OUTLINE – EDUCATIONAL RETURN ON INVESTMENT

Prepared for the Delaware Department of Education

September 2015

In the following document, Hanover Research presents a revised outline of a proposed approach to investigating the returns on educational investments among public schools and districts in the state of Delaware. The document describes data provided by the Delaware Department of Education to date, as well as requests additional data and clarification from the Department.

HR HANOVER RESEARCH

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OVERVIEW

INTRODUCTION

The Delaware Department of Education (DDOE) has requested the support of Hanover Research in undertaking an analysis of the educational returns on investment in public schools in the state of Delaware. The main purpose of this study will be to link educational expenditures to student outcomes and ascertain whether the investments made are yielding adequate returns, in the form of favorable student academic achievement. This document describes our revised approach based on data provided by the DDOE, describes the data we have received to date, and requests additional data/clarification necessary to complete this research.

Figure 1, below, provides a summary of the proposed research, divided into two phases.

Figure 1: Overview of Proposed Research

REPORT	DESCRIPTION	ESTIMATED TIMELINE
Phase 1: Data Snapshot and Exploratory Analysis	This first project will provide a snapshot of school-level academic outcomes and school-/district-level per pupil expenditures adjusted for regional cost of living. The exploratory portion of the analysis will include scatterplots of select academic outcomes against financial resource allocations, offering initial insight into potential relationships between these measures.	6-10 weeks
Phase 2: School-Level Return on Investment Analysis	The second project will enable us to measure the ROI for each school given the total per-pupil expenditures incurred by the corresponding school district,* and assess whether the ROI computed for each school meets, falls below, or falls above the expected ROI for the state.	6-10 weeks

*As described in greater detail later in this document, the DDOE has provided academic outcomes data at the school level and financial data at the district level. Particularly for Phase 2, we would ideally compare school-level academic outcomes with school-level financial data. In support of this project, we will request school-level financial data from the DDOE or guidance on how to allocate district-level expenditures across schools. If such data are unavailable, or if allocation of expenditures across each district's constituent schools is not appropriate, we will further explore the feasibility of calculating (a) district-level return on investment and/or (b) a ratio of school-level academic outcomes to district-level per pupil expenditures. We note that both (a) and (b) may face sample size constraints, and that (b) would not offer a precise estimate of school-level returns, as district-level financial data would only serve as a rough proxy for the resources expended on a given school.

PROPOSED METHODOLOGY

PHASE 1: DATA SNAPSHOT AND EXPLORATORY ANALYSIS

As a first phase of this research, Hanover proposes creating a data snapshot of school and district academic outcomes, as well as district-level finances. In addition to providing descriptive information of key factors underlying school/district return on investment, this phase will also assist us in determining the feasibility of completing the second phase of proposed research. As described in the next subsection and in the "Data Overview," we have some concerns regarding the available financial data and requisite sample size for the full return on investment analysis.

The data snapshot would begin by describing the academic outcomes data (DCAS reading and mathematics proficiency, high school drop-out rates, and four-year high school graduation rates) at the school and district levels. Next, we would present district-level per pupil expenditure information (for select categories of expenditures), adjusted for the cost of living of the region in which each district is located (see Phase 2 for additional description of this cost of living calculation).[1] This adjustment will allow the Department to view investments in each of its districts, while accounting for regional variation in the cost of living throughout the state.

Representing the exploratory portion of this analysis, Hanover would create scatterplots, investigating the relationship between school-level academic outcomes and district-level per pupil expenditures. We emphasize that the results of this exploratory analysis should be treated with caution, as this approach does not account for variations in academic outcomes and expenditure levels based on differences in school and district student populations. Rather, this would provide some initial insight into whether a relationship may exist between financial resource allocations and student academic outcomes that could be explored further, using regression-based techniques such as those discussed in Phase 2.

