School Spending and Student Performance in OECD Countries, 1998-2011

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Abstract: Using data on school spending for 31 OECD countries over years 1988 to 2011 by level and type of expenditure, I first present a new formulation of the cost disease model and derive a new implicit price deflator for educational expenditures. The cost disease effect in overall education spending is estimated to be about one percentage point per year relative to the GDP deflator. Second, unlike many previous studies, I find a positive and significant effect of secondary school spending on both PISA math and literacy scores (both significant at the one percent level). Primary school spending is also a significant factor in explaining PISA literacy scores. The econometric results are slightly weaker on the basis of the new educational deflator.

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1. INTRODUCTION

The rising costs of education have long been a matter of considerable concern in the United States and most other advanced countries. Baumol (1967) called this phenomenon the "cost disease" and provided the basic theory.

This paper has two objectives. The first is an econometric examination of the cost disease model using data on educational expenditure by level and type for 31 OECD countries over the years 1998 to 2011. The second is an econometric analysis of the effect of school spending on student performance, as measured by achievement on PISA tests.[1]

Recent years have witnessed a variety of labor saving innovations in education, most notably those connected with the computer, the internet, and other hi-tech developments. But the cost disease analysis, which seeks to shed light on the causes of the continued relative increase in educational costs, takes as its premise the idea that while some valuable avenues for labor saving have already been employed in the educational process, none of these has resulted in steadily decreasing costs anywhere near what, for example, manufacturing has been able to achieve. Baumol, Blackman, and Wolff (1985) called this phenomenon "asymptotic stagnancy."

The principal argument of the cost disease model is that activities or industries that experience slower than average productivity growth will have rising relative prices over time. As a result, their share of (nominal) GDP will increase over time. These activities are called "stagnant" and they differ from "progressive" activities in that they undergo lower than average productivity growth.

This model was extended by Baumol, Blackman and Wolff (1985) to include industries that are composed of two disparate activities — one of which experiences rapid productivity growth and the other of which experiences slow productivity gains. One example is computing, which has a "hardware" component that undergoes very rapid technological change, as well as a "software" component, which experiences relatively slower technological advance. The idea is that new technologies (e.g., computers) are constantly being introduced into the educational process. However, since these new devices are "hardware," their costs decline relative to the costs of their software component, the teacher. As a result, the cost disease takes effect and this slows down productivity growth over the long run. Baumol, Blackman and Wolff (1985) show formally that eventually the software component will dominate both the overall productivity growth of the

[1] This paper updates results from Wolff (2015) from 2008 to 2011 and makes a few data corrections as well. It should be noted that there are substantial differences in regression result, particularly with regard to the GMM coefficient estimate for TIME. See below for more details.

industry and, as a result, the cost structure of the industry. Such an industry's cost behavior will approach closer and closer to that of a stagnant industry (thus the term "asymptotic stagnancy.")

Extensive data on school spending are available for OECD countries. The relevant data will be analyzed systematically to estimate the rates of cost increase of education by *level* of education and *component* of educational expenditure. In so doing, I will introduce a new formulation of the cost disease model. The position of the United States relative to the other OECD countries will also be highlighted. In particular, I will determine whether the experience of the U.S. with regard to the rise of the ratio of school spending to GDP is "exceptional" *vis-à-vis* that of other advanced economies. Are other countries doing better – that is, undergoing a slower growth in this ratio? Can we draw any lessons from the experience of other countries?

In addition, I will relate school spending by level and component to country-level average PISA test scores by year. The main contribution here is to introduce a new deflator for school spending based on the regression results of the cost disease model and contrast the results of the econometric investigations of this relationship based on the standard deflator for educational spending, which is the GDP deflator. In so doing, I will re-examine using the new implicit deflator the seeming paradox noted by Gundlach, Wössmann, and Gmelin (2001), among others, that while real educational spending per pupil has risen over time among OECD countries, test scores have remained flat. Moreover, I will once again highlight the performance of the U.S. in this regard. In particular, if we consider output measures (outcomes) in an international context, we may get a different picture of U.S. performance relative to other advanced countries.

The rest of the paper is organized as follows. The next section, Section 2, discusses the data sources on educational spending used in the study. Section 3 formally develops a new version of the cost disease model for educational expenditures. Descriptive statistics are provided in Section 4 on school spending. The regression results on educational costs are then presented in Section 5. Whenever possible I consider three levels of education – primary, secondary, and tertiary – and four components of educational expenditures – current expenditures, compensation of educational personnel, non-personnel costs, and capital costs. Of particular interest is whether the cost disease is more prevalent in some areas than in others. Section 6 discusses the data sources for the PISA test scores and presents descriptive statistics. Regression results on educational expenditures and test scores are presented in Section 7. Concluding remarks are provided in Section 8.

