.

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Appendix

Table A1. Sample Composition by Year of Starting Work

| Years Since | Year of Starting Work | | | | | | | |
Initial Work	79	80	81	82	83	84	85	Sample Size
1	451	68	19	6	6	9	4	563
2	438	60	18	6	8	9	6	545
3	421	60	19	6	9	9	8	532
4	407	61	20	9	9	10	7	523
5	421	58	17	5	6	10	6	523
6	411	65	19	7	4	9	6	521
7	428	69	23	6	3	9	7	545
8	433	63	20	5	3	11	6	541
9	419	64	21	7	3	11	6	531
10	417	70	24	7	4	9	7	538
11	427	66	22	6	6	10	7	544
12	406	68	25	8	5	12	7	531
13	409	67	25	8	5	13	0	527
14	423	67	25	8	4	0	0	527
15	438	66	27	10	0	0	0	541
17	450	76	29	0	0	0	0	555
19	466	71	0	0	0	0	0	537
21	476	0	0	0	0	0	0	476

[a] The sample size for x year since initial work with x ranging 1 to 21 corresponds to estimation results reported in Table 2. For estimation of x years since initial work, the dependent variables is a post wage at x + year of starting to work. For example, wages in 1982 for workers who have started to work in 1979 and wages in 1983 for workers who have started to work in 1980 and so on are used in the estimation for 3 years since initial work in Table 2.

Table A2. Initial Wage Regression

Variable	(1) Coefficient	t-Ratio	Std. Dev.	(2) Coefficient	t-Ratio	Std. Dev.
Constant	4.293***	17.41	.2465	2.974***	4.57	.6502
Age	.048***	4.02	.0120	.051***	4.22	.0120
Education	.011	.78	.0137	.278**	2.16	.1288
Education^2				- .013**	-2.00	.0067
AFQT	.002***	3.25	.0007	- .005	- .66	.0079
AFQT* Education				- .0007	.98	.0007
White	- .033	- .68	.0482	- .031	- .64	.0481
Male	.256***	8.17	.0313	.249***	7.92	.0314
Married	- .029*	- .79	.0369	- .032	- .87	.0368
Start 79	.705***	5.51	.1278	.688***	5.39	.1278
Start 80	.624***	4.75	.1313	.602***	4.58	.1314
Start 81	.691***	4.88	.1415	.678***	4.80	.1413
Start 82	.305*	1.81	.1684	.277	1.64	.1684
Start 83	.393**	2.23	.1759	.407**	2.31	.1759
Start 84	.365**	2.28	.1594	.345**	2.16	.1595
No. Obs.		697			697	
Adjusted R^2		.240			.244	

[a] Start 79-85 dummies for the year of starting to work between 1979 and 1985.

[b] Result (2) is the first step estimation of initial wage associated with Table 2.

Table A3. Post Wage Regressions (1980-1994, 1996, 1998, 2000)

Yrs Since	Age	Education	AFQT	White	Male	Married	Exp	Exp²
1	-.035	.022	-.0005	.015	-.048	.040		
2	-.036	.013	. 0008	.028	.050	.032	.216***	
3	-.083***	.004	-.0009	.055	-.138	.068	.681**	-.109*
4	-.036	.026	.0013	-.018	.129	.016	.194	-.001
5	-.031	.055***	.0023	-.066	.188	.038	.132	-.005
6	.005	.036*	.0019	.022	.277*	.080*	-.049	.017
7	.007	.062***	.0034*	-.036	.350**	.021	.024	.004
8	.016	.092***	.0041**	.024	.409**	.013	.168**	-.008
9	.014	.033	.0064**	-.079	.361	.022	.142	-.007
10	-.017	.053**	.0036	-.005	.251	.024	-.054	.007
11	.002	.048***	.0028*	-.006	.277*	.027	.086	-.001
12	.006	.052**	.0022	-.032	.268	.080	.213***	-.008**
13	-.011	.012	.0039	-.031	.123	.121*	.122	-.002
14	.058	-.0008	.0045*	-.037	.407*	.081	.048	.002
15	-.022	.014	.0021	.030	.038	.022	.075*	-.0006
17	.028	.071***	.0034	.019	.428**	-.068	.017	.001
19	.042	.073***	.0058***	-.006	.533***	-.005	-.020	.002
21	-.027	.076***	.0040	.070	.189	-.001	.011	.0009

[a] Since the NLSY1979 conducted the survey biannually since 1994, no information about 1995, 1997 and 1999 wages are available.

