Illinois Wesleyan University
Digital Commons @ IWU

Honors Projects

Economics Department

2014

The Effects of Background Factors on AFQT Score

Jaret Kanarek

Illinois Wesleyan University, jkanarek@iwu.edu

Recommended Citation

The Effects of Background Factors on AFQT Score
Jaret Kanarek
Illinois Wesleyan University
Honors Research, Economics Department
April 2014

Project Advisor:
Professor Michael Seeborg, Economics Department.

Research Honors Committee:
Professor Craig Broadbent, Economics Department
Professor Mark Criley, Philosophy Department
Professor Robert Leekley, Economics Department
Professor Michael Seeborg, Economics Department

ABSTRACT: The introduction of the National Longitudinal Survey of the Youth (NLSY) 1979 and 1997 cohorts made Armed Forces Qualifications Test (AFQT) score data widely available and has thus dramatically increased its use in academic research. However, there is strong evidence that a wide variety of background factors, such as poverty status, race, and parent's education level, affect AFQT score. Human capital theory, in conjunction with the pathways framework, suggests that these background factors have both direct and indirect effects on AFQT score. The focus of this research is measuring some of the important direct and indirect pathways through which background factors affect AFQT score. The purpose of measuring these pathways is to identify the effects that some background factors have on AFQT score, thus elucidating how AFQT score is determined by some background factors.

I. Introduction & Literature Review

The introduction of the National Longitudinal Survey of Youth 1979 Cohort (NLSY) made Armed Forces Qualifications Test score data widely available and has thus dramatically increased their use in academic research (Blackburn, 2004). Blackburn (2004) aptly notes that the AFQT is generally assumed to measure human capital skills and, as a result, is often used as a proxy for human capital skills. The AFQT is comprised of four sections—word knowledge, paragraph comprehension, arithmetic reasoning, and numerical operations—to all of which the human capital theory is uniquely attuned.

However, a wide range of factors, including family background, educational attainment, personal choices, and social circumstances, influence AFQT score. Blackburn (2004) demonstrates how differences in race, for example, can predict AFQT scores: whereas, individuals who are black and Hispanic typically perform worse on the AFQT than do white individuals. Neal & Johnson (1996), alternatively, find that AFQT scores are affected by educational attainment and family socioeconomic circumstances. Indeed, many researchers emphasize the importance of socioeconomic circumstances as central to interpreting AFQT scores (Caspi, Moffitt, Silva, and Wright, 1998; Currie, 2009; Currie & Thomas 1999; Cordero-Guzman 2001; and Israel & Seeborg, 1998), while others focus on the importance of educational attainment as a determinant of AFQT scores (Cascio & Lewis, 2006; Goldberger & Manski, 1995; Griliches & Mason, 1972; Cordero-Guzman, 2001; Hansen, Heckman, & Mullen, 2003; Hause, 1972; and Munday, 2001). Others have emphasized the importance of volitional factors, such as self-esteem, locus of control, career expectations, and participation in illegal activities (Dunifon & Duncan, 1998; Farkas & Hall, 2011; Heckman, Stixrud, & Urzua, 2006).

Given the diversity of these factors, they are unlikely to affect AFQT scores in the same way. For example, many of these factors are accidents of birth and beyond individuals' control, e.g. early childhood health. These variables are categorized as "background variables." There are other factors affecting AFQT scores that are, to varying degrees, subject to individuals' choices. An example is educational attainment. These choice variables can also be influenced by background variables. This paper designates the variables that are both subject to choice and influenced by background variables as intervening variables. Figure 1 helps clarify how background and intervening variables affect AFQT score.

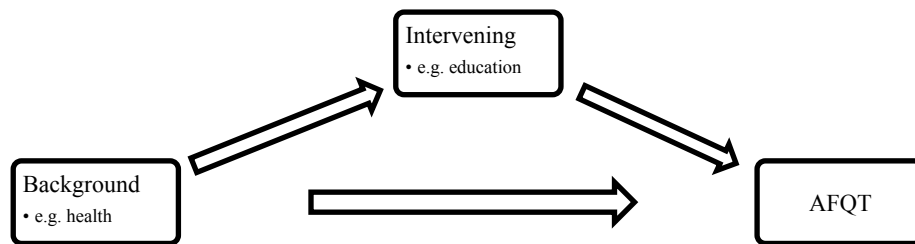Figure 1: Example of a Direct and Indirect Pathway

Figure 1 shows that the background factor of early childhood health is directly linked to outcomes later in life, including outcomes on tests like the AFQT (Currie, 2009). The limiting impact of certain conditions upon the physical and mental capacities of individuals provides the basis for the direct link to AFQT scores as shown by the direct path from background to AFQT in Figure 1, but they also have an impact on educational attainment (Currie, 2009). Unhealthy children, for instance, are likely to miss more days of school or lack the capacity to perform the same workload as other students (Currie, 2009; Haas & Foss, 2008). Haas & Foss (2008) analyze the relationship between adolescent health and educational attainment and find that there is a significant relationship between health and educational attainment. Yet, educational attainment also greatly affects AFQT scores, and thus there are at least two pathways—one direct, and one

indirect—through which early childhood health can affect AFQT scores. Figure 1 shows the indirect pathway through the arrows connecting background to the intervening variable and the arrow connecting the intervening variable to AFQT.