Lastly, this first phase of research will allow Hanover to better determine whether the second phase will be feasible. As school-level financial data are not available at this time (only district-level data), and given the relatively small number of school districts in the state, we are concerned that the sample size available for the return on investment analysis proposed below will not be large enough to support meaningful estimates of return on investment. As described in the following subsection and in the "Data Overview," we will request additional information regarding school-level finances from the Department. However, in the event such data are unavailable, we will provide the DDOE with a firmer assessment of the feasibility of the second phase as part of our Phase 1 deliverable.

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[1] Faculty at the Bush School of Government & Public Service at Texas A&M University maintain comparable wage index (CWI) data for individual school districts aligned with labor market regions (originally produced for the National Center for Education Statistics). For the state of Delaware, there are three labor market regions represented in the CWI data: Sussex County, Dover, and the Wilmington DE-MD-NJ Metropolitan Division. See: Taylor, L. and Fowler, W. "The National Center for Education Statistics Comparable Wage Index." Texas A&M University. http://bush.tamu.edu/research/faculty/Taylor_CWI/

PHASE 2: SCHOOL-LEVEL RETURN ON INVESTMENT ANALYSIS

Next we describe the second phase of our research, an analysis of school-level return on investment. Please note that the following represents a project proposed in June 2015, the description of which has been updated to reflect data provided by the DDOE. As discussed in the "Data Overview" section of this outline, in order to conduct a full school-level return on investment analysis, we will need school-level financial data from the Department or guidance on how best to allocate district-level expenditures among constituent schools. Alternatively, we may compare district-level per pupil expenditures to school- and/or district-level academic outcomes, though sample size may limit our ability to provide meaningful estimates of "adequate ROI."[2]

DEFINITION OF EXPENDITURES AND OUTCOMES

Based on data provided by the DDOE in support of this analysis, the **four outcomes** that we suggest using in our proposed approach include:

- Percentage of students who achieved proficiency ("meet standard") on the Delaware Comprehensive Assessment System (DCAS) in reading
- Percentage of students who achieved proficiency on the DCAS in mathematics
- High school drop-out rates
- Four-year high school graduation rates

It is important to note that the above measures represent non-pecuniary based outcomes, i.e., dollar amounts cannot be applied to these educational returns directly.

We define **investments**, in the proposed analysis, as all expenditures and resources allocated to districts, and if available, to individual schools. Note that this is the most conservative approach as we cannot discern whether certain types of spending do not affect student outcomes. However, given the vast number of expenditure categories involved in financing education in Delaware, we may analyze expenditures of interest to only those that affect instruction directly and in instructional support roles. As discussed in the "Data Overview" section of this outline, we request further guidance from the DDOE on which expenditure measure would be most helpful/appropriate for this analysis.[3]

Given that the outcomes are non-pecuniary and normative in nature, it is important for this analysis to establish a baseline to determine whether a given ROI is adequate, below standards, or above standards. This would provide the DDOE with further insight on whether the level of investment is appropriate. Below we describe how we propose to calculate return on investment and determine "adequate ROI."

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[2] As described under "Determining Adequate ROI" below, "adequate ROI" involves adjusting academic outcomes and expenditures for student population characteristics that may affect these measures (i.e., percent of the student population that is of low-income, limited English proficient, and special education status). Expenditures are further adjusted for regional cost of living.

[3] Our approach can be flexible to accommodate changes to the definitions of both the returns and the investments.

RETURN ON INVESTMENT CALCULATION

The first stage of this analysis, before determining whether the returns on specific investments were found to be adequate at the school/district level, is to define the returns on educational investment and formalize the ROI calculation method. The basic method is to compute the per pupil average expenditure for each location (school or district), and relate it to the outcomes produced at that location. In short, the basic ROI measures the amount of academic achievement 'produced' per (thousand) dollar(s) spent. However, because it does cost more to educate students in special programs as well as those receiving subsidized lunches, we propose calculating an adjusted ROI for each location to account for differences in the student population served, and by adjusting the per pupil expenditure (PPE) for cost of living. The latter adjustment ensures that expenditure figures are not biased by potential geographic differences in cost of living.

We compute the cost of living adjusted ROI as follows. Note that we have framed these equations in terms of school-level ROI calculations but will adjust them depending on the availability of school-level financial data.

