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[†]The views expressed are my own and do not necessarily reflect official positions of the Federal Reserve System

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This research was conducted with restricted access to Bureau of Labor Statistics (BLS) data. The views expressed here do not necessarily reflect the views of the BLS.

Minimum Wages and Occupational Skills Acquired During High School

1. Introduction

Training is important for even low-skilled jobs. Sommers and Morisi (2012) found that only 30 of 446 occupations open to individuals with no more than a high school education required no training. Consequently, almost all jobs that would employ high school students will involve some firm investments in training, and that training is likely to be expensive.[1] The training may have only a transitory effect on earnings, but many papers have shown that working in high school can have a significant effect on earnings years afterward (Ruhm, 1997; Light, 2001; Neumark and Nizalova, 2007; and Baum and Ruhm, 2016). A plausible assumption is that job training completed while in high school can have permanent effects on lifetime earnings.

If true, then government policies that reduce access to training can have long-term adverse consequences for lifetime earnings, while policies that increase training provision would have positive effects. Becker (1964) argued that minimum wages lower firm provision of training. Acemoglu and Pischke (1998, 1999) presented conditions under which minimum wages would increase firm provision of training. This study will examine which of the scenarios holds, using public and restricted geocode data obtained from the National Longitudinal Survey of Youth 1997 (NLSY97).

The novelty of this study lies in its use of the recently developed O*NET database[2] which allows us to convert information on occupations held by high school students into the implied on-the-job training acquired while in high school. This in turn allows us to assess how minimum wages, truancy laws, and local labor market conditions affect the types of jobs offered to high school students and the implied job skills attached to those jobs. We also test whether

[1] Firms spend 4.3% of their payroll on direct training, averaging $1,273 per worker (ATD, 2017).

[2] The O*NET Resource Center has detailed information on the database development including 277 descriptors for each of 974 occupations. See http://www.onetcenter.org/overview.html

these job skills acquired in high school have effects on adult incomes, wages, and occupational skills as suggested by the past studies linking high school employment with subsequent labor market earnings.

Our results strongly support Becker's (1964) prediction that minimum wages will lower the provision of training. The mechanism is not from loss of employment: there is no significant difference in high school employment in high versus low minimum wage states. Instead, firms alter the types of jobs they offer high school students in high minimum wage states so that the filled jobs involve less training. We also show that training in high school persists to raise income, wages, employment and skills as the students age.

Our estimated impact of the minimum wage on adult training and income is modest because students have many years to acquire the training they did not receive in high school. The main avenue for making up for lost job training in high school is through additional schooling in college. Consequently, the students most adversely affected by the lost job training opportunities in high school are those who do not go on to college.

We open the discussion with a review of the literature on the effects of minimum wages on training. We then present a model based on Acemoglu and Pischke (2003) that provides the Becker and Acemoglu-Pischke models as special cases. We use that theory to motivate the data and estimation that follows.

2. Literature Review

Few issues in economics have been investigated more intensively than the effect of minimum wages on employment.[3] And yet recent studies continue to generate incongruent results. Recent highly cited studies of the impacts of rising minimum wages include Giuliano

[3] Google Scholar listed more than 1.6 million results to a search including key words 'minimum wage' and 'employment.'

(2013) who report an increase in teenage employment, Allegretto *et al.* (2011) who report no significant effects, and Neumark *et al.,* (2014) and Meer and West (2016) who both report modest decreases. One source of imprecision in the estimated employment effects is the small fraction of workers for whom the minimum wage binds. Until recent increases in the passage of state minimum wages, there was little variation in the minimum wage over time or in cross-section, and the minimum wage was binding for only a small fraction of the labor market (Autor *et al.,* 2016). Moreover, most of the prominent analysis occurs at the aggregated level which combines workers below and above the new minimum wage thresholds. Because we would expect firms to be substituting away from the subminimum workers toward higher skilled super-minimum workers, the net employment effect combines workers whose employment should be falling with those experiencing rising demand in response to the new minimum. This conflation suggests that the use of aggregated employment data biases downward the estimated employment response. To the extent that any consensus exists, it is that minimum wages likely have small negative effects on low-skill employment at the levels of minimum wages implemented (Neumark and Wascher, 2008).[4]

Less attention has been paid to other responses to rising minimum wages. One recent area of exploration has been the role of minimum wages on worker flows. It appears that minimum wages reduce both the rate of separations and new hires (Brochu and Green, 2013; Dube *et al.*, 2016; Gittings *et al.*, 2016. The resulting decreasing churning rate in the labor market would be expected to lower the rate of productivity growth – fewer potentially rewarding matches will be tried (Pries and Rogerson, 2005; Davis and Haltiwanger, 2014; Lazear and McCue, 2017). [5] In

[4] Recent implementation of substantially higher minimum wages in some cities will offer a better environment in which to test effects.

[5] Churning rate is defined as the sum of the separation rate plus the hiring rate beyond that necessary to meet the needs of job creation and destruction.

addition, the cost of a replacement hire rises, so firms may have an incentive to retain a worker in what otherwise would have been a bad match. However, the average quality of matches rises because less-skilled workers are priced out of the market.

A potential productivity gain from the minimum wage occurs if it increases training. In the Becker (1964) formulation, minimum wages make it more expensive for a firm to invest in training. On the other hand, higher minimum wages can raise the opportunity cost of time spent in schooling or other forms of general training. In addition, the lower hiring rate of less-skilled workers and the possible higher return if hired may induce more low-skilled workers to invest in their own skills (Cahuc and Michel, 1996; Flinn and Mullins, 2015). Firms may even have an enhanced incentive to provide training if the lower probability of separations induced by the minimum wage (or other labor market frictions) that reduce turnover encourage firms to make investments in training. These incentives arise from a firm's ability to capture rents from the worker's improved skill set (Acemoglu and Pischke 1998, 1999).

Empirical evidence on the impact of the minimum wage on training is mixed. Mattila (1982) found positive effects of minimum wages on college but not high school education. Flinn and Mullins (2015) provide supporting evidence based on estimates from their structural model of job search and schooling decisions. Conflicting evidence was reported by Neumark and Nizalova (2007) who found that high school graduates in high minimum wage states were less likely to pursue a college degree.

The limited evidence on the effects of minimum wages on firm provision of training also lacks consensus. Barron *et al.* (1989, 1999) showed that firms paid the majority of the cost of training that occurred within the firm, and they estimated that training costs comprise about 4% of the annual wage bill (ADP, 2017). Using samples of employees or firms, Grossburg and

Sicilian (1999) and Fairris and Pedace (2004) find no impacts of minimum wages on training, while Arulampalan *et al.* (2004) find positive effects. However, reliance on samples of employees or firms can bias results since the analyses focus on impacts only among those who successfully found and retained employment. Acemoglu and Pischke (2003) find small negative effects in a sample that focuses on youth most likely to be affected by the minimum wage. Bellman *et al.* (2017) examine training provided in German establishments that vary in the number of minimum wage workers they employ. They find that firms with higher shares of minimum wage workers are less likely to train. However, firms are selecting whom to hire and whom to train, so the exposure to minimum wage workers is endogenous to the training decision. Neumark and Wascher (2001) did find evidence that young workers receive less firm-provided formal training. However, the adverse effects were concentrated among workers in their early 20s and not teenagers, the focus of our analysis.