Since these various factors all appear to affect AFQT scores, and some background variables are likely affecting AFQT scores through intervening variables, a focus on these direct and indirect pathways is needed in order to understand what factors are influencing AFQT score, and how they do so. The unique feature of this research is its focus on the direct and indirect pathways through which background factors affect AFQT score.

The impetus for this research is twofold. First, knowing what factors most affect AFQT score, and how they do so, is a *prerequisite* to understanding past and future research utilizing the AFQT. Second, it helps to direct social policy given that there is an empirically established link between income and AFQT scores; whereas, youth with higher AFQT scores have higher adulthood income levels (Blackburn, 2004; Caspi, Wright, Moffitt, & Silva, 1998; Farkas & Hall, 2011; Griliches & Mason, 1972; Hause, 1972; Heckman, Stixrud, & Urzua, 2006; Kanarek, 2013; Neal & Johnson, 1996; Rogers III & Spriggs, 1996). Better understanding what factors most affect AFQT scores can help direct and enhance the efficacy of policy directed toward improving youth's future outcomes. Directing investments in the areas that matter most to achievement on the AFQT would build income-generating skills. These labor market policy implications are strongly emphasized by some economists who claim that investments in the youth are not only critical to their adulthood success, but also to national economic growth (Heckman, 2011; Heckman & Masterov, 2007; Knudsen, Heckman, Cameron, & Shonkoff, 2006; MacEwan, 2013).

II. Theory & Hypothesis

The framework guiding this research is the human capital theory,[1] which is essential to understanding the factors that determine AFQT score. Not only are the components of the AFQT very much affected by human capital investments, but also the human capital theoretical framework is paramount in the AFQT literature (Blackburn, 2004). Indeed, the majority of factors at play in determining AFQT scores are either human capital investments or background factors that influence these direct investments. In this way, human capital theory helps to isolate the different ways by which various factors may directly and indirectly affect AFQT scores.

In conjunction with the human capital theory, the pathways framework is utilized in order to identify and estimate the different ways in which background factors can affect AFQT scores. The child health and educational attainment example in Figure 1 makes evident that there are direct and indirect pathways through which background factors can affect AFQT scores. The indirect pathways include intervening variables, which are typically some human capital investment. A pathway framework makes sense of the more complex relationships by accounting for them in empirical models. The framework allows researchers to examine the effect of background variables on a dependent variable like AFQT as a combination of direct and indirect effects (Hayes & Preacher, 2010). While the specific pathway model of this paper will be presented in Section IV, it is important to note that pathway analysis allows researchers to modify the standard OLS regression model (Hayes & Preacher, 2010). In these standard approaches, a single OLS regression equation is run for all the independent variables on the right-hand side of the equation and the dependent variable on the left-hand side, which treats all the factors as if they affect the dependent variable in the same way. However, the pathways framework—in conjunction with the human capital theory—suggests that taking the standard

---

[1] For further explanation of the human capital theory, please see Rosen (2008).

would be inadequate in attempting to understand the factors affecting AFQT scores because it does not determine indirect path effects. A pathways based approach, conversely, provides a more accurate picture of the total effects of background factors by partitioning the total effect into direct and indirect effects. Given the human capital theory and the pathways framework, I hypothesize that background factors significantly affect AFQT scores through both direct and indirect pathways.

III. Data

The NLSY 1997 cohort is a natural fit for this study. The NSLY is a panel dataset, which surveyed a cohort of 8,984 individuals between the ages 12 and 18 starting 1997 (Bureau of Labor Statistics). It should be noted that the number of 18-year-olds in the study is negligible, since the study only included individuals that would, given their age, be eligible to attend school. Further, the dataset includes myriad variables germane to analyzing AFQT scores and the factors affecting it, thus making the dataset rich in the choices of variables it provides. There are many background factors as well as intervening human capital investment variables included in the dataset. This richness is important for helping to understand the unique pathways through which AFQT scores are affected. The major downside to the NLSY is that it does not include data on school quality. Although this research includes variables that partly compensate for this omission, it is still noteworthy as it is a significant aspect of individuals' lives that is not accounted for in the NLSY.

IV. Empirical Model

A. Variables

The variables are listed in Table 1 along with a brief description and predicted sign. Variable selection followed a set of criteria, including but not limited to: their basis in the AFQT literature, basis in the human capital theory, and number of missing values. AFQT score, which is the dependent variable in the empirical model, is a general measure of cognitive ability. The AFQT comprises four sections—word knowledge, paragraph comprehension, arithmetic reasoning, and numerical operations—and as such, it is geared much more toward estimating overall cognitive ability than specific vocational knowledge and skills. AFQT scores are percentile ranks, which are calculated by grouping individuals in the NLSY 1997 sample "into three-month age groups [over] a total of 20 cohorts" (NLSY Investigator)[2]. Resultantly, the inherent control for age in the percentile based AFQT data eliminated the need for an age control variable, despite that it is often a central variable in human capital-based regressions. Within each cohort, individuals' scores were distributed evenly on a scale from zero to 99. The ideal sample mean, then, would be at the 50th percentile. However, the omission of cases due to inclusion of certain variables in the empirical model results in the mean AFQT score being at the 45th percentile for each age group. While slightly skewed downward due to omitted case bias, the skew is not enough to warrant concern.

---

[2] For an explanation of how this variable is calculated by NLS Program staff, please see the NLS Investigator explanation for variable R98296 in the 1997 cohort, or pages 80-83 of *NLSY97 User's Guide*.