2. DATA SOURCES ON EDUCATIONAL EXPENDITURES

The main data source is the OECD's online statistical database,[2] which provides detailed data on educational expenditures for 31 OECD countries (see Table 2 for a complete listing). The period of coverage is from 1988 to 2011, though for some countries the period is shorter and for some countries there are missing values over this time interval. Although most of the countries fall into the category of advanced industrialized countries, there are several that are more accurately considered middle income countries, including the Czech Republic, Greece, Mexico, Poland, the Slovak Republic, and Turkey. I will thus be able to exploit the large variation in per capita income levels when the data are analyzed in a regression model.

The data show not only educational expenditures as a share of GDP but also actual educational expenditure levels per pupil. The data are provided separately for three levels of schooling: primary, secondary, and tertiary. In addition, the OECD database provides details on educational expenditures by type. These are broken down into expenditures for educational personnel, educational administrative and professional support personnel, total current expenditures, and capital expenditures. This breakdown will allow a determination of whether there are systematic variations in the operation of the cost disease by educational level and also by type of educational expenditure.

The actual econometric estimation will take advantage of the variation of annual educational expenditures by country and year. I will estimate whether the share of school spending in GDP accelerates over time with overall labor productivity. I do not necessarily expect a linear relationship to exist between this share and labor productivity. In fact, the relationship may be curvilinear (or some more complex form), and the basic regression uses a logarithmic specification.

I also will take advantage of both the time and cross-sectional variation in the sample. Of particular interest is whether there are any country-specific effects. For example, the United States may be suffering from the "cost disease" more than other OECD countries, after controlling for pertinent variables. Both Ordinary Least Squares (OLS) and the Generalized Method of Moments (GMM) estimators will be used for this purpose (see, for example, Hall, 2005).

Another key independent variable in the econometric model will be the overall level of labor productivity (LP). The cost disease model posits that the relative cost of an activity will rise if its rate of productivity growth is *slower* than average. Thus, the relative rise in educational expenses as

[2] The source is: http://stats.oecd.org/Index.aspx?DatasetCode=RFIN2.

a share of GDP will, in general, be greater as the rate of overall productivity growth increases. I will also make use of the OECD database for data on overall levels of productivity by country and year.

Another important independent variable in the econometric analysis will be the number of students at each educational level. Since expenditures on education will generally be higher as the number of students increases (though not necessarily), the number of students will be another important part of the explanation. However, here, too, it is unlikely that the relationship between the number of students per capita and total educational expenditures as a share of GDP will be linear, since class sizes will vary across country and over time. Data on the number of students will come from the OECD database.

3. MODEL SPECIFICATION FOR EDUCATIONAL EXPENDITURES

The basic model analyzes how educational expenditures vary with country-wide average labor productivity and students per capita. I can write the ratio of educational expenses in current prices to GDP in current prices as follows:

$$\begin{aligned} EDUCGDP_{ct} &= [(EDUC_{ct} / STUD_{ct}) / (GDP_{ct}/HRS_{ct})]\cdot[STUD_{ct}/HRS_{ct}] \\ &= [(EDUC_{ct} / STUD_{ct})\cdot (PPP_{ct} / LP_{ct})]\cdot(STUD_{ct}/POP_{ct}) / (HRS_{ct}/POP_{ct}) \\ &= (EDUCSTUD_{ct} /LP_{ct})\cdot(PPPED_{ct}/PPP_{ct})\cdot STUDPOP_{ct} / EMPPOP_{ct} \end{aligned}$$

where $EDUC_{ct}$ is annual educational expenditures in current prices in country c at time t; GDP_{ct} is GDP in current prices in country c at time t; $STUD_{ct}$ is the number of students in country c at time t; HRS_{ct} is total hours worked in country c at time t; $EDUCGDP_{ct}$ is the ratio of annual educational expenditures to GDP for country c at time t; LP_{ct} is the average labor productivity of country c at time t in Purchasing Power Parity (PPP) exchange rates; PPP_{ct} is the overall PPP exchange rate of country c at time t; POP_{ct} is the population of country c at time t; $PPPED_{ct}$ is the PPP exchange rate for educational output of country c at time t; $EDUCSTUD_{ct}$ is educational expenditures per student in PPP exchange rates of country c at time t; POP_{ct} is the population of country c at time t; $STUDPOP_{ct}$ is the ratio of students to population in country c at time t; and $EMPPOP_{ct}$ is the ratio of employment in hours to population in country c at time t.