Several studies have linked work experiences while in high school to higher earnings later in life (Ruhm, 1997; Light, 2001; and Baum and Ruhm, 2016). If the minimum wage reduces access to work during this period, it can lower future earnings as an adult, as found by Neumark and Nizalova (2007). The existence of a link between work during high school and lifetime earnings is consistent with human capital being acquired through the job. Indeed, Light (1998, 2001) found that working in high school was positively associated with returns to schooling, suggesting complementarities between skills acquired on the job and in school. Nevertheless, measuring the link between work in high school and future labor market success will be complicated by the role of unobserved ability (Stinebrickner and Stinebrickner, 2003; Lee and Orazem, 2010), a result of the fact that firms will have a greater incentive to train more able workers (Barron *et al*. 1989).

This existing work on minimum wages and investments in skill acquisition suggests several issues that must be considered when assessing the effects of minimum wages on training. First, firms in advanced economies invest considerable resources into training their workers (Bassanini *et al.*, 2005). Virtually all jobs involve some training which typically occurs early in the employment relationship and at young ages (Barron *et al.*, 1999). The intensity of training is related to both observed and unobserved ability. Minimum wages alter the incentives to invest in training the least-skilled and may sort out the least able while not affecting training for more able workers. Hence, analysis should focus on relatively less-skilled populations.

Moreover, the minimum wage will also affect the types of jobs offered and ration the availability of those jobs. For example, Aaronson and Phelan (2018) and Lordan and Neumark (2018) find that minimum wages reduce the number of automatable or cognitively repetitive jobs for low-skilled workers. The changing number and distribution of jobs available to less-skilled workers will also affect their likelihood of receiving on-the-job training. The next section provides a model that illustrates these issues.

3. Theory

Acemoglu and Pischke (2003) provide a hybrid model of on-the-job training that includes the Becker (1964) and Acemoglu Pischke (1999) models as special cases. The hybrid model will illustrate the conditions under which a minimum wage increase could increase or decrease firm provision of training. Suppose that workers' natural abilities are continuously distributed $G[\eta_m, \eta^m]$. Workers supply labor inelastically over two periods in which the first period can also involve training. Training, τ, is a dichotomous variable that, if undertaken, costs c in period 1. Trained workers produce added value $\varphi > c$ in period 2. Because the value of training outweighs its cost, training is socially desirable. A worker's natural ability generates output η_i in period 2.

Workers are less productive in period 1 when they produce $\theta\eta_i$, where $0 < \theta < 1$ such that $0 < \theta\eta_i \leq \eta_i$. They gain additional skills attributable to tenure with the firm, δ, which also raises worker output in period 2. While training raises a worker's productivity in all firms, the gains in productivity resulting from job tenure only raise value in the incumbent firm. Hence, δ represents match capital shared by the firm and the worker that limits incentives for the worker to leave.

Firms have the same technologies and compete for workers so that economic profits are zero in equilibrium. The equilibrium wage and training is derived by backward induction. In period 2, workers are paid

$$W_2(\eta_i, \tau = 0) = \eta_i \text{ if they do not train in period 1 and} \quad (1A)$$

$$W_2(\eta_i, \tau = 1) = \eta_i + \varphi \text{ if they do train in period 1.} \quad (1B)$$

Case 1: Only firms can pay for training

Firm profits from hiring the i^{th} worker untrained or trained, respectively, are given by

$$\Pi(\eta_i, \tau = 0) = [\theta\eta_i - W_1(\eta_i)] + [\eta_i + \delta - W_2(\eta_i, \tau = 0)] \quad (2A)$$

$$\Pi(\eta_i, \tau = 1) = [\theta\eta_i - c - W_1(\eta_i)] + [\eta_i + \delta + \varphi - W_2(\eta_i, \tau = 1)] \quad (2B)$$

where W_1 is the first period wage. Substituting in the wages and differencing, we have $\Pi(\eta_i, \tau = 1) - \Pi(\eta_i, \tau = 0) = -c$ which shows that firms cannot profit from providing training. Workers capture all the rewards from training because if the firm does not pay φ to the trained worker, the worker can obtain that offer from another firm. As a result, the firm sets $\tau = 0$. First period wages are set so as to satisfy the zero profit condition at $\tau = 0$:

$$W_1(\eta_i) = \theta\eta_i + \delta. \quad (3)$$

In other words, anticipating the match-specific rent associated with tenure, firms bid up the wage in the first period up to the level that exactly equals the anticipated gain in the second period.

Case 2: Some workers can pay for training

The equilibrium in case 1 is inefficient because training adds social value. Because the worker receives all the rewards from training, the firm has no incentive to invest in training. Suppose, however, that some fraction of workers $\lambda \in [0,1]$ are able to contract with the firm to gain training. Following Becker (1964), they would do so by accepting a wage below their output in the training period and then reaping the reward in the second period. Second period wages would remain as given by (1A) and (1B), but first period wages would become

$$W_1(\eta_i, \tau = 0) = \theta\eta_i + \delta \quad (4A)$$

for the $1 - \lambda$ proportion of workers who do not train and

$$W_1(\eta_i, \tau = 1) = \theta\eta_i + \delta - c \quad (4B)$$

for the λ proportion who do train.

Without constraints on contracting, all workers would pay for training. Because firms neither gain nor lose from the training, however, they have no incentive to enter the training contract. So one reason that $\lambda \neq 1$ is that some fraction of firms may not want to bother with the training provision. In addition, some workers may not be able to borrow against their anticipated future earnings due to credit constraints. Finally, the least skilled for whom $\eta_i \to \eta_m$ may have training wages that are so low (or even negative) that they would be unable to meet their first period consumption requirements.

Case 3: Binding Minimum Wage

If a minimum wage is imposed such that $W_M > \eta_m$, period 2 wages will become

$W_2(\eta_i, \tau = 0) = \max\{W_M, \eta_i\}$ if the worker does not train in period 1 and (5A)

$W_2(\eta_i, \tau = 1) = \max\{W_M, \eta_i + \varphi\}$ if the worker does train in period 1. (5B)

Some of the workers in the training group λ will no longer be able to pay for their training because the minimum wage will prevent them from taking a cut in pay. These workers will be drawn from the lower skilled groups such that

$$W_1(\eta_i, \tau = 1) = \theta\eta_i + \delta - c < W_M, \tag{6}$$

so the fraction or workers self-financing their training will be

$$T^w = \lambda\left[1 - G\left(\frac{W_M - \delta + c}{\theta}\right)\right], \quad \frac{\partial T^w}{\partial W_M} < 0. \tag{7}$$

As the minimum wage rises, the fraction of workers self-financing their education falls.