Table 1: Summary Table of Variables

Variable	Description	Expected Sign
AFQT	Dependent variable; AFQT composite score as a percentile rank on a 0-99 scale; continuous.	n/a
Background Variables		
POVERTY	Individuals whose ratio of household income to poverty level is 1 or less (at the poverty level or below it): In Poverty = 1, Not In Poverty = 0.	Negative
EDMOTHER	Highest grade completed by residential mother; continuous: each additional unit equates to an additional year of schooling.	Positive
IMPAIRED	Physical or emotional condition limiting school performance: Has Condition = 1, No Condition = 0.	Negative
MALE	Male = 1, Female = 0.	Negative[1]
BLACK	Black = 1, White/Mixed Race = 0.	Negative
HISPANIC	Hispanic = 1, White/Mixed Race = 0.	Negative
URBAN	The geographic setting of the individual's residence: Rural = 0, Urban = 1[2].	Positive
Intervening Variables		
EDAFQT	Years of formal schooling at time of taking AFQT; continuous: each additional unit equates to an additional year of schooling.	Positive
DAYSABSENT	Days absent from school: the value corresponds to the number of days missed; continuous.	Negative
OPTIMISM	Degree of optimism about future: larger values indicate greater degree of optimism: Strongly Unoptimistic = 0, Unoptimistic = 1, Optimistic = 2, Strongly Optimistic = 3.	Positive
ARRESTS	Number of arrests; values correspond to number of arrests; continuous.	Negative
FEELSAFE	How safe one feels at school: Very Safe = 0, Safe = 1, Unsafe = 2, Very Unsafe = 3.	Negative
PEERPERCEPT	Perception of individual regarding how many of their peers are planning to go to college: Almost None = 0, About ¼ = 1, About ½ = 2, About ¾ = 3, Almost All = 4.	Positive

Notes:
1. When controlling for other factors, males tend to perform worse on standardized tests then women.
2. The NLSY 1997 cohort included "unknown" as an option in the answer set. In order to avoid losing approximately 300 cases, the respondents who answered "unknown" were added to the group responding "urban," which outnumbered the "rural" group 3 to 1, during the data transformation process of this research. As such, URBAN only provides an approximation of the effect of living in an urban area versus that of a rural area on AFQT score.

A few background variables, listed in Table 1, deserve additional explanation and descriptive statistic analysis. Notably, the mean AFQT score varied significantly across Blacks, Hispanics, and Caucasians (See Table 2). Such differences are not unique, as racial differences in AFQT scores have been a focus of much of the literature on the AFQT (Blackburn, 2004; Cordero-Guzman, 2001; Herrnstein & Murray, 1994; Neal & Johnson, 1996; Rodgers & Spriggs, 1996). While that research examined racial differences in context of the wage-AFQT score relationship, this research differs in its focus on the relationship between race and AFQT scores, and does so by examining the direct and indirect effects comprising this relationship.

Table 2: AFQT Scores by Race

Race	Mean	N
Black	28.69	1808
Hispanic	35.48	1360
Caucasian	56.43	3856

The human capital theory paired with the pathways framework provides sound reasoning for the selection of IMPAIRED. IMPAIRED is defined as a condition limiting academic achievement, and thus it will in most cases be a barrier to human capital investment. Having an impairment of this kind will likely decrease the capacity to acquire AFQT score-building skills. It may also affect other intervening variables, such as DAYSABSENT and EDAFQT, thus further affecting AFQT scores. The initial descriptive results for IMPAIRED support this interpretation. The mean score for individuals who have a physical or emotional condition limiting their academic work is 36.53, which is approximately 10 percentiles lower than the mean of 46.74 for individuals without a limiting condition.[3]

---

[3] N=8426 and Standard Deviation = 29.33. The difference is within one standard deviation, so the final results may not be very robust. However, the presence of a difference nonetheless may provide at least enough statistical impetus to include IMPAIRED in the model.

EDMOTHER, which measures the educational attainment of individuals' mothers, is well established in the literature as a predictor of AFQT score or some other important outcome, e.g. poverty status, income, labor market performance (Blackburn, 2004; Currie & Thomas, 2009; Israel & Seeborg, 1998; Todd & Wolperin, 2007). The argument is that, because mothers are likely to spend a large amount of time with their children, they pass down skills, expectations, and values that are influential in determining the direction of their children's lives. Those things, in turn, contribute to the determination of AFQT score. It is clear that the effect of mother's educational attainment fits closely in line with the pathways framework and human capital theory. A more educated mother is more likely to have the knowledge, resources, and ability to convey higher levels of skills and knowledge to their child, which in turn provides a direct pathway through which AFQT scores are affected. A higher educated mother, additionally, is likely to place more emphasis on the importance of education, as she herself clearly values it, thus influencing her child's expectations and performance in school, which can indirectly result in a higher AFQT score.

Table 2 also defines a number of important intervening variables that influence AFQT score. In the pathways framework, these variables are influenced by background variables, and in turn influence AFQT score. ARRESTS, which measures the number of times an individual has been arrested, is an intervening variable that can proxy how individuals spend their time. Those who have been arrested can be assumed to be spending their time engaging in activities detrimental to acquiring the skills and knowledge necessary to a strong performance on the AFQT. Heckman, Stixrud, & Urzua (2006) utilize a very similar variable in their wage regression, and find that the variable helps account for differences in wages, and thus likely is a contributing factor to different levels of human capital attainment, and in turn, AFQT scores.