Suppose that overall labor productivity in country c grows at a constant annual rate of r_{1c} and the productivity of the education sector in country c as measured by $EDUCSTUD_{ct}$ grows at a constant rate of r_{2c} (this is the standard measure of educational productivity). Moreover, suppose that PPP_{ct} changes at a constant rate of s_{1c} over time and that $PPPED_{ct}$ changes at a constant rate of s_{2c} over time. Then,

$$\text{(1) } EDUCGDP_{ct} = (EDUCSTUD_{c0}\, e^{r2c\,t} / LP_{c0}\, e^{r1c\,t})\cdot(PPPED_{c0}\, e^{s2c\,t} / PPP_{c0}\, e^{s1c\,t})\cdot(STUDPOP_{ct}) / (EMPPOP_{ct})$$

where the subscript 0 indicates the value of the variable at time 0. In natural logarithms (ln), this becomes

$$\ln(EDUCGDP_{ct}) = \ln(EDUCSTUD_{c0}) + r_{2c}t - \ln(LP_{c0}) - r_{1c}t + s_{2c}t - s_{1c}t - \ln(STUDPOP_{ct}) - \ln(EMPPOP_{ct})$$

and

$$\text{(2) } \ln(EDUCGDP_{ct}) = CNTY_c + [(r_{2c} - r_{1c}) + (s_{2c} - s_{1c})]t + \ln(STUDPOP_{ct}) - \ln(EMPPOP_{ct}).$$

Since r_{2c} and s_{2c} are not known, the corresponding estimating form becomes

$$\text{(3) } \ln(EDUCGDP_{ct}) = \beta_0 + \beta_1\, TIME_c + \beta_2 \ln(STUDPOP_{ct}) + \beta_3 \ln(EMPPOP_{ct}) + \textstyle\sum_c \varphi_c\, CNTY_c + \varepsilon_{ct}$$

where $TIME_t$ is time, defined as current year minus 1997; $CNTY_c$ is a set of dummy variables for countries; and ε_{ct} is a stochastic error term assumed to be identically and independently distributed (i.i.d.).

The key coefficient of interest is β_1. This coefficient is implicitly the measure of the "cost disease". What would we expect the sign of β_1 to be? We would expect that the change in the overall PPP of a country to be inversely related to its overall rate of labor productivity growth, since the relative price of an output declines as the rate of technological change rises. As a result, the sum $r_{1c} + s_{1c}$ should be approximately zero.[3] Moreover, it is likely that the rate of productivity growth in the educational sector is about zero. As a result, the coefficient β_1 is approximately equal to s_{2c}, the change in the price of educational output *relative* to the overall GDP deflator. I would therefore

[3] The two terms may not completely cancel out since the first term is the rate of *labor* productivity growth of the overall economy whereas the second term may largely reflect changes in the total factor productivity (TFP) of the economy. In general, TFP growth will not equal overall labor productivity growth.

expected that the coefficient β_1 is positive, and its estimated value will approximately give us a new implicit price deflator of educational spending.

I also expect that the coefficient β_2 is positive, since educational spending should, in general, rise with the number of students. Likewise, I would predict that the coefficient β_3 is negative on the basis of equation (2). With regard to the country dummy variables, of particular interest will be the coefficient on the United States dummy variable. If the value of the coefficient is positive, relative to the mean of the other country dummy variables, this result will indicate that the United States is experiencing greater than average levels of educational spending.

V. DESCRIPTIVE STATISTICS

Table 1 shows basic statistics for the key variables used in the analysis. Of primary interest is the variable EDUCGDP, the ratio of educational expenditures to GDP in national currency and current prices. Its average value over the 31 countries and 14 years was 5.64 percent. Moreover, its mean value grew by 12.3 percent, from 5.2 percent in 1998 to 5.9 percent in 2011.[4] Average labor productivity (LP) grew by 22 percent over this period, or by 1.5 percent per year. The average ratio of students to population was 0.238. This ratio, on average, remained fairly constant over the period. The ratio of employment to population averaged 0.439 and grew by 0.014 over the 13-year stretch.

[Table 1 about here]

Next we consider the different components of educational expenditures, which were made up of the compensation of educational personnel (68 percent), non-personnel costs (22 percent), and capital expenditures (9 percent).[5] The first two components increased as a share of GDP over the decade, whereas the third showed virtually no change. The biggest percentage increase was in non-personnel costs as a share of GDP, 26 percent over the 13-year period. Secondary education made up the largest share of educational expenditures (38 percent), followed by primary education (27 percent) and tertiary education (25 percent).[6] These three components also rose as a share of GDP from 1998 to 2011. The rises were more moderate in relative terms than total educational spending for the first two components but much higher for tertiary spending as a share of GDP, 22 percent.

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[4] It should be noted that the sample of countries may change over time due to missing values.

[5] These three components do not add up to 100 percent because of missing values.