On the other hand, the minimum wage will provide the firm an incentive to pay for the training of the least skilled workers in the $(1 - \lambda)$ group for whom the minimum wage condition (6) also binds. Within that group, consider the workers for whom $\eta_i \leq W_M - c$. Because training is productive, $c < \varphi$ so there will be some workers whose untrained skills are below $W_M - c$ but who have skills worth more than W_M in period 2. This means that for some workers in the $1 - \lambda$ group, the firm can profitably pay for training. The profitability condition for firms training workers whose first period wage is W_M is

$$(1 + \theta)\eta_i + \delta + \varphi - c - W_M - \max\{\eta_i + \varphi, W_M\} \geq 0. \tag{8}$$

The least these workers would be paid in period 2 is W_M. Applying condition (8), the skill groups for workers who would receive training paid for by the firm under the minimum wage are

$$T^f = (1 - \lambda)\max\left\{0, G(W_M - c) - G\left(\frac{2W_M + c - \delta - \varphi}{1 + \theta}\right)\right\}. \tag{9}$$

For at least some values of the minimum wage, $T^f > 0$, and so increases in the minimum wage can increase the fraction of workers receiving firm-financed training.

This theory illustrates that receipt of training paid for by the firm depends on a worker's ability, with firms paying for the training only of the least skilled. More skilled workers will also receive training by the firm, but they pay for that training with a wage below their period 1

productivity. As the minimum wage rises, less training will be paid for by the workers but more training will be paid for by the firm over at least some range of the minimum wage. At some point, however, further increases in the minimum wage would render all training opportunities unprofitable, whether financed by the firm or the worker.

The model illustrates that if the minimum wage has an effect on training, it will be concentrated among the least skilled workers. Our dataset incorporating the employment and training experiences of high school students fits the model's focus on low skill workers very well.

4. Data

The theory suggests that minimum wages will alter the types of jobs offered by firms. Specifically, it will reduce the number of jobs that would allow the workers to self-finance their training, but it can increase the number of positions involving firm-financed training as a job attribute. Hence, the model suggests that we compare the mix of jobs associated with on-the-job training provided to less-skilled workers across places or time periods with relatively high or low minimum wages.

We test the model using data from the March 2014 release of the National Longitudinal Survey of Youth 1997 (NLSY97). The dataset contains 8,984 respondents who were between 12 and 17 years of age during the first round of the survey in 1997. By 2014, respondents were aged 29 – 34 which means that most were no longer in school and have relevant measures of early economic success. The NLSY97 provides longitudinal data on each respondent's work history, educational attainment, and earnings which will allow us to determine adult economic outcomes as a result of training access while in high school.

We focus on the training that respondents acquired while in high school. We depart from past studies by allocating training based on the individual's occupation during that time. To define job skills acquired during high school, we need to designate which years belong to that period. This is straightforward for high school graduates, but not so for students who drop out of high school or attrite from the sample before graduation. Respondents who did not report a year of graduation were assigned a graduation year at their 18th birthday if they were born January through August, or at their 19th birthday if they were born September through December. Using the proxy for high school graduation year, a representative high school occupation was selected by choosing the job with the most hours worked in the year of graduation. If no job was reported during the graduation year, then the last year with a job was used. Respondents who did not work at any time within the four years preceding their graduation year are treated as not working in high school. Assigned graduation years range from 1997 to 2003. As described below, we link each individual's Standard Occupation Classification for the high school job to the O*NET database of occupational information managed by the U.S. Department of Labor. The O*NET database includes detailed information on the importance of these skills associated with each job.

Similarly, the job with the most hours reported during the most recent survey year was selected as the representative adult occupation. If the respondent did not work within the last year, the occupation with the most hours worked in the previous year was used. If there was no job worked within the last two years, the job with the most hours worked in the last three years was used. If there was no job worked in the past three survey years, the respondent was assumed not to be working.

The choice of working while in high school is endogenous and will depend on unobservable and observable skills as described in the theory. Among other factors, high school

work will depend also on government policy regulating youth employment. We make use of the restricted Geocode supplement file that allows us to merge in measures of the strength of the local youth labor market at the time each individual was in high school. During the period when respondents in our data attended high school, the federal minimum wage increased from $4.75 to $5.15 per hour. State minimum wages during that period varied considerably, with the highest being $6.90 in Washington state.

Equations (7) and (9) indicate that the minimum wage effect depends on its level relative to the distribution of skills and the wage growth over the career. In addition, while prices were not explicitly incorporated into the model, the effect of the same nominal minimum wage will depend on the local price level which will be reflected in area wages. Therefore, in addition to using the minimum wage at the start and completion of the high school period, we include the ratio of the state minimum wage to the average county retail wage. A higher ratio increases the likelihood that the minimum wage binds and limits the ability of workers to finance their training by accepting a lower wage. We complete our characterization of the strength of the local labor market with the local unemployment rate in 1998.

The theory also requires that we control for the respondent's natural ability η_i. Our measure is the score on the Armed Services Vocational Aptitude Battery. Other controls for unmeasured ability include the parents' education and income that are assumed to correlate with their children's skills through human capital transfers. We also include a vector of demographic attributes.

Because local governments may set minimum wages in part to reflect work attitudes and abilities of the local population, we consider additional sources of exogenous variation in labor supply decisions. Lee and Orazem (2010) show that work in high school depends on the age at

which a student starts high school. This starting date is related to the month of birth because states set minimum ages of school entry. A complete summary of all variables used in the analysis appears in Appendix Table A1.

Measuring occupational training while in high school

The O*NET online database contains 277 job descriptors including typical tasks, technology, knowledge, skills, abilities, and work environment encountered. The job descriptors include detailed measures of skills required for performance in each of the 974 occupations including 10 indicators of basic skills, one complex problem solving skill, four resource management skills, six social skills, three system skills, and 11 technical skills.[6] From these 35 indicators, we selected 17 that were commonly present in the types of jobs performed by high school students in our database and that were also commonly found on jobs performed by young adults. Our 17 skill indicators included all the basic and complex problem solving categories and subsets of the skills in resource management, social, and systems categories. Technical skills were too narrowly focused on selected occupations and were excluded. Appendix Table A2 provides a listing of the 17 included skills and brief descriptions.

The O*NET dataset provides two skill measures: the level or mastery of the skill required for the job and the importance of the skill to performance of the job. In practice, the two measures generated similar results. Nevertheless, we focused on the importance measure for this analysis because we are interested in measuring how doing the job involves practice applying these skills in the workplace. O*NET rates each skill on a scale from 1 (not important to the occupation) to 5 (extremely important to the occupation).