OPTIMISM is included as an intervening variable because of the strong role perceptions can play in an individual's success. Individuals who are more optimistic, and therefore contend that they can affect their lives and outcomes in a positive way, have more incentive to invest in the skills necessary to do so. Investments in those skills may then result in a higher AFQT score. Conversely, it may be the case that it is individuals' awareness of their skills and ability to succeed that drives their optimism upward. In either case, OPTIMISM captures the effect of various degrees of optimism on AFQT scores.

Finally, EDAFQT, DAYSABSENT, FEELSAFE, and PEERPERCEPT are included as intervening variables that measure individuals' educational experience. EDAFQT is a human capital investment, and provides a measure of the total sum of individuals' education at the time of taking the AFQT. The central role of education in human capital theory and its reaffirmed importance in the AFQT literature (Cascio & Lewis, 2006; Goldberger & Manski, 1995; Griliches & Mason, 1972; Cordero-Guzman, 2001; Hansen, Heckman, & Mullen, 2003; Hause, 1972; Munday, 2001). DAYSABSENT gives insight into students' involvement in school and FEELSAFE and PEERPERCEPT are included as intervening variables to measure the overall educational environment experienced by the respondent. The inclusion of FEELSAFE is based in the fact that degrees of feeling safe help to proxy whether an educational environment is conductive to building those skills necessary to high achievement on the AFQT. For example, a student not feeling safe is unlikely to focus on class material, or the student may skip classes due to fear of dangers present in those situations. As such, the student's degree of safety affects the ability of the student to internalize the skills and knowledge that lead to high AFQT scores.

The reasoning for the inclusion of PEERPERCEPT is very similar to that of FEELSAFE and OPTIMISM. Students face peer pressure on a daily basis, and that peer pressure can greatly

influence the values they hold and the actions they take. For example, if a student thinks that his peers are going on to obtain further education, and that this is the expected norm, he may feel pressure to meet these expectations and also pursue further education. Conversely, a student whose perception of the norm is the reverse may not only lack the social impetus to pursue further skills and knowledge, but may be pressured to disvalue AFQT score-building skills and knowledge. The research done by Heckman, Stixrud, & Urzua (2006) supports the inclusion of these three expectations related variables because they are shown to have a sizeable and significant impact on outcomes.

B. Overview of the Model

Israel & Seeborg's (1998) model is the basis for the empirical model utilized in this research. Following their lead, the empirical model used in this research comprises two sections. First, I estimate the total and direct effects of the background and intervening variables using two OLS regression equations (presented below), which are termed the background model and the overall model. The background model includes only background factors as the independent variables, while the overall model includes background *and* intervening factors as independent variables. The purpose of the background model is to identify the total effects of the background variables on AFQT scores ("AFQT" in the models). Since the intervening variables are excluded from the background model, the coefficients of the background variables estimate their total effect on AFQT (Israel & Seeborg, 1998). The purpose of the overall model is to identify the estimated direct effects of both the background and intervening variables on AFQT. The estimated direct effect is measured by the respective coefficients of the variables in the overall model assuming that the model is correctly specified. Indeed, Israel & Seeborg (1998) note that, when inadequate controls are in place in a regression model, the omitted indirect effects will be

grouped into the direct effect of the variables. The magnitude of a background variable may be skewed in the overall model if it is without adequate controls.

(i) Background Model:

$$AFQT = \alpha_1 + \beta_1(POVERTY) + \beta_2(EDMOTHER) + \beta_3(IMPAIRED) + \beta_4(MALE)$$
$$+ \beta_5(BLACK) + \beta_6(HISPANIC) + \beta_7(AGE) + \beta_8(URBAN)$$

(ii) Overall Model:

$$AFQT = \alpha_1 + \beta_1(POVERTY) + \beta_2(EDMOTHER) + \beta_3(IMPAIRED) + \beta_4(MALE)$$
$$+ \beta_5(BLACK) + \beta_6(HISPANIC) + \beta_7(AGE) + \beta_8(URBAN) + \beta_9(EDAFQT) +$$
$$\beta_{10}(DAYSABSENT) + \beta_{11}(FEELSAFE) + \beta_{12}(OPTIMISM) +$$
$$\beta_{13}(PEERPERCEPT) + \beta_{14}(ARRESTS)$$

Second, I calculate the indirect effects of the background variables using the direct and total effects of the background and intervening variables (the process is outlined in the corresponding results section). This calculation allows the total effects to be decomposed into corresponding direct and indirect effects, thus providing a detailed look into how background variables affect AFQT. The total, direct, and indirect effects are presented in the last part of the results section of this research. Significant variables with the predicted sign and sizeable magnitude for the background model, overall model, and indirect effects are necessary to support my hypothesis, as it demonstrates the measureable presence of two significant pathways—one direct, and another indirect—through which background variables do affect AFQT score.

VI. Results

The purpose of this section is to examine the total effects of the background variables on AFQT, and more importantly, further break down the total effect into direct and indirect effects in order to examine the pathways through which background variables affect AFQT score.