[1] $$\mathrm{ROI}_s^i = \mathrm{Y}_s^i \div \mathrm{C}_s$$

and

[2] $$\mathrm{C}_s = \mathrm{PPE}_s \div \mathrm{CWI}_s$$

ROI_s^i denotes the return on investment from outcome *i* in school *s*, calculated as the ratio of the outcome Y_s^i and C_s (the cost of living-adjusted per pupil expenditure at school *s*). Y_s^i denotes the outcomes of interest to this analysis and will include: **the percentage of students meeting DCAS proficiency standards in mathematics and reading (separately), high school dropout rates, and high school graduation rates.** Note that dropout rates are considered negative outcomes, meaning that a lower ROI is more favorable in this case. PPE_s is the per pupil expenditure in school *s*, while CWI_s is the comparable wage index for the region in which school *s* is located, accounting for regional variation in the cost of living in the United States.[4] This allows us to adjust all expenditures by the cost of living in each school's geographic region, so as not to confuse high spending with a regional high cost of living.

Once we have computed the ROI for each school or district in the state of Delaware, we will present the full list of schools (also aggregated to the district level) with associated ROI numbers for each outcome. For ease of maneuverability with the results, we propose creating a user-friendly "dashboard" in Microsoft Excel format, to include all schools and districts under the jurisdiction of the DDOE.[5]

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[4] "The National Center for Education Statistics Comparable Wage Index." Op. cit.
[5] Note that the final analysis will be delivered in the form of a technical report and an accompanying data supplement to display the full results.

DETERMINING ADEQUATE ROI

Although, we adjust the per pupil expenditures for cost of living, it is still difficult to ascertain whether a particular school or district is spending and producing a level of academic achievement that is more or less than what is expected. This is because schools and districts serve different student populations, which in turn leads to differential outcomes and differential levels of expenditures. Therefore, to ensure comparability in schools' returns relative to their expenditure levels, we propose a regression analysis to accurately assess whether each school is spending more or less than other schools with a similar student population and whether each school's achievement is above or below the average of similar schools. Thus, we estimate the following regression equation:

[3] $$C_s = \beta_0 + \beta_1 \text{LowInc}_s + \beta_2 \text{LEP}_s + \beta_3 \text{SpEd}_s + \varepsilon_s$$

where C_s denotes the cost of living adjusted PPE for school *s.* LowInc, LEP, and SpEd refer to the percentage of all students enrolled in school *s* who are of low income status, have limited English proficiency, and receive special education, respectively. Lastly, ε_s is the idiosyncratic residual term. A positive value of ε_s denotes that spending at school *s* was above the average of similar schools in the state, i.e., higher than expected.

Similarly, we estimate the same regression equation, but with Y_s^i as the academic outcome of interest. In this case, the regression estimates will determine whether each school's achievement is above or below the average achievement among similar schools in the state. We estimate the following regression equation:

[4] $$Y_s^i = \delta_0 + \delta_1 \text{LowInc}_s + \delta_2 \text{LEP}_s + \delta_3 \text{SpEd}_s + \nu_s$$

Once we have estimated equations [3] and [4],[6] we will determine whether each school's expenditures and outcomes were above or below similar schools' average expenditures and outcomes by computing the values of the residual terms ε_s and ν_s. Next, we will group each school's results into three categories of high spending, average spending, and low spending; and high achievement, average achievement, and low achievement. Formally, the groupings will be created by grouping all residuals into thirds. The grouping of the residuals will enable us to determine the schools that were most efficient in terms of achievement per spending level, while adjusting for both the cost of living as well as the student population served. Figure 2, below, is an illustration of the ROI evaluation matrix.[7]

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[6] We will estimate four specifications for equation [4], with one specification for each of the four academic outcomes of interest.

[7] We will produce four such matrices – one for each of the four academic outcomes analyzed.