[6] For details, see https://www.onetonline.org/find/descriptor/browse/Skills/.

We use principle components analysis (PCA) to generate weighted averages of the 17 skills, where the first set of weights is the eigenvector that explains the greatest amount of the covariation among the 17 factors, the second explains the second most covariation, and so on. The results of the PCA are summarized in Table 1. Following convention, we include all eigenvectors for which the associated eigenvalue is greater than 1. The first three principle components explained 79% of the covariation among the 17 factors. Among these, the first eigenvector explained 61% of the covariation. Since all of the skills entered with positive weights, we designated this component as the "level of general skills." The second eigenvector explained 11% of the covariation among the 17 skill measures. The positive weights were all associated with interpersonal skills, and we label them accordingly. The third eigenvector explained 8% of the covariation, with positive weights attached to skills related to managerial talents.

We performed a comparable analysis using the adult occupations. Only two eigenvectors had eigenvalues greater than 1. As with the youth aggregations, the first two were related to general skills and interpersonal skills, explaining 69% and 8%, respectively, of the covariation among adult occupations.

5. Testing whether the minimum wage raises or lowers job training

The theory shows not only that that the minimum wage can either increase or decrease training, but also that it may change the probability that a low-skill individual is employed. The same skills that affect the likelihood of being trained will affect the probability of finding a job. Because we observe training only for individuals who are employed, we ought to correct our training assessment for the nonrandom sorting of high school students into the labor market. We specify labor force participation while in high school as

$$L_{ijt} = P'_{jt}\beta_P + \beta_\eta \eta_i + R'_{ijt}\beta_R + Z'_{ijt}\beta_Z + e^L_{ijt} \quad (10)$$

where L_{ijt} is a dichotomous variable that takes the value of 1 if student *i* in market *j* and time *t* worked while in high school, P'_{jt} is a location specific measure of the rewards for participating in the labor force, η_i is the measure of the student's ability, R_{ijt} is a vector of regulations that can limit access to the labor market based on age, Z_{ijt} is a vector of household and demographic attributes, and e^L_{ijt} captures unobserved influences on participation. Elements of the vector of rewards measures include the current county unemployment rate, the local minimum wage relative to the average wage in retail, and the prevailing local minimum wage in the first and last year of high school. Again, our measure of worker ability is the student's score on the Armed Services Vocational Aptitude Battery. The regulatory measures include dummy variables for the month of birth and the year of birth, the state truancy age, and the measures of the relevant minimum wage during high school. The remaining variables are controls for parental education, race or ethnicity, gender, and census region. Results of a probit estimation of Equation (10) are reported in Table 2.

The results show that higher minimum wages did not lower the probability of employment during high school. In fact, the coefficients suggest that high school students were more likely to work at some time during their four high school years in states with higher minimum wages, although the estimated effect is not statistically significant at standard significance levels. High school students were more likely to work in states that do not require attendance after age 16. High county unemployment rates lowered the probability of working. The most able, as measured by their Armed Services test score, were most likely to work.

There are significant differences in the probability of working depending on month of birth, with those born early in the year less likely to work and those born later in the year more

likely to work. The latter are more likely to be held back for school entry and so will start high school at an older age. Individuals in states with more restrictive truancy laws are less likely to work, as are youth in areas with higher unemployment rates.

Do minimum wages raise or lower job training for high school students?

Conditional on working, we can test the hybrid theory of Equations (7) and (9) that minimum wages may raise or lower training. Our selection process includes the vector of monthly date of birth dummy variables which we use to generate exogenous variation in the probability of working while in high school while assuming on-the-job training is not offered based on birth month. Let T_{ijt}^{k} be the k^{th} type of training undertaken by individual *i* in location *j* and year *t.* These measures are generated by the weighted sum of the occupational attributes as described in Table 1. We specify the equation

$$T_{ijt}^{k} = \gamma_{Mk} W_{M}^{jt} + \gamma_{\eta k}\eta_i + Z'_{ijt}\gamma_{Zk} + \gamma_{\lambda k}\lambda_{ijt} + e_{ijkt}^{T} \qquad (11)$$

where W_{M}^{jt} is the minimum wage relative to the local retail wage, η_i is the measure of individual ability, Z_{ijt} is the vector of demographic and household controls, and λ_{ijt} is the selection correction based on Equation (10). We present the results for each of our three measures of training in Table 3.

For each of our measures of training obtained on a job while in high school, the minimum wage relative to the local retail minimum wage significantly reduces training. This occurs even though high school students were no less likely to work in the high minimum wage states. The mechanism in our sample is that a higher minimum wage changes the type of jobs offered to high school graduates. High school students in high minimum wage states are given jobs that involve less skill acquisition. We report the magnitude of the minimum wage effect on training at the bottom of Table 3. The decline in general skills is modest at -3.7%, but the decline in

interpersonal and managerial skills acquired on high school jobs as a result of higher minimum wages is much more substantial.

In the model, higher ability workers are able to finance their training by accepting a lower wage in exchange for firm training as long as the minimum wage does not constrain the contract space. Consistent with that hypothesis, the higher skilled students as measured by the Armed Services test were the most likely to work. Students whose parents were more educated and had higher incomes were also more likely to acquire general and interpersonal skills, consistent with the hypothesis if there is intergenerational transfer of human capital.

The purpose of this section is to test whether higher minimum wages lowers training as predicted by the Becker (1964) model or raises firm training as predicted by Acemoglu and Pischke (1998, 1999). The result of the test is clearly in favor of the Becker prediction. Higher minimum wages lower all types of training: general, interpersonal and managerial.

6. Does job training in high school have persistent value?

It remains to show that these training measures actually matter for lifetime labor market outcomes. Ruhm (1997), Light (2001) and Baum and Ruhm (2016) among others have shown that working in high school is positively correlated with favorable adult outcomes. The presumption is that high school work generates work-related skills that persist into adulthood. Table 3 shows that minimum wages reduce occupation-specific skill generation. Next, we illustrate that these skills acquired in high school can generate the long-term benefits such as later earnings previously associated with working while in high school. Let A^n_{ijt+T} be the n^{th} adult outcome *T* years after the expected high school graduation date. The adult outcomes include the skill content of the adult job, hourly wage and income earned as an adult, and whether or not the individual has a job as an adult. Our specification is

$$A^n_{ijt+T} = \sum_{k=1}^{3} \psi_k T^k_{ijt} + \psi_{\eta n}\eta_i + Z'_{ijt}\psi_{Zn} + e^A_{ijnt} \quad (12)$$

where ψ_k captures the effect of training while in high school on adult outcomes. If training obtained while in high school matters for lifetime earnings, employment, or adult skills, then $\psi_k > 0$ for that outcome.