Section A focuses on the total effects of the background variables on AFQT score, which are estimated by the coefficients of the background variables in the background model. Section B presents the direct and indirect effects of the background variables on AFQT score. The direct effects of the background variables on AFQT are represented by the coefficients of the background variables in the overall model. The indirect effects of the background variables on AFQT score are calculated by using OLS regression to calculate the effect (given by the corresponding coefficient) of the background variables on each intervening variable. The results for these auxiliary regressions are presented in Appendix A. Then, I use the following equation (using the background variable POVERTY as an example) to calculate the total indirect effect of each background variable:

(i)   Total Indirect Effect of POVERTY =

(δAFQT/δARRESTS) * (δARRESTS/δPOVERTY) +

(δAFQT/δDAYSABSENT) * (δDAYSABSENT/δPOVERTY) +

(δAFQT/δFEELSAFE) * (δFEELSAFE/δPOVERTY) +

(δAFQT/δPERPERCEPT) * (δPEERPERCEPT/δPOVERTY) +

(δAFQT/δOPTIMISM) * (δOPTIMISM/δPOVERTY) +

(δAFQT/δEDAFQT) * (δEDAFQT/δPOVERTY)

As Israel & Seeborg (1998) explain, "each of the six products," e.g. (δAFQT/δARRESTS) * (δARRESTS/δPOVERTY), "…represent an indirect effect through the corresponding intervening variable." The sum of all these indirect effects for each of the intervening variables garners the total indirect effect of the background variable. The first term used in computing the individual products, (δAFQT/δARRESTS), "is the coefficient of the relevant intervening variable in the overall model," while the second term,

(δARRESTS/δPOVERTY), "is the coefficient of the relevant background variable in the auxiliary regression which predicts the corresponding intervening variable" (Israel & Seeborg, 1998). Thus, the computation of the indirect effect of a background variable on AFQT can be decomposed into six different indirect effects.

Continuing with the POVERTY example calculation, the total indirect effect of POVERTY = (-0.777*0.687) + (-0.207*1.406) + (-4.476*0.081) + (3.302*-0.109) + (1.395*-0.113) + (3.307*-0.451). Each of the products represents an individual indirect effect of POVERTY on AFQT through some intervening variable. The first term, (-0.777*0.687), for example, is comprised of the coefficient of ARRESTS in the overall model multiplied by the coefficient of POVERTY in the auxiliary regression in which background factors predict ARRESTS. This term represents the indirect effect of POVERTY on AFQT through the intervening variable ARRESTS, and is equal to -.534.

A. The Total Effects of the Background Variables

The results for the background and overall model are presented in Table 3. In the background model, the coefficients of the background variables estimate their total effect on AFQT. Notably, all the background variables in the background model are significant at the .01 level and have the predicted sign. This, along with the sizeable magnitudes of the coefficients, suggests that there are meaningful significant total effects of the background variables on AFQT score, thus giving impetus to their decomposition into direct and indirect effects.

Table 3: Background and Overall Model Regression Results

	Background Model	Overall Model
CONSTANT	15.475***	-13.026***
	(8.519)	(-3.745)
Background Variables		
POVERTY	-9.302***	-6.945***
	(-10.065)	(-6.609)
MALE	-3.070***	-1.778**
	(-4.821)	(-2.389)
IMPAIRED	-11.207***	-8.360***
	(-8.765)	(-5.531)
URBAN	1.959***	2.045**
	(2.583)	(2.343)
EDMOTHER	3.239***	2.790***
	(25.881)	(19.294)
HISPANIC	-10.891***	-11.135***
	(-11.468)	(-10.216)
BLACK	-23.526***	-21.294***
	(-29.095)	(-22.350)
Intervening Variables		
ARRESTS	n/a	-.777***
		(-5.795)
ABSENT	n/a	-.207***
		(-3.321)
FEELSAFE	n/a	-4.476***
		(-8.366)
PEERPERCEPT	n/a	3.302***
		(6.373)
OPTIMISM	n/a	1.395***
		(2.827)
EDAFQT	n/a	3.307***
		(12.059)
Adjusted R Square	.31	.368
N	5862	4095

Notes: * indicates significance at the .1 level; ** indicates significance at the .05 level; *** indicates significance at the .01 level.

The total effects of the background variables on AFQT score underlie the importance that these background factors can play in determining it. For example, POVERTY is a significant predictor of AFQT, and the total effect of being in poverty on an individual's AFQT score is a decline of about 9.3 percentiles. Clearly, being in poverty has detrimental effects for AFQT scores on a broad scale, likely through the lack of resources inherent to states of impoverishment. This result supports the conclusions of Heckman (2011), Heckman & Masterov (2007), Knudsen, Heckman, Cameron, & Shonkoff (2006), and MacEwan (2013) who argue that investing resources for impoverished children is critical to helping them achieve success, whether in school or in the labor force.

The total effect of IMPAIRED is a decrease of 11.2 percentiles in AFQT score, which is one of the largest total effects in the background model. Like being in poverty, having a physical or emotional condition that limits one's endeavors represents a barrier to investment in those skills likely to garner a higher AFQT score. Unlike poverty, IMPAIRED represents a condition that will likely remain present in all aspects of life. This facet of IMPAIRED may account for its significant and relatively large negative total effect, and the deconstruction of the variable into direct and indirect effects is important for further understanding this total effect.

The total effect of EDMOTHER is 3.24 percentiles on AFQT score. While the magnitude of this effect appears relatively small, its total effect is actually quite large since there is a predicted 3.24 percentile bump in individuals' AFQT score for *each additional year* an individual's mother is educated. For example, an individual whose mother graduated from a 4-year college versus one whose mother graduated only from high school (16 and 12 years of education, respectively) is predicated to score approximately 13 percentiles higher on the AFQT. This is important because these results suggest that the presence of a more educated mother can

offset some of the negative total effects of other variables. These results are concurrent with much of the literature on mother's education (Blackburn, 2004; Currie & Thomas, 2009; Israel & Seeborg, 1998; Todd & Wolperin, 2007).