[b] All of the regressors reported above are included in the regression along with the predicted initial wage, the estimated residual and dummies for each year of starting to work during 1979-1985. Table 2 only presents results of the predicted initial wage and the estimated residual.

[c] Standard errors, t-ratios and results for the start-to-work year dummies are provided upon request.

Years Since Initial Work	Specification II			Specification III		
	$\hat{w}_0$ (t-Ratio)	$\hat{\varepsilon}_0$ (t-Ratio)	Adj. R^2	$\hat{w}_0$ (t-Ratio)	$\hat{\varepsilon}_0$ (t-Ratio)	Adj. R^2
1	.561 (1.65)*	**.451 (11.36)**	.371	.842 (2.34)**	**.447 (11.25)**	.373
2	.318 (.93)	**.495 (12.37)**	.415	.487 (1.37)	**.493 (12.31)**	.415
3	.641 (1.39)	**.374 (6.81)**	.243	1.105 (2.29)**	**.369 (6.72)**	.246
4	.560 (1.20)	**.213 (4.00)**	.230	.497 (.98)	**.212 (3.98)**	.229
5	.241 (.59)	**.314 (6.18)**	.295	.015 (.03)	**.317 (6.22)**	.296
6	-.228 (-.51)	**.417 (7.75)**	.317	-.270 (-.55)	**.419 (7.77)**	.317
7	.356 (.77)	**.238 (4.85)**	.288	.069 (.14)	**.241 (4.88)**	.288
8	.139 (.27)	**.209 (3.73)**	.243	-.500 (-.90)	**.220 (3.89)**	.246
9	.365 (.71)	**.254 (4.52)**	.264	-.170 (-.30)	**.262 (4.61)**	.265
10	.102 (.19)	**.259 (4.33)**	.231	.003 (.01)	**.260 (4.34)**	.231
11	.153 (.35)	**.206 (4.21)**	.324	-.130 (-.27)	**.210 (4.27)**	.324
12	.486 (1.04)	**.296 (5.41)**	.339	.256 (.46)	**.297 (5.42)**	.339
13	.652 (1.07)	**.310 (3.98)**	.226	.351 (.49)	**.313 (3.99)**	.226
14	.992 (1.52)	**.220 (3.06)**	.256	-.120 (-.18)	**.228 (3.16)**	.254
15	.331 (.63)	**.203 (3.53)**	.275	.309 (.54)	**.202 (3.52)**	.275
17	. 284 (.55)	**.292 (4.95)**	.256	-.410 (-.75)	**.301 (5.08)**	.258
19	.369 (.74)	**.236 (3.96)**	.282	-.520 (-.95)	**.246 (4.15)**	.285
21	-.164 (-.26)	**.227 (3.01)**	.198	-.340 (-.49)	**.229 (3.04)**	.199

[a] Specification II: in the first step regression of initial wage, we include only family variables; father's and mother's educational attainment in 1979, the closest sibling's gender and years of education in 1993.

[b] Specification III: in the first step regression of initial wage, we include age, gender (dummy), marital status (dummy), race (dummy), education, education squared, AFQT score, an interaction term of education and AFQT score and starting-to-work year dummies as well as father's and mother's educational attainment in 1979, the closest sibling's gender and years of education in 1993.

[c] All estimated coefficients for $\hat{\varepsilon}_0$ are significant at 1% level. WE omit *** for concision.

[d] Results not presented here are provided upon request.

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