We report the estimated impacts of training while in high school on adult income, adult hourly pay, and adult job skills in Table 4. Although the measures are not always individually significant, they are jointly significant in all cases. General skills and managerial skills acquired in high school have persistent positive effects on adult incomes. High school general skills also raise adult wages and employment prospects and the stock of general skills as an adult. High school interpersonal skills only significantly raise adult interpersonal skills. At the bottom of Table 4, we measure the percentage change in adult outcomes associated with high school acquired skills. The wage and income effects are more modest than the ones found by Ruhm (1997), Light (2001) and Baum and Ruhm (2016), but they are not small. Moreover, they show more directly that job skills earned in high school are related to permanent income gains as adults.

We showed in Table 3 that minimum wages affect the types of jobs offered to high school graduates in that employers in high minimum wage states offer jobs with fewer required skills. We can estimate the magnitude of he minimum wage effects on adult outcomes through training by computing $\frac{\partial A_{ijt+T}^{n}}{\partial T_{ijt}^{k}} \cdot \frac{\partial T_{ijt}^{k}}{\partial W_{M}^{jt}}$ using the coefficients on training in Table 4 and the coefficient on minimum wages in Table 3. The estimates reported at the bottom of Table 4 are quite small. Lifetime income is only 0.1% lower on average due to lost job training in high school attributable to minimum wages. This is not surprising. Workers have a lifetime to make up for lost training opportunities while in high school with additional schooling and job training. Moreover, we are averaging the effects across all high school students, whether they work or not.

Our population estimates will be larger if we focus only on the directly affected population who worked while in high school.

We can illustrate this point by dividing the sample into the group that did not go to college versus the group that completed at least a four-your college degree. High school training will be most important for the 43% of the sample who did not gain any schooling beyond high school. We report these results in Table 5. The permanent effects of training on adult income and wages are concentrated on the group that stopped with the high school degree. Hence, the long-term costs of the minimum wage are borne most by the least-educated who do not replace potential lost job training in high school with further schooling.

7. Conclusion

This study shows that job training in high school can have persistent favorable impacts on adult outcomes. On average, skills acquired in high school jobs increased adult incomes by 7.5% and adult hourly wages by 16%. These estimates are somewhat smaller than previously reported effects of working in high school on adult earnings, but they are large enough to suggest that on-the-job training in high school is an important reason for the persistence in high school earnings later in life.

We also provide evidence that minimum wages limit on-the-job training received in high school. This is consistent with the predictions of Becker's (1964) theory of firm-specific human capital but conflicts with the Acemoglu and Pischke (1998, 1999) model that minimum wages could raise firm-sponsored training. Nevertheless, our estimated effects of the minimum wage on lifetime earnings are small, mainly because students have plenty of time later in their careers to make up for any foregone opportunity to acquire human capital while in high school.

The estimated adverse effects of the minimum wage are largest for groups that did not go on to college. This finding is especially concerning in the context that the labor force participation rate of teens aged 16-19 declined to 35% in 2016 from 53% in the early 1990s and is projected to decline further to 32% by 2026.[7] This drop in teen labor market activity is much larger than the increase in time spent in school, so these changes are primarily due to changes in time use away from school. While increased time spent in extracurricular activities such as sports, school-related functions, and other productive uses of time can also augment a teen's skill development, decreasing time spent in work while in school could affect long-term future earnings, particularly among those not going on to college.

[7] Estimates from the U.S. Bureau of Labor Statistics are reported at http://www.bls.gov/emp/ep_table_303.htm.

References

Aaronson, Daniel, and Brian J. Phelan. 2018. "Wage Shocks and the Technological Substitution of Low-Wage Jobs." *Economic Journal,* Forthcoming.

Acemoglu, Daron, and Jörn-Steffen Pischke. 1998. "Why do firms train? Theory and evidence." *The Quarterly Journal of Economics* 113(1): 79-119.

Acemoglu, Daron, and Jorn-Steffen Pischke. 1999. "Beyond Becker: training in imperfect labour markets." *The Economic Journal* 109(453): 112-142.

Acemoglu, Daron, and Jörn-Steffen Pischke. 2003. "Minimum wages and on-the-job training." in S.W. Polachek, ed. *Worker Well-Being and public policy*. Emerald Group Publishing Limited.

Allegretto, Sylvia A., Arindrajit Dube, and Michael Reich. 2011. "Do minimum wages really reduce teen employment? Accounting for heterogeneity and selectivity in state panel data." *Industrial Relations: A Journal of Economy and Society* 50(2): 205-240.

Arulampalam, Wiji, Alison L. Booth, and Mark L. Bryan. 2004. "Training and the new minimum wage." *The Economic Journal* 114(494): C87-C94.

Association for Talent Development (ATD). 2017. *2017 State of the Industry*

Autor, David, H., Alan Manning, and Christopher L. Smith. 2016. "The contribution of the minimum wage to US wage inequality over three decades: a reassessment." *American Economic Journal: Applied Economics* 8(1): 58-99.

Barron, J.M., Berger, M.C. and Black, D.A., 1999. "Do workers pay for on-the-job training?" *Journal of Human Resources* 34(2): 235-252.

Barron, John M., Dan A. Black, and Mark A. Loewenstein. 1989. "Job matching and on-the-job training." *Journal of Labor Economics* 7(1): 1-19.

Bassanini, Andrea, Alison L. Booth, Giorgio Brunello, Maria De Paola, and Edwin Leuven. 2005. *Workplace training in Europe*. IZA Discussion Paper No. 1640.

Baum, Charles L., and Christopher J. Ruhm. 2016. "The Changing Benefits of Early Work Experience." *Southern Economic Journal* 83(2): 343-363.

Becker, Gary S. 1964. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* New York: National Bureau of Economic Research.

Bellmann, Lutz, Mario Bossler, Hans-Dieter Gerner, and Olaf Hübler. 2017. "Training and minimum wages: first evidence from the introduction of the minimum wage in Germany." *IZA Journal of Labor Economics* 6(8): 1-22.

Brochu, Pierre, and David A. Green. 2013. "The impact of minimum wages on labour market transitions." *The Economic Journal* 123(573): 1203-1235.

Cahuc, P. and Michel, P., 1996. Minimum wage unemployment and growth. *European Economic Review*, *40*(7): 1463-1482.

Davis, Steven J. and John C. Haltiwanger. 2014. "Labor market fluidity and economic performance." National Bureau of Economic Research, w20479.

Dube, Arindrajit, T. William Lester, and Michael Reich. 2016. "Minimum wage shocks, employment flows, and labor market frictions." *Journal of Labor Economics* 34(3): 663-704.

Fairris, David, and Roberto Pedace. 2004. "The impact of minimum wages on job training: an empirical exploration with establishment data." *Southern Economic Journal* 70(3): 566-583.