The especially large total effects of HIPSPANIC and BLACK indicate that there are notable negative consequences for minorities in terms of AFQT score. BLACK's negative total effect exceeds all other variables in magnitude, and thus highlights the need to understand what is operating in the determination of this total effect. There have been some well-known attempts at explaining this disparity. One explanation that has been widely disputed is that there are innate differences between races (Herrnstein & Murray, 1994); another argues that the negative effects of race are simply functions of background socioeconomic factors (Neal & Johnson, 1996); and the last argues that discrimination is the cause (Rogers & Spriggs, 1996). Decomposing the direct and indirect effects may help to elucidate what is at issue. Regardless, this result is unsurprising. Blackburn (2004) and Todd & Wolperin (2007) specifically focus on the relationship between AFQT score and race, and they demonstrate that there are distinct racial differences in AFQT scores even with robust controls for other factors. Also, it is surprising that the total effect of HISPANIC is approximately half that of BLACK, considering that there are sometimes language barriers to overcome for Hispanics that are not present for Blacks. Ultimately, the total effects is that background factors in total significantly affect AFQT score, thus warranting further analysis of what comprises the total effects and discussion of the policy implications for addressing the role these background factors in individuals' lives.

B. The Direct and Indirect Effects of the Background Variables

In Table 4, the direct and indirect effects are presented in the last two columns. Note that the indirect effect is the product of coefficients as described by equation "i" above. The

coefficients from the regressions that predict each intervening variable as a function of

background variables are presented in Appendix A at the end of the paper. Each of the

appropriate coefficients are multiplied by the coefficient from the direct effect model to get the

indirect effect. All of the background variables in the overall model have the predicted sign,

while all of the variables except URBAN and MALE are significant at the .01 level. This

suggests that, on the whole, there is at least a direct pathway through which background

variables significantly affect AFQT score.

Table 4: Estimated Total, Direct, and Indirect Effects of Background Variables

Background Variables	Total Effect	Direct Effect	Indirect Effect
POVERTY	-9.302***	-6.945***	-3.196
	(-10.065)	(-6.609)	
MALE	-3.070***	-1.778**	-1.493
	(-4.821)	(-2.389)	
IMPAIRED	-11.207***	-8.360***	-3.655
	(-8.765)	(-5.531)	
URBAN	1.959***	2.045**	.007
	(2.583)	(2.343)	
EDMOTHER	3.239***	2.790***	.488
	(25.881)	(19.294)	
HISPANIC	-10.891***	-11.135***	-.575
	(-11.468)	(-10.216)	
BLACK	-23.526***	-21.294***	-2.588
	(-29.095)	(-22.350)	
Adjusted R Square	.31	.368	n/a
N	5862	4095	n/a

Notes: * indicates significance at the .1 level; ** indicates significance at the .05 level;
*** indicates significance at the .01 level.

There is a clear pattern present: direct effects are in all cases greater than indirect effects. POVERTY and IMPAIRED have a similar direct-indirect effect ratio, in which about 70 percent of the total effect is direct. Relative to the other variables, their indirect effect makes up a much larger portion of the total effect. From earlier analysis, this was expected. The influence of being in poverty and having a limiting physical or emotional condition affect many, if not all, aspects of an individual's life, such that there is expected to be significant barriers in pursuing endeavors that may be AFQT score-building. For example, having a limiting physical or emotional condition would be expected to negatively affect school attendance. In Appendix A, Table 6 shows that the effect of IMPAIRED on DAYSABSENT is not only significant, but has the largest magnitude of all the auxiliary regression results.

BLACK, HISPANIC, and URBAN affect AFQT score almost completely through the direct pathway. Future research should seek to explain why the direct effect of these variables constitutes nearly, if not all, of the total effect. Interestingly, MALE is on the opposite side of the spectrum. The direct and indirect effects of MALE on AFQT score are almost equal. Although the size of the indirect effect is roughly in the middle of the scale of magnitudes for the indirect effects, the direct effect is the second smallest of the direct effects. This gives further reason to suggest that the indirect effect of MALE is much more pronounced and important to interpreting the variable than the direct effect is to other variables.

EDMOTHER falls in the middle, with the direct effect making up nearly 85 percent of the total effect. Similar to IMPAIRED and POVERTY, the human capital theory and pathways framework provided good reason to suspect that both these pathways are significant and important. The magnitude of the indirect effect, while relatively small, is not so when considering that the variable is continuous. Four extra years of schooling, would boost AFQT

score by 2 percentiles. In this context, the relative size of the indirect effect of EDMOTHER does not appear to be insignificant. Overall, the direct pathway is more robust than the indirect pathway, but both are present in affecting AFQT score. Ultimately, my hypothesis that there are direct and indirect pathways through which background factors affect AFQT score is supported by the results.

VII. Conclusion

The purpose of this research is to address what AFQT can suitably proxy by examining the pathways through which background factors determine AFQT scores. The results demonstrate the presence of significant direct and indirect pathways, and that the direct pathway is in all cases larger than the indirect pathway. Two main conclusions can be drawn from this research. First, background factors robustly determine AFQT score. The total effects of the background factors are significant and have a large magnitude. Moreover, when separating the total effects into direct and indirect effects, direct effects are in all cases greater than indirect effects. When using AFQT as a proxy, the variable must be, in part, understood as a function of these background factors. The significant direct and indirect pathways of these background factors further underlie that the determination of AFQT score is complex, and it would be incorrect to assume that the AFQT proxies some isolated factor or set of factors. Regardless, AFQT score represents general cognitive capacities, which is important to success in all endeavors. That these background factors can either aid or hamper an individual's cognitive abilities indicates the importance of this research to better understand the role of background in determining AFQT score.