[6] Once again, these components do not add up to 100 percent because of missing values

The same ranking also holds for the compensation of educational personnel by schooling level, and the number of students by schooling level. The share of educational compensation in GDP rose modestly at the primary and secondary level but increased sharply at the tertiary level (0.16 percentage points). Both primary school students and secondary school students as a percentage of the population both fell, on average, over the 13 years, while students in higher education increased modestly, relative to the total population.

On a per student basis the results are even more striking. It is first of note that average spending in 2005 PPP dollars per student was highest at the tertiary level, followed by the secondary school level and then the primary school level. However, the percentage gain from 1998 to 2011 was greatest at the primary school level, followed by the tertiary school level and then the secondary school level. Average spending on primary education in 2005 PPP dollars rose from $4,900 in 1998 to $7,400 in 2011, a 54 percent increase, that on secondary schooling from $5,700 to $8,000, a 41 percent rise, and that on tertiary education from $7,500 to $10,800, an 45 percent advance. The same pattern holds for the U.S. expenditures on primary school in 2005 PPP dollars which rose by 35 percent from $7,100 to $9,500, while those on secondary school increased by 22 percent from $9,100 to $11,100, and those on tertiary education by 34 percent from $22,800 to $30,600. It is noteworthy that in 2011 U.S. school spending in PPP$ was higher than average OECD spending at all three educational levels. In the case of higher education, U.S. spending was almost *three times* the OECD average.

Table 2 shows data by country on labor productivity levels and various measures of educational expenditures for the year 2011. Luxembourg is far and away the highest in total educational expenditures per student in 2011 PPP$, at $19,823 The U.S. is a distant second, at $13,416, followed closely by Norway in third place at $13,410. However, the U.S. is not too far above average in the ratio of total educational expenditures in current prices to GDP in current prices (0.071 versus an average of 0.058) and also in the ratio of total educational expenditures per student in current prices to GDP per capita in current prices (0.279 versus an average of 0.248). Denmark actually ranks first in terms of the ratio of total educational expenditures to GDP at 0.080, and New Zealand and Iceland are tied for second at 0.076. Canada ranks first in terms of the ratio of total educational expenditures per student to GDP per capita, at 0.312, with Denmark second at 0.301. Interestingly, Luxembourg which ranks first in total educational expenditures per student (way ahead of the pack) is below average in terms of these other two dimensions – a reflection of its very high per capita income.

[Table 2 about here]

It is also apparent that the results are weakly in accord with the cost disease model, which predicts that the ratio of educational expenditures to GDP rises with overall labor productivity. First, there is a very modest positive 0.056 correlation between the ratio of total education expenditures to GDP and the level of labor productivity across OECD countries. As shown in Figure 1a, the U.S. lies considerably above the regression trend line, indicating higher than average educational spending conditional on its level of labor productivity.

[Figure 1a about here]

Second, there is a slightly higher positive correlation of 0.092 between the ratio of total education expenditures per student to GDP per capita and the level of labor productivity across OECD countries. Also, as shown in Figure 1b, the U.S. once again lies considerably above the regression trend line. Third, there is a very strong positive correlation of 0.84 between real educational expenditures per student and the level of labor productivity across OECD countries. In this case, the U.S. lies only somewhat above the regression trend line (see Figure 1c).

[Figures 1b and 1c about here]

Tables 3 to 6 show a similar set of results for different components of total educational spending. Table 3 considers current educational expenditures only (total educational spending consists of both current and capital expenditures). Results are very similar to those of Table 2 (current spending makes up about 90 percent of total spending). Luxembourg still ranks first in terms of current educational expenditures per student, with the U.S. again a distant second. The correlation between current spending as a percent of GDP and labor productivity levels and current spending per student as a ratio to GDP per capita and labor productivity are now higher than the corresponding correlations involving total educational spending (0.190 versus 0.056 and 0.132 versus 0.092, respectively).[7] This is not surprising since current expenditures should conform to the cost disease model whereas capital expenditures should not, as the model of asymptotic stagnancy implies. On the other hand, the correlation between current spending per student in PPP$ and labor productivity is about the same as that between total spending per student in PPP$ and labor productivity. The U.S. continues to lie above the regression trend line in all three cases (see Figures 2a, 2b, and 2c).

[Table 3 and Figures 2a, 2b and 2c about here]

[7] These comparisons should be qualified since the country samples are slightly different in the two cases.

Table 4 looks at the compensation of educational personnel only. In this case there is an even stronger positive correlation of 0.315 between the compensation of educational personnel as a percent of GDP and labor productivity levels (also see Figure 3a). The correlation, as expected, is stronger than that between total educational spending as a percent of GDP and labor productivity and even that between current educational spending as a percent of GDP and labor productivity. Here again, the U.S. is above the trend line. Likewise, there is a much stronger positive correlation between the compensation of educational personnel per student as a ratio to GDP per capita and labor productivity than that between current school spending per student as a ratio to GDP per capita and labor productivity – 0.403 versus 0.132 (also see Figure 3b). The U.S. again lies above the trend line. As in the case of total and current educational expenditures, there is a positive correlation between real compensation of educational personnel per student and the level of labor productivity across OECD countries (also see Figure 3c). The correlation coefficient is 0.86, but in this case the U.S. lies only slightly above the regression trend line.