Figure 2: Return on Investment Evaluation Matrix

	LOW ACHIEVEMENT	AVERAGE ACHIEVEMENT	HIGH ACHIEVEMENT
LOW EXPENDITURES			
AVERAGE EXPENDITURES			
HIGH EXPENDITURES			

Notes: The matrix displays the number of schools in each bin consisting of a pairwise combination of achievement and expenditure levels.

For instance, the least desirable outcome would be if a school falls in the low achievement/high expenditures category, whereas, the most favorable would be to fall in the high achievement/low expenditures category.

As described in the following section, if school-level financial data are unavailable, or if there is no appropriate means of allocating district-level expenditures across constituent schools, we could still frame the above matrix as school-level academic achievement versus district-level expenditures. Though this will represent a less precise measure of schools' return on investment, district-level expenditures would serve as a rough proxy for the financial resources expended on each districts' constituent schools.

DATA OVERVIEW

In this section, we review the data provided by the DDOE. It should be noted that with the exception of graduation and drop-out rates (discussed below), all provided data were for the 2013-2014 academic school year. These data include financial information at the district level, and academic outcomes and student demographic data at the school level.

FINANCIAL DATA

DESCRIPTION

The DDOE provided Hanover with detailed financial data for the 2013-2014 school year for each of the 19 districts in the state.[8] The data include information on income and expenditures, sources of revenues (state, local, federal), and expenditure categories (current expenses, facilities construction, debt service, etc.). Current expenses are available by type: expenses on net instruction, support services (students, instructional staff, administration, etc.), and food services.[9] Current expense categories are further broken out by detailed subcategories, such as salaries, benefits, supplies, etc.[10] Lastly, we note that the budget document includes some district-level per pupil expenditure calculations (i.e., current expenses per pupil and local bonded debt per pupil).[11]

DATA CLARIFICATION/REQUEST

- **Expense Categories:** Based on the district-level data provided, we wish to confirm that *current expenses per enrolled pupil* (Table 48, Column 6, page 178 in the provided PDF document) would serve as an appropriate measure of district expenditures for return on investment calculations.

- **Charter Schools:** In addition to district expenditures, the financial data include "Charter Totals" throughout the budget document. We wish to confirm whether charter schools should be included in this analysis. If so, unless more detailed data are available, we would treat charter schools as representing a single "district" and would allocate the "Charter Totals" across all charter schools.

- **School-Level Expenses:** As described previously, ideally we would be able to link school-level academic outcomes to school-level finance data. We understand that this information may not be readily available. If this is the case, we would ask the DDOE for guidance on how to allocate district-level finances across each district's constituent schools.
  - For example, taking the broadest approach, we could simply take the district current (or total) expenses and pro-rate them by each school's enrollment. If a certain amount should be withheld from this school-level pro-ration as

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[8] "Fiscal District Financial Report – Regular School FY 2014_20150526." Provided by DDOE. p. 153.
[9] Ibid., p. 167.
[10] Ibid., pp. 169-177.
[11] Ibid., p. 178.

funds allocated to the district office, we would ask the DOE for guidance on this as well.

- o Alternatively, even if total expenditures are not available at the school level (e.g., due to shared expenditure categories, such as transportation), if there are relevant expenditure categories that can be allocated directly to the school level (e.g., instruction and instruction support expenses) we could use these for our return on investment calculations.

- ■ **Additional Years of Data:** If school-level financial data are unavailable, or if we are unable to reasonably allocate district-level expenditures across schools, we will seek to match each district's expenditures with the academic outcomes of its constituent schools. Beyond the issue of not being able to precisely measure school return on investment (as expenditures will not be at the school level),[12] we are further concerned about the sample size available for estimating the district-level regressions (i.e., there will only be 19 data points, representing the state's 19 districts). We would therefore request another year of budget data (2012-2013) to increase our sample size, as well as DCAS reading and mathematics results, graduation rates, and enrollment data from the same year for comparison (we already have received 2012-2013 drop-out rates).