Second, social policy should be directed in accordance with these results. That background factors determine AFQT score in such a robust way, and that AFQT scores strongly

predict youth's future labor market outcomes, suggests the need for social policy to address these background factors. The focus of this policy would be on present generations, and influencing them such that there are substantial returns for future generations. For example, individuals cannot change the education level of their mother at time of their birth, nor can they change the effect this factor has had on their lives (although, they can take other actions that may offset this effect). Policy, however, can be directed at incentivizing young women to obtain more education before becoming mothers. If young women obtain more education before becoming young mothers as result of this policy, then their children can expect to benefit greatly in terms of AFQT score and corollary labor market outcomes.

Thus, directing investments toward those background factors that can be influenced by policy and matter most to achievement on the AFQT can result in substantial returns. This remains especially true for those individuals that would otherwise be disadvantaged very early on life, if not from the beginning, by some background factors. This research, then, can be impactful because society is faced with limited resources, and knowledge about direct and indirect pathways through which background factors affect AFQT score can help direct social policy and resources toward the factors and pathways that matter most. Moreover, this research helps to put the effect of intervening factors in context of the background factors, thus suggesting ways in which resources may be more efficiently allocated. For example, policy intended to remedy disparities evident in intervening factors, such as feelings of safety in school environments, could greatly benefit from understanding the role of background factors, such as poverty. Those feelings of safety may simply be, to a large extent, symptoms of growing up in poverty, and policy directed toward alleviating poverty may do more to improve school environments and resultantly academic performance than directly targeting feelings of safety.

While this research does make clear how investing in the education of underprivileged females, for example, can have lasting intergenerational benefits, there are limitations to the conclusions that can be drawn in this regard. For one, it is unclear why BLACK and HISPANIC are so significant and impactful in determining AFQT scores. This research only makes known *that* they have large and significant total effects, and that these effects are direct. However, there may be other channels that are not controlled for being lumped into their direct effects, and future research should focus on *how* race results in the direct effect on AFQT score.

Finally, it is important to note that this research provides only a snapshot into the different pathways through which background factors determine AFQT score. There are two further avenues of research that would greatly enhance the soundness of these results. The first is the inclusion of background variables related to family structure. Whether an individual grows up in a one or two-parent household, the number of siblings in the household, etc., are elucidating and feasible additions to the empirical model. Indeed, family structure is a missing dimension in this research, and the inclusion of variables for it would therefore give a more complete picture of how background factors determine AFQT scores. For example, the importance of a mother's educational attainment may matter much more or less depending on whether a father figure is present. EDMOTHER, as well as the other background variables, can be better understood in an empirical model that includes family structure variables.

The second avenue of improvement is through disaggregating each indirect effect reported in Table 3 into its six components. Then, a bootstrapping technique, or other means of calculating confidence intervals for the various indirect effects, could be utilized to determine which indirect pathways matter most in determining AFQT scores. Notably, calculating confidence intervals for the indirect effects is challenging because the indirect effects are

products, and thus are not normally distributed (Israel & Seeborg, 1998). Israel & Seeborg

(1998) use a bootstrapping method that is both rigorous and econometrically advanced. Overall,

the benefit to isolating the individual indirect effects and their significance would greatly help to

isolate which background factors, and the pathways through which they operate, most determine

AFQT score.

VIII. Appendix A

Table 6 presents the regression results for the auxiliary regressions in which the background variables are predicting intervening variables. The top row represents the dependent intervening variable, and the left-most column represents the independent background variables that are predicting the intervening variables. The coefficients of the background variables represent the effect of the background variables on the intervening variables in each regression, and are used to calculate the indirect effects as described in the respective results section.

Table 6: Auxiliary Regressions of Background Variables Effects on Intervening Variables

	ARRESTS	DAYS ABSENT	FEELSAFE	PEERPERCEPT	OPTIMISM	EDAFQT
Background Variables						
POVERTY	.687***	1.406***	.081***	-.109***	-.113***	-.451***
	(6.887)	(5.855)	(3.473)	(-3.162)	(-4.094)	(-9.02)
MALE	1.066***	-.520***	0	-.125***	-.028	-.186***
	(14.886)	(-3.032)	(.013)	(-5.036)	(-1.383)	(-5.164)
IMPAIRED	.659***	3.618***	.166***	-.17***	-.056	-.306***
	(4.661)	(10.54)	(4.979)	(-3.455)	(-1.375)	(-4.292)
URBAN	.227***	.599***	.014	.093***	.046*	-.003
	(2.614)	(2.885)	(.687)	(3.098)	(1.852)	(-.061)
EDMOTHER	-.049***	-.187***	-.021***	.061***	.012***	.03***
	(-3.505)	(-5.608)	(-6.531)	(12.569)	(2.996)	(4.296)
HISPANIC	-.079	.085	.064***	-.158***	.067**	.029
	(-.742)	(.334)	(2.585)	(-4.299)	(2.212)	(.532)
BLACK	.285***	-.276	.303***	-.279***	.066**	-.072
	(3.136)	(-1.270)	(14.194)	(-8.864)	(2.552)	(-1.568)
Adj. R-Square	.047	.033	.05	.058	.007	.028
N	7143	6927	7123	7053	5396	6671

Notes: * indicates significance at the .1 level; ** indicates significance at the .05 level; *** indicates significance at the .01 level.