[Table 4 and Figures 3a, 3b, and 3c about here]

Table 5 considers (total) educational expenditures on primary school only, The results are similar to those for total educational expenditures at all levels of schooling. The correlation coefficient between the ratio of primary school expenditures to GDP and labor productivity is 0.190, higher than between total spending and productivity, and that between the ratio of primary school expenditures per student to GDP per capita and labor productivity is 0.097, about the same as the total educational spending counterpart. The correlation between real primary school expenditures per student and labor productivity is somewhat lower than that between real educational expenditures per student and labor productivity (0.77 versus 0.84).

[Table 5 about here]

In the case of the ratio of total primary school expenditures to GDP, the U.S. lies somewhat above the regression trend line, indicating higher than average primary educational spending conditional on its level of labor productivity (Figure 4a). In the case of the ratio of total primary school expenditures per student to GDP per capita, the U.S. lies only slightly above the regression trend line (Figure 4b). Finally, in the case of real primary educational expenditures per student, the U.S. lies just about on the regression trend line (Figure 4c).

[Figures 4a, 4b, and 4c about here]

Results are somewhat different for total expenditures on secondary school only (see Table 6 and Figures 5a, 5b, and 5c). The correlation coefficient between the ratio of secondary school expenditures to GDP and labor productivity is 0.122, less than that of primary schooling spending. Interestingly, in this case, the U.S. actually falls below the regression trend line (the U.S. was somewhat above the regression line for primary spending). The correlation coefficient between the ratio of secondary school expenditures per student to GDP per capita and labor productivity is virtually zero, compared to a correlation of 0.097 in the case of primary spending. In this case, the U.S. lies considerably above the regression trend line, whereas the U.S. was only slightly above the trend line for primary spending. The correlation between real secondary school expenditures per student and labor productivity is 0.91, much stronger than that for primary spending. The U.S. this time lies just above the regression trend line, whereas the U.S. was just about on the trend line in the case of primary spending.

[Table 6 and Figures 5a, 5b, and 5c about here]

Results are once again a bit different for expenditures on tertiary education (see Table7 and Figures 6a, 6b, and 6c). In this case, the correlation coefficient between the ratio of tertiary expenditures to GDP and labor productivity is 0.178, higher than that for secondary spending but about the same as for primary spending. The U.S. now lies way above the regression trend line. The correlation coefficient between the ratio of tertiary expenditures per student to GDP per capita and labor productivity is 0.113, compared to a correlation of 0.014 for secondary spending and 0.097 for primary spending. The U.S. data point is once again way above the trend line. The correlation between real tertiary education expenditures per student and labor productivity is 0.56, weaker that those for secondary and primary spending. The U.S. data point is again way above the regression line.

[Table 7 and Figures 6a, 6b, and 6c about here]

4. REGRESSION RESULTS ON EDUCATIONAL EXPENDITURE

The first column of Table 8 shows the regression results for Equation (3) using OLS. First we note that the estimated coefficient of TIME (β_1) is positive and significant at the one-percent level. The results indicate that the relative price effect between the education sector and the total economy dominates the relative labor productivity growth effect. The coefficient estimate of β_1 is 0.0106. This can be interpreted to mean that over this period among these 31 countries, the average rate of increase of the ratio of educational spending to GDP was 1.06 percentage points per year after controlling for other factors. This value is line with the actual average annual change in ln(EDUCGDP) of 1.16 percentage points (derived from the first line of Table 1). The coefficient estimate for ln(STUDPOP) is positive, as predicted, and significant at the one percent level, while that for ln(EMPPOP) is negative, as predicted, and also significant at the one percent level.

[Table 8 about here]

The coefficient for the U.S. dummy variable is 0.266, which is significant at the one percent level, relative to the omitted country (Australia). A more interesting statistic is the U.S. coefficient minus the average value of the dummy variables of the other 29 countries. Its value is 0.365. This result can be interpreted to mean that even after controlling for differences in the ratio of the student population to the total population and the ratio of employment to population, the ratio of educational spending to GDP was, on average over the period, 36.5 percent higher than the OECD average. The R^2 statistic is 0.91. Its value is very high because of the presence of country dummy variables.[8]

An alternative estimation using GMM comes from taking the first differences of Equation (3) as follows:

$$(4)\quad \Delta\ln(EDUCGDP_{ct}) = \beta_1 + \beta_2\, \Delta\ln(STUDPOP_{ct}) + \beta_3\, \Delta\ln(EMPPOP_{ct}) + u_{ct}$$

where Δ refers to the annual difference in variable values and the error term u_{ct} is now, by construction, autocorrelated. The constant term β_1 in Equation (4) refers to the same coefficient as the coefficient on TIME in Equation (3). As shown in Column 2 of Table 8, the coefficient of TIME is slightly higher than the OLS estimate (0.0121 versus 0.0106) and also significant at the one percent level. On the other hand, the coefficient estimates for ln(STUDPOP) and ln(EMPPOP) are not statistically significant. The Sargan Test statistic (for over-identifying restrictions) is significant at the one percent level.