Flinn, Christopher, and Joseph Mullins. 2015. "Labor market search and schooling investment." *International Economic Review* 56(2): 359-398.

Gittings, R. Kaj, and Ian M. Schmutte. 2016. "Getting handcuffs on an octopus: Minimum wages, employment, and turnover." *Industrial and Labor Relations Review* 69(5): 1133-1170.

Giuliano, Laura. 2013. Minimum wage effects on employment, substitution, and the teenage labor supply: Evidence from personnel data. *Journal of Labor Economics*, 31(1): 155-194.

Gorry, Aspen. 2013. “Minimum wages and youth unemployment.” *European Economic Review* 64(1): 57-75.

Grossberg, A.J. and Sicilian, P., 1999. Minimum wages, on-the-job training, and wage growth. *Southern Economic Journal*, 65(3): 539-556.

Lazear, Edward P., and Kristin McCue. 2017. “Hires and Separations in Equilibrium.” National Bureau of Economic Research, w23059.

Lee, Chanyoung, and Peter F. Orazem. 2010. “High School Employment, School Performance, and College Entry.” *Economics of Education Review* 29(1): 29-39.

Light, Audrey. 1998. “Estimating returns to schooling: When does the career begin?.” *Economics of Education Review* 17(1): 31-45.

Light, Audrey. 2001. “In-school work experience and the returns to schooling.” *Journal of Labor Economics* 19(1): 65-93.

Lordan, Grace, and David Neumark. 2018. “People versus Machines: The Impact of Minimum Wages on Automatable Jobs.” *IZA Discussion Paper No. 11297.*

Lordan, Grace, and David Neumark. 2018. “People versus Machines: The Impact of Minimum Wages on Automatable Jobs.” *IZA Discussion Paper No. 11297.*

Mattila, J. Peter. 1982. “Determinants of male school enrollments: A time-series analysis.” *The Review of Economics and Statistics* 64(2): 242-251.

Meer, Jonathan, and Jeremy West. 2016. “Effects of the minimum wage on employment dynamics.” *Journal of Human Resources* 51(2): 500-522.

Neumark, David, and Olena Nizalova. 2007. “Minimum wage effects in the longer run.” *Journal of Human Resources* 42(2): 435-452.

Neumark, David, JM Ian Salas, and William Wascher. 2014. “Revisiting the Minimum Wage—Employment Debate: Throwing Out the Baby with the Bathwater?” *Industrial and Labor Relations Review* 67, Supplement: 608-648.

Neumark, David, and William Wascher. 2001. “Minimum wages and training revisited.” *Journal of Labor Economics* 19(3): 563-595.

Neumark, D. and Wascher, W., 2003. Minimum wages and skill acquisition: Another look at schooling effects. *Economics of Education Review* 22(1): 1-10.

Neumark, David, Wascher, William. 2008. Minimum Wages. Cambridge, MA: MIT Press.

Occupational Information Network. *O*NET Resource Center*. https://www.onetonline.org/.

Pries, Michael, and Richard Rogerson. 2005. “Hiring policies, labor market institutions, and labor market flows.” *Journal of Political Economy* 113(4): 811-839.

Ruhm, Christopher J.1997. “Is high school employment consumption or investment?.” *Journal of Labor Economics* 15(4): 735-776.

Sommers, Dixie, and Teresa L. Morisi. 2012. “Employment projections through the lens of education and training.” *Monthly Labor Review* 135(4): 13-28.

Stinebrickner, Ralph, and Todd R. Stinebrickner. 2003. “Working during school and academic performance.” *Journal of Labor Economics* 21(2): 473-491.

U.S. Bureau of Labor Statistics. *National Longitudinal Survey of Youth*. Retrieved from NLSY97: http://nlsinfo.org/content/cohorts/NLSY97.

U.S. Department of Commerce, Bureau of Economic Analysis, “County Estimates of Compensation by Industry.

U.S. Department of Labor. *History of Federal Minimum Wage Rates Under the Fair Labor Standards*.

Table 1. Principal component analysis of O*NET skill importance level

Importance Rating:	Youth (N = 7,987)			Adult (N = 7,162)	
	1	2	3	1	2
Skill*	**General**	**Interpersonal**	**Managerial**	**General**	**Interpersonal**
Critical Thinking	0.246	-0.294	-0.016	0.260	-0.242
Time Management	0.224	-0.285	0.201	0.242	-0.189
Judgement and Decision-making	0.260	-0.187	0.088	0.265	-0.202
Complex Problem Solving	0.238	-0.261	-0.293	0.249	-0.249
Monitoring	0.229	-0.220	-0.084	0.243	-0.127
Coordination	0.243	-0.097	-0.251	0.247	0.051
Management of Personnel Resources	0.230	-0.197	0.336	0.238	-0.183
Reading Comprehension	0.250	-0.124	-0.026	0.249	-0.154
Writing	0.264	-0.119	0.043	0.255	-0.122
Mathematics	0.126	0.159	0.774	0.151	-0.196
Speaking	0.268	0.258	-0.110	0.261	0.216
Persuasion	0.245	0.320	-0.163	0.238	0.307
Negotiation	0.259	0.226	0.051	0.249	0.216
Social Perceptiveness	0.255	0.263	-0.182	0.241	0.334
Service Orientation	0.208	0.449	0.062	0.178	0.566
Active Listening	0.261	0.276	-0.047	0.258	0.200
Active Learning	0.279	-0.106	0.030	0.268	-0.115
Eigenvalue:	10.4	1.93	1.16	11.7	1.42
Proportion of Covariance	61.1%	11.3%	6.8%	69.1%	8.4%
Cumulative Proportion	61.1%	72.4%	79.2%	69.1%	77.5%

*See Table A2 for the full list of skills and descriptions.

Table 2. Probit estimation of the probability of working at any time while in high school

Variable Name	**Marginal Effects (Std. Err.)**	**Elasticities**
Relative Minimum Wage	0.739* (0.392)	0.0371* (0.0195)
Minimum Wage first year of High School	-0.026 (0.0559)	-0.0289 (0.062)
Minimum Wage last year of High School	0.116 (0.101)	0.115 (0.0999)
Residing in a state that requires students to be enrolled until age 17	-0.130** (0.0628)	-0.0034* (0.0018)
Residing in a state that requires students to be enrolled until age 18	-0.0112 (0.046)	-0.0009 (0.0039)
Unemployment Rate in 1998	-0.0028** (0.0007)	-0.0347** (0.0088)
Birth Month Dummies:	included	included
Birth Year	-0.242** (0.0698)	-99.8** (28.9)
ASVAB percentile	0.517** (0.0849)	0.0268** (0.0039)
Highest grade completed by either biological parent	-0.0068 (0.0042)	-0.0168 (0.0105)
Parents' Gross Household Income (x10,000)	0.0164** (0.0058)	0.006**
Graduation Year	0.224** (0.0712)	93.3** (29.8)
Male	-0.0119 (0.0367)	-0.0037 (0.0114)
Joint test of minimum wage effects $\chi^2(3)$	5.56	
N	8,842	
Pseudo R^2	.058	

Standard errors in parentheses. ** $p < 0.05$, * $p < 0.10$
Includes controls for missing values for parental income and education and missing Armed Services Vocational Aptitude Battery, and controls for race and region of the country.