Works Cited

Blackburn, M. (2004). The Role Of Test Scores In Explaining Race And Gender Differences In

       Wages. *Economics of Education Review*, *23*(6), 555-576. Retrieved September 12, 2013,

       from the Econlit database.

Bollinger, C. R. (2003). Measurement Error In Human Capital And The Black-White Wage Gap.

       Review of Economics and Statistics, *85*(3), 578-585. Retrieved September 12, 2013,

       from the Econlit database.

Bureau of Labor Statistics, U.S. Department of Labor. National Longitudinal Survey of Youth

       1997 cohort, 1997-2010 (rounds 1-14) [computer file]. Produced by the National

       Opinion Research Center, the University of Chicago and distributed by the Center for

       Human Resource Research, The Ohio State University. Columbus, OH: 2012.

Cascio, E. C., & Lewis, E. (2006). Schooling and the Armed Forces Qualifying Test: evidence

       from school-entry laws. *The Journal of Human Resources*, *41*(2), 294-318. Retrieved

       May 14, 2013, from the Econlit database.

Caspi, A., Wright, B., Moffitt, T., & Silva, P. (1998). Early failure in the labor market: childhood

       and adolescent predictors of unemployment in the transition to adulthood. *American*

       Sociological Review, *63*(3), 424-451.

Cordero-Guzman, H. R. (2001). Cognitive skills, test scores, and social stratification: the role of

       family and school-level resources on racial/ethnic differences in scores on standardized

       tests (AFQT). *The Review of Black Political Economy*, *28*(4), 31-71. Retrieved May 14,

       2013, from the Econlit database.

Currie, J. (2009). Healthy, wealthy, and wise: socioeconomic status, poor health in childhood,

       and human capital development. *Journal of Economic Literature*, *47*(1), 87-122.

Currie, J., & Thomas, D. (1999). The intergenerational transmission of "intelligence": down the
slippery slopes of The Bell Curve. *Industrial Relations*, *38*(3), 297-330. Retrieved May
15, 2013, from the Econlit database.

Goldberger, A. S., & Manski, C. (1995). Review article: The bell curve by Herrnstein and
Murray. *Journal of Economic Literature*, 33, 762-776.

Griliches, Z., & Mason, W. M. (1972). Education, Income, And Ability. *Journal of Political
Economy*, *80*(3), 74-103. Retrieved May 13, 2013, from the Econlit database.

Hall, M., & Farkas, G. (2011). Adolescent Cognitive Skills, Attitudinal/Behavioral Traits And
Career Wages. *Social Forces*, *89*(4), 1261-1285. Retrieved September 17, 2013, from
the Project Muse database.

Hansen, K., Heckman, J., & Mullen, K. (2004). The effect of schooling and ability on
achievement test scores. *Journal of Econometrics*, *121*(1), 39-98. Retrieved May 14,
2013, from the Econlit database.

Haas, S. A., & Fosse, N. E. (2008). Health and the Educational Attainment of Adolescents:
Evidence from the NLSY97. *Journal of Health and Social Behavior*, *49*(2), 178-192.

Hause, J. C. (1972). Earnings profile: ability and schooling. *Journal of Political Economy*,
80(S3), S108.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive
abilities on labor market outcomes and social behavior. *Journal of Labor Economics*,
24(3), 411-482.

Herrnstein, R. J., & Murray, C. A. (1994). *The bell curve: intelligence and class structure in
American life*. New York: Free Press.

Israel, M., & Seeborg, M. (1998). The impact of youth characteristics and experiences on

transitions out of poverty. *Journal of Socio-Economics*, *27*(6), 753-776.

Kanarek, J. (2014). Youth Aptitude as a Predictor of Adulthood Income. *Undergraduate Economic Review*, *10*(1). Retrieved January 25, 2014, from http://digitalcommons.iwu.edu/uer/vol10/iss1/9

Munday, A. (2001). Neighborhood Effects and the Development of Cognitive Ability: A Re-examination of The Bell Curve. *Honors Projects*, *Paper 78*, 1-25. Retrieved May 12, 2013, from http://digitalcommons.iwu.edu/econ_honproj/78

Neal, D. A., & Johnson, W. R. (1996). The role of premarket factors in black-white wage differences. *Journal of Political Economy*, *104*(5), 869. Retrieved May 14, 2013, from the Econlit database.

NLSY97 User's Guide: A Guide to the Rounds 1-5 Data. National Longitudinal Survey of Youth 1997. (2003). Columbus, Ohio: Center for Human Resource Research, Ohio State University.

Rodgers III, W. M., & Spriggs, W. E. (1996). What does the AFQT really measure: race, wages, schooling and the AFQT score. *The Review of Black Political Economy*, *24*(4), 13-46. Retrieved May 14, 2013, from the JSTOR database.

Rosen, S. (2008). Human capital. *The New Palgrave Dictionary of Economics Online.* Retrieved March 10, 2014, from http://dictionaryofecnomics.com/.

Todd, P. E., & Wolpin, K. I. (2007). The Production of Cognitive Achievement in Children: Home, School, and Racial Test Score Gaps. *Journal of Human Capital*, *1*(1), 91-136. Retrieved October 13, 2009, from http://www.jstor.org/stable/10.1086/526401.