ACADEMIC OUTCOMES DATA

DESCRIPTION

The DDOE provided Hanover with school- and district-level information on academic achievement, representing the following outcomes:[13]

- ■ **Delaware Comprehensive Assessment System (DCAS) Reading and Mathematics Results (2013-2014):** The DCAS data provided by the DDOE include multiple measures, such as percent below standard, percent meeting standard, mean scale score, and number of students tested for the full student population of each school/district and for specific subgroups (ELL, special education, low income, etc.). For the purpose of our analysis, we plan to focus on the percent of all tested students meeting the DCAS standard on the mathematics and reading assessments, respectively.

- ■ **High School Drop-Out Rates (2012-2013 and 2013-2014):** The DDOE provided two years of high school drop-out rates. These data are contained in two files, one representing 38 high schools and the other representing 42 (though the four additional high schools are listed as having zero enrollments for 2013-2014). In addition to the rates, these data include counts of total enrollment and total drop-outs, and could therefore be further aggregated to the district level.

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[12] More specifically, variation in the calculated ROI numbers for schools within a given district would be explained entirely by the variation in academic outcomes across schools within that district, not by the variation in expenditures within the same district (since, by definition, there would be no such variation in district-level expenditure data).

[13] "DOE46 Data Request HRDSL 842015" and "Dropout Table 13 for D Stouffer 080515." Provided by DDOE.

- **Four-Year High School Graduation Rates ("SY14" and "SY13" – dates to be confirmed with the DDOE):** The DDOE provided two years of high school graduation rates, labeled "SY14" and "SY13" at the school and district levels. The "SY14" data include two types of rates (AFGR and AYP). We interpret these to represent average freshman graduation rate and adequate yearly progress graduation rate, respectively.

DATA CLARIFICATION/REQUEST

- **Years and Types of HS Graduation Data:** As noted above, we received two sets of graduation rate data. First, a tab marked "SY14 Graduation Calculations" presents AFGR and AYP graduation rates for schools and districts, representing the Class of 2014. A second tab, marked "SY13 Graduation Calculations" presents a single graduation rate ("4YR Grad Rate") for each school and district.
  - We wish to clarify the years these two tabs represent, as the "SY13 Graduation Calculations" have a header of "2013-2014" above the data. More specifically, does SY14 correspond to 2014-2015 and SY13 correspond to 2013-2014?
  - With respect to the "SY13 Graduation Calculations," we wish to confirm what type of graduation rate these data represent and whether they correspond to the AFGR or AYP graduation rates presented in the "SY14 Graduation Calculations" tab.
  - With respect to the "SY14 Graduation Calculations," we observe that some of the graduation rates are above 100 percent. We wish to confirm the accuracy of these rates.

- **Drop-Out Rate Clarification:** As noted above, we received two sources of drop-out data (both with 2012-2013 and 2013-2014 data). The difference between these sources appears to be the inclusion of four schools (Pencader Charter HS, MOT Charter School, Delaware Design-Lab High School, and Campus Community) with zero enrollments but positive drop-out numbers for 2013-2014. We plan to exclude these four schools from the analysis.

- **Additional Years of Data:** If an additional year of district-level expenditure data is provided (2012-2013), we would request the corresponding year of academic outcome data. We have already received 2012-2013 data for drop-out rates. If comparable 2012-2013 data are available for DCAS reading/mathematics results and graduation rates, we would incorporate these into our analysis.

ENROLLMENT DATA

DESCRIPTION

Lastly, the DDOE provided Hanover with school- and district-level enrollment information, illustrating the total number of students enrolled, and the percent and number of students in various subgroups, including low income, limited English proficient, special education, and race/ethnicity categories. For the purpose of our analysis, we plan to focus on the

percentage of enrolled students in three categories: low income, limited English proficient, and special education.[14]

DATA CLARIFICATION/REQUEST

- **Additional Years of Data:** If an additional year of district-level expenditure data is provided (2012-2013), we would request the corresponding year of school-/district-level enrollment data.

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[14] "DOE46 Data Request HRDSL 842015." Provided by DDOE.

PROJECT EVALUATION FORM

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CAVEAT

4401 Wilson Boulevard, Suite 400
Arlington, VA 22203
P 202.559.0500 **F** 866.808.6585
www.hanoverresearch.com