Table 3. Selection bias corrected estimates of the impacts of the minimum wage and demographics on the acquisition of skills

Dependent Variable:	**General skills**	**Interpersonal skills**	**Managerial skills**
Relative Minimum Wage	-2.1241** (0.284)	-0.512** (0.150)	-0.2869** (0.124)
Minimum Wage first year of High School	0.0150 (0.015)	-0.0304 (0.022)	-0.0126 (0.018)
Minimum Wage last year of High School	0.0031 (0.073)	-0.0227 (0.039)	0.0147 (0.032)
Residing in a state that requires students to be enrolled until age 17	-0.0678 (0.050)	-0.0089 (0.026)	0.042* (0.022)
Residing in a state that requires students to be enrolled until age 18	-0.0289 (0.034)	-0.0001 (0.018)	0.0011 (0.015)
Unemployment Rate in 1998	0.0003 (0.001)	-0.0007** (0.000)	2.20e-6 (0.000242)
ASVAB percentile	0.0043** (0.001)	0.0017** (0.000315)	0.0001 (0.019)
Highest grade completed by either biological parent	0.0172** (0.004)	0.0016 (0.002)	-0.0048** (0.002)
Parents' Gross Household Income (x10,000)	0.068** (.034)	0.011 (0.018)	-0.027* (0.015)
Graduation Year	-0.0024 (0.020)	0.01 (0.011)	-0.0065 (0.009)
Male	0.623** (0.028)	0.321** (0.015)	0.152** (0.012)
Lambda (λ)	-0.206** (0.105)	0.621** (0.011)	-0.0337 (0.077)
Minimum wage effect at sample means	-3.8%	-73.0%	-10.6%
N	8,842	8,842	8,842

Standard errors in parentheses. ** $p < 0.05$, * $p < 0.10$
Includes controls for missing values for parental income and education and missing Armed Services Vocational Aptitude Battery, along with controls for race and region of the country.

Table 4. Estimated impacts of youth-acquired job skills on adult outcomes

Regression:	Linear	Linear	Probit	Linear	Linear
Dependent Variable	**ln(Adult income)**	**ln(adult hourly pay)**	**Working as Adult**	**Adult general skills**	**Adult interpersonal skills**
High school general skills	0.0694** (0.0166)	0.0382** (0.0071)	0.0086** (0.0037)	0.331** (0.1083)	0.007 (0.0063)
High school interpersonal skills	-0.0559 (0.0352)	-0.0421** (0.015)	0.008 (0.0077)	0.257 (0.230)	0.0563** (0.0134)
High school managerial skills	0.0888** (0.0369)	0.0141 (0.0157)	-0.0036 (0.0081)	-0.141 (0.241)	-0.0183 (0.0141)
Male	0.381** (0.0416)	0.171** (0.0177)	0.0004 (0.009)	-0.523* (0.271)	-0.243** (0.0158)
Adult Age	0.820* (0.485)	0.0755 (0.206)	0.467** (0.0898)	37.7** (2.5105)	1.42** (0.147)
(Adult Age)^2	-0.0114 (0.0085)	-0.0004 (0.0036)	-0.0067** (0.0016)	-0.613** (0.0442)	-0.0232** (0.0026)
Highest grade completed by either biological parent	-0.0058 (0.0058)	0.0055** (0.0025)	-0.0002 (0.0013)	0.023 (0.0385)	-0.0005 (0.0023)
Parents' Gross Household Income (ten thousands)	0.0325** (0.0046)	0.0134** (0.002)	0.0014 (0.0011)	0.0529* (0.0307)	-0.0032* (0.0018)
ASVAB percentile	0.810** (0.0839)	0.407** (0.0357)	0.0411** (0.0185)	2.28** (0.551)	-0.105** (0.0322)
Number of Observations	6,247	6,276	7,987	7,987	7,987
R^2	0.087	0.095	0.17	0.18	0.11
Joint Significance high school skills	8.17**	10.9**	8.57**	4.46**	7.83**
Joint effect of high school skills (%)	7.5%	16.0%	12.9%	62.5%	25.8%
Minimum wage effect at sample means (%)	-0.1%	0.0%	-0.8%	-3.8%	-6.1%

Standard errors in parentheses. ** $p < 0.05$, * $p < 0.10$. Pseudo-R^2 is reported for the limited dependent variable equation on labor force participation.
Regressions include all variables specified in Table 3.

Table 5. Separate estimation of adult outcomes by completed education level

	ln(adult income)		ln(adult hourly pay)		Probability of Working as an Adult		Adult General Skills		Adult Interpersonal Skills	
Variable Name	< 13 Years	> 15 years	< 13 Years	> 15 years	< 13 Years	> 15 years	< 13 Years	> 15 years	< 13 Years	> 15 years
High school general skills	0.084*** (0.029)	0.017 (0.026)	0.038*** (0.012)	0.020* (0.012)	0.209 (0.164)	-0.012 (0.010)	0.075 (0.187)	0.209 (0.164)	-0.012 (0.010)	0.011 (0.011)
High school interpersonal skills	-0.072 (0.060)	0.029 (0.056)	-0.026 (0.024)	-0.012 (0.026)	0.266 (0.357)	0.071*** (0.021)	0.174 (0.381)	0.266 (0.357)	0.071*** (0.021)	0.008 (0.025)
High school managerial skills	0.089 (0.063)	0.057 (0.060)	-0.0001 (0.026)	0.025 (0.027)	-0.008 (0.381)	-0.037* (0.022)	0.075 (0.187)	0.209 (0.164)	-0.012 (0.010)	0.011 (0.011)
Number of Observations	2,470	1,933	2,471	1,934	3,291	2,133	3,291	2,133	3,291	2,133
R^2	0.091	0.055	0.079	0.051	0.186	0.178	0.196	0.124	0.146	0.072
Joint significance of high school skills	3.72**	0.61	3.49**	1.23	0.04	2.18	0.20	0.87	4.48**	0.37

Standard errors in parentheses. ** $p < 0.05$, * $p < 0.10$. Pseudo-R^2 is reported for the limited dependent variable equation on labor force participation. Regressions include all variables specified in Table 3.