I next look at different components of total educational spending. The first is the total compensation of educational personnel, COMP. This component made up, on average over the 31 countries and 14 years, 68 percent of total educational expenditures. We would expect that this component is most strongly subject to the cost disease because it represents pure labor costs. The OLS results, shown in the third column of Table 8, show rather different coefficient estimates for ln(COMPGDP) than for ln(EDUCGDP). For the key variable, TIME, the coefficient estimate is now 0.0087, a bit lower than the value of 0.0106 in Column 1, though both coefficients are

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[8] The sample size is 343, rather than 434 (31 times 14), because of the existence of a large number of missing values.

significant at the one-percent level. The coefficient estimate for ln(STUDPOP) is no longer significant, while that for ln(EMPPOP) is still negative, though greater in absolute value, and still significant at the one-percent level. The value of the U.S. coefficient minus the average value of the dummy variables of the other 29 countries is now 0.383, compared to a value of 0.365 in Column 1. The GMM estimates for ln(COMPGDP) indicate that the coefficient of TIME is a little higher than the OLS estimate (0.0102 versus 0.0087) but also significant at the one percent level. The coefficient estimates for ln(STUDPOP) and ln(EMPPOP) are not significant. The Sargan Test is again significant at the one percent level.

The second component is non-personnel educational spending (NONPGDP). I did not expect that this component would be subject to the cost disease to the same extent as educational personnel costs, but the results indicate otherwise. The OLS coefficient estimate for TIME is now 0.0247, which is much higher than the coefficient value of 0.0106 in Column 1, and it is significant at the one percent level. This result likely reflects the rise in administrative costs relative to those for educational personnel. The coefficient estimate for ln(STUDPOP) is positive and significant at the one percent level, while that for ln(EMPPOP) remains negative, is greater in absolute value than that for ln(EDUCGDP), and is significant at the one percent level. The value of the U.S. coefficient minus the average value of the dummy variables of the other 29 countries is 0.619, which is much higher than the comparable value of 0.365 in column 1. The GMM estimates for ln(NONPGDP) indicate that the coefficient of TIME is even higher than the OLS estimate (0.0319 versus 0.0247) and also significant at the one percent level. The coefficient estimates for ln(STUDPOP) and for ln(EMPPOP) are once again not significant.

The third component is educational capital expenditures, given as a share of GDP (CAPGDP). In this case, the results indicate that this component is not subject to the cost disease, as expected, since it is likely that the relative price of capital goods has declined over time. The OLS coefficient estimate for TIME is actually negative, -0.0007, though it is not statistically significant. The coefficient estimate for ln(STUDPOP) is still positive, though significant at the ten percent level, and that for ln(EMPPOP) is positive and significant at the ten percent level. The value of the U.S. coefficient minus the average value of the dummy variables of the other 29 countries is 0.392, which is comparable to column 1. The GMM estimate for TIME is 0.0044, but it is statistically significant.

In Table 9, I look at the same set of regression specifications by level of education: primary, secondary, and tertiary. Results differ across levels of education. In the case of primary school, the coefficient on TIME is 0.0094 and is significant at the one percent level in the OLS regression and equal to 0.0099 in the GMM regression, though significant at only the 10 percent level. In the secondary school case, the coefficient of TIME is 0.0115 in the OLS regression and significant at the one percent level but is higher, at 0.0162, in the GMM case and again significant at the one percent level. For higher education, the coefficient of TIME is even higher -- 0.0194 in the OLS case and 0.200 in the GMM case -- and significant at the one percent level in both cases.

[Table 9 about here]

The coefficient estimate for ln(STUDPOP) is positive and significant at the one percent level in OLS regressions for primary and secondary spending but is not significant for tertiary spending.[9] It is also significant at the ten percent level in the GMM estimations for secondary spending and at the five percent level for tertiary spending but is not significant for primary spending. The coefficient of ln(EMPPOP) is negative, as predicted, in all six cases but is significant (at the one percent level) only in the OLS regressions for secondary and tertiary spending. The value of the U.S. coefficient minus the average value of the dummy variables of the other 29 countries is actually negative (-0.069) in the primary-school regression, 0.230 in the secondary-school regression, and 0.849 in the tertiary-school regression. The results indicate that the school spending as a share of GDP, after controlling for the number of students as a share of the population, was 23 percent greater in the U.S. at the secondary school level and 85 percent greater at the tertiary-school level but actually slightly below average at the primary school level.