Appendices

Table A1. Variable names and descriptions

Variable Name	Description
ln(AdultOccInc)	Natural log of the total income from the chosen adult occupation. Total income from the occupation calculated by multiplying total hours by hourly pay.
ln(HrlyPayAdult)	Natural log of the hourly pay from the chosen adult occupation.
Minimum Wage	The local minimum wage the first year of high school
Relative Minimum Wage	The ratio of the state minimum wage to the average retail compensation by county
Not Truant at 17	States that require students to remain enrolled until age 17
Not Truant at 18	States that require students to remain enrolled until age 18
Male	1 if male
AdultAge	Age of adult during survey the year from which adult occupation was chosen. Found by subtracting birth year from survey year.
$(AdultAge)^2$	(AdultAge)x(AdultAge)
dNoWorkHS	1 if did not work in high school (determined to have worked if had positive high school occupation code)
WorkAdult	1 if work as adult (determined as working if have positive adult occupation code)
dUrbanHS	1 if lived in an urban area during survey from which high school occupation was chosen
dNEHS	1 if lived in the northeast during survey from which high school occupation was chosen
dSouthHS	1 if lived in the south during survey from which high school occupation was chosen
dWestHS	1 if lived in the west during survey from which high school occupation was chosen
dGED	1 if highest degree received is a GED
dHS	1 if highest degree received is a high school diploma (regular 12 year program)
dAssoc	1 if highest degree received is from associate/junior college (AA)
dBach	1 if highest degree received is a bachelor's degree (BA, BS)
dMaster	1 if highest degree received is a master's degree (MA, MS)
dPhD	1 if highest degree received is a PhD
dPro	1 if highest degree received is a professional degree (DDS, JD, MD)
dBlack	1 if race/ethnicity is black
dHispanic	1 if race/ethnicity is Hispanic
dNBNH	1 if race/ethnicity is non-black, non-Hispanic
TtlHrsHS	Total hours worked at chosen high school job. Found by multiplying hours per week by total number of weeks worked.
CumulativeHrsHS	Cumulative hours worked during high school/teen years
HighestParentHGC	Highest grade completed by either biological parent
dParentHGCMissing	1 if missing information for parent's highest grade completed

Table A1, continued. Variable names and descriptions

Variable Name	Description
GrossHHIncHS	Gross household income reported in survey from which high school occupation was chosen
dHHIncHSMissing	1 if missing information for gross household income during high school
ASVAB	Percentile score on ASVAB
dASVABMissing	1 if missing value for ASVAB percentile
HS importance rating of General Work Experience	The created skills variable from component 1 of the principal component analysis on the importance ratings of the chosen skills, high school job.
HS importance rating of Interpersonal Skills	The created skills variable from component two of the principal component analysis on the importance ratings of the chosen skills, high school job.
HS importance rating of Managerial Skills	The created skills variable from component three of the principal component analysis on the importance ratings of the chosen skills, high school job.
HS level rating of General Work Experience	The created skills variable from component 1 of the principal component analysis on the level ratings of the chosen skills, high school job.
HS level rating of Managerial Skills	The created skills variable from component two of the principal component analysis on the level ratings of the chosen skills, high school job.
Adult importance rating of General Work Experience	The created skills variable from component 1 of the principal component analysis on the importance ratings of the chosen skills, adult job.
Adult importance rating of Interpersonal Skills	The created skills variable from component 2 of the principal component analysis on the importance ratings of the chosen skills, adult job.
Adult level rating of General Work Experience	The created skills variable from component 1 of the principal component analysis on the level ratings of the chosen skills, adult job.

Table A2. Descriptions and abbreviations for chosen skills. Descriptions come directly from the O*NET database

Skill	Abbr.	Description*
Critical Thinking	CT	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
Time Management	TM	Managing one's own time and the time of others.
Judgment and Decision Making	JDM	Considering the relative costs and benefits of potential actions to choose the most appropriate one.
Active Listening	ALST	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
Active Learning	ALRN	Understanding the implications of new information for both current and future problem-solving and decision-making.
Complex Problem Solving	CPS	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
Speaking	S	Talking to others to convey information effectively.
Monitoring	M	Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
Reading Comprehension	RC	Understanding written sentences and paragraphs in work related documents.
Coordination	C	Adjusting actions in relation to others' actions.
Persuasion	P	Persuading others to change their minds or behavior.
Negotiation	N	Bringing others together and trying to reconcile differences.
Writing	W	Communicating effectively in writing as appropriate for the needs of the audience.
Mathematics	MTH	Using mathematics to solve problems.
Social Perceptiveness	SP	Being aware of others' reactions and understanding why they react as they do.
Service Orientation	SO	Actively looking for ways to help people.
Management of Personnel Resources	MPR	Motivating, developing, and directing people as they work, identifying the best people for the job.

*Descriptions from http://www.onetonline.org/find/descriptor/browse/Skills/.

Table A3. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Adult importance rating of interpersonal skills	8,984	0.393	0.708	-1.24	2.90
Adult importance rating of general skills	8,984	6.18	13.0	-45.0	17.0
Hourly Adult Wage in chosen occupation (natural log)	6,892	2.64	0.697	-4.60	9.32
Annual Adult Wage in chosen occupation (natural log)	6,856	10.9	1.62	2.13	19.6
Probability of Working as an Adult	8,984	0.786	0.410	0.000	1.00
Adult importance rating of general skills	8,984	6.18	13.0	-45.0	17.0
High school importance rating of general skills	7,987	11.5	1.27	8.48	16.2
High school importance rating of interpersonal skills	7,987	0.537	0.6012	-1.16	2.47
High school importance rating of managerial skills	7,987	0.504	0.537	-0.875	1.81
Male	8,984	0.512	0.500	0.000	1.00
Adult Age	8,984	28.4	1.61	25.0	31.0
Adult Age Squared	8,984	811	91.4	625	961
High School in Northeastern Census Region	8,984	0.170	0.376	0.000	1.000
High School in Southern Census Region	8,984	0.376	0.484	0.000	1.000
High School in Western Census Region	8,984	0.219	0.414	0.000	1.000
Race Ethnicity Black	8,984	0.260	0.439	0.000	1.000
Race Ethnicity Hispanic	8,984	0.212	0.409	0.000	1.000
Highest grade completed by either biological parent	8,984	12.3	5.38	-4.00	95.0
Parents' Gross Household Income (10 thousands)	8,984	2.93	4.99	-0.001	42.6
ASVAB percentile	8,984	0.358	0.318	0.000	1.000
Missing ASVAB value	8,984	0.210	0.408	0.000	1.000
Missing value for parent's highest grade completed	8,984	0.053	0.225	0.000	1.000
Missing value for gross household income	8,984	0.458	0.498	0.000	1.000
Cumulative hours worked during high school/teen years	8,984	2.96	2.20	0.000	8.000
Total hours worked at chosen high school job. Found by multiplying hours per week by total number of weeks worked.	8,984	1.06	1.23	0.000	6.500
Years of Education	8,364	13.3	2.91	5.00	20.0