The results of Table 9 also give us implicit price deflators for educational spending by educational level. Recall from Equation (2) that the coefficient of TIME, β_1, is $[(r_{2c} - r_{1c}) + (s_{2c} - s_{1c})]$. Let us now assume that the productivity growth of the educational sector, r_{2c}, is zero in each country. Moreover, let us calculate the educational deflator *relative to* educational spending in constant PPP dollars, so that s_{1c} is zero. Then, the implicit price deflator for educational expenditure is given by: $s_{2c} = \beta_1 + r_{1c}$. As may be apparent, the implicit price deflator s_{2c} will vary both across countries and over time depending on the country-level rate of productivity growth.

On the basis of the GMM results, s_{2c} was 0.99 percent per year for primary school spending on average over the period from 1998 to 2011, 1.62 percent per year for secondary school spending, and 2.00 percent per year for tertiary school spending. It is notable that tertiary education spending "suffers" the most from the cost disease, followed by secondary spending and then primary

[9] I include primary school students only, secondary school students only, and tertiary school students in the three regression equations, respectively.

spending. These estimates, moreover, are likely to be upper bound estimates for s_{2c} since if educational productivity increases over time (that is, r_{2c} is positive), then s_{2c} is correspondingly lower.[10] In comparison, Gundlach, Wössmann, and Gmelin (2001) use three different deflators for their educational spending series: (1) the standard GDP deflator, (2) the SNA-based deflator for the sector "producers of government services", and (3) the SNA-based deflator for the sector "community, social, and personal services." However, these deflators show a smaller rate of price increase than my regression-based implicit price deflator.

5. EDUCATIONAL EXPENDITURES AND PISA RESULTS

I next turn to output measures of educational performance. Output measures are always hard to come by in studies of education—particularly when constructing an educational production function. However for the purposes here, it appears that one of the most appropriate measures is PISA (Programme for International Student Assessment) test scores on (i) reading and (ii) mathematics. The PISA program provides comparable tests on these subjects for students in roughly 65 countries (the number varies by year). The test is typically administered to 15-year olds (secondary school students) in the various countries.[11] Almost all the OECD countries participated in PISA in 2000, 2003, 2006, 2009, and 2012. Non-OECD countries like Thailand, Brazil, and Columbia also participated in many years.[12]

There is a sizeable literature on estimating educational production functions, on which I will draw (see, for example, Hanushek 1979, 1992, 1999, and 2007; Hanushek and Kimko, 2000; Hanushek, Rivkin, and Taylor, 1996; Krueger, 1999; and Rivkin, Hanushek, and Kain, 2005). In this literature some measure of academic achievement (or its logarithm) is regressed on a set of educational inputs. In an excellent summary of the literature, Hanushek (2007) provides a list of the most common inputs and output. On the input side are such variables as the ratio of teachers to number of students, teacher background (education level and experience, typically) classroom size, school facilities, administrative expenditures, school curricula, and overall educational expenditures. In some studies, family background as measured by parental education and income

[10] Of course, it is also possible for educational productivity to decline, in which case s_{2c} would be higher.

[11] The PISA website is: http://nces.ed.gov/surveys/pisa/. See Hanushek and Wössmann (2010) for an extended discussion of the reliability of the PISA data.

[12] Participating countries are as follows: PISA 2000 – 43 countries; PISA 2003 – 41 countries; PISA 2006 – 57 countries; PISA 2009 – 65 countries; and PISA 2012 -- 65 countries.

provide additional controls. On the output side are variables such as standardized test score results, grade point averages, and graduation rates.

Hanushek surveyed 90 individual studies of educational production functions published before 1995. He reports that only 9 percent of estimates for teacher education, 14 percent for teacher-pupil ratios, and 29 percent for teacher experience yielded a positive and statistically significant coefficient. These results, in addition, were counterbalanced by other studies that reported negative correlations. Studies on the effect of financial resources, overall spending on education, and teacher salaries also produced mixed results. Only 27 percent of studies found a positive and significant effect of educational expenditures per student, while 7 percent found a negative effect.

As Hanushek notes, while academic achievement is typically measured at a discrete point in time, the educational process is cumulative so that inputs applied in the past may affect current achievement levels. As a result, it is methodologically superior to use a "value added" estimation rather than a "level" form of estimation. In this regard, one should relate the *change* in academic achievement over time to the *change* in educational inputs. This estimation approach also reduces problems of omitting prior inputs of schools and family background since such effects will be incorporated in the initial achievement levels. I will use both the level form and first differences. The rationale for using the former is that because of missing values the sample size is much larger than for the latter.

Our first measure of output, as indicated above, will be the average text scores on PISA test by country and year. Data are available for 2000, 2003, 2006, 2009, and 2012.The production function follows from a standard Cobb-Douglas production function:

$$(5) \quad \ln(PISA_{ct}) = \beta_0 + \beta_1 \ln(PRIMCOMPUSD05STUD_{ct}) + \beta_2 \ln(PRIMNONPUSD05STUD_{ct}) + \beta_3 \ln(PRIMCAPUSD05STUD_{ct}) + \beta_4 \ln(SCNDCOMPUSD05STUD_{ct}) + \beta_5 \ln(SCNDNONPUSD05STUD_{ct}) + \beta_6 \ln(SCNDCAPUSD05STUD_{ct}) + \beta_7 TIMEA + \sum_c \varphi_c CNTY_c + \varepsilon_{ct}$$

where PISA is the average test score on the PISA exam and, as before, I have introduced time and country dummy variables. TIMEA=1 for 2000, 2 for 2003, 3 for 2006, 4 for 2008, and 5 for 2012. I separate out expenditures on educational personnel from those on non-personnel educational expenditures and capital expenditures per student. The key variable of interest is expenditures on the secondary school level. However, primary school spending (PRIMSTUD) may also affect PISA outcomes for secondary students. The coefficients on the expenditure terms indicate elasticities of the percentage change in spending on the different items on the percentage change in the average PISA score. The regression results will enable us to see what type of educational resource works best, at least in terms of test scores.

I first begin with descriptive statistics on PISA and secondary educational expenditures (see Table 10 and Figures 7a to 7f). The correlation coefficient between the ratio of total secondary expenditures to GDP in 2011 and PISA math scores in 2012 is positive though modest, 0.24. The U.S. is just about on the regression trend line (see Figure 7a). The correlation coefficient between the ratio of secondary expenditures per student to GDP per capita and the PISA math scores is also positive and somewhat higher, 0.38. The U.S. data point is now quite a bit above the regression line (see Figure 7b). The correlation between real secondary education expenditures per student and PISA math scores is even higher – 0.44 – as is expected. The U.S. data point is now way above the regression line, meaning here that given what the U.S. spends on secondary education per student in real terms, its PISA score is quite a bit lower than expected (see Figure 7c).

[Table 10 and Figures 7a, 7b, and 7c about here].

Results are quite similar for PISA literacy scores. The correlation coefficient between the ratio of total secondary expenditures to GDP and PISA literacy scores 0.18, somewhat lower than that with PISA math scores. The data point for the U.S. is somewhat below the trend line (see Figure 7d). The correlation coefficient between the ratio of secondary expenditures per student to GDP per capita and the PISA literacy score is higher, 0.45, higher than that with PISA math scores. The U.S. lies above the regression line (see Figure 7e). The correlation between real secondary education expenditures per student and PISA literacy scores is 0.43, about the same as that with PISA math scores. As in the case of PISA math scores, the U.S. data point is way above the regression line, meaning once again that given what the U.S. spends on secondary education per student, its PISA literacy score is quite a bit lower than expected (see Figure 7f).

[Figures 7d, 7e, and 7f about here]

Before proceeding to the regression results, I consider time trends in test scores and educational spending (see Table 11). These figures are based on unweighted country averages. As is apparent, there is almost no time trend in average PISA math or literacy scores. On the other hand, "real" educational spending based on the standard GDP deflator on both the primary and secondary school levels increased quite substantially from 2000 to 2011. These two contrasting trends are the basis of the Gundlach, Wössmann, and Gmelin (2001) paradox that educational spending rose dramatically while test scores remained flat. However, once I use the implicit price deflators for educational spending, s_{2c}, the results change rather substantially. “Real” primary school spending per student grows much more slowly than the one based on the GDP deflator (a 1.9 percentage point per year difference over years 2000 to 2011), as does “real” secondary school spending per student (a 2.4 percentage point per year difference). Indeed, secondary spending deflated by s_{2c} actually declined over this period. Likewise, “real” tertiary school spending per student grew much more slowly than the one based on the GDP deflator (a 2.8 percentage point per year difference). Indeed, using the implicit price deflator, I also find that real tertiary expenditures per student showed an absolute decline from 2000 to 2011.

[Table 11 about here]

Regression results based on Equation (5) are shown in Table 12. Results are based on OLS.[13] I begin as a benchmark with total educational expenditures on both the primary and secondary school level. Results shown in column 1, including country dummy variables, indicate that the coefficient of ln(SCNDUSD05STUD) is positive and significant at the ten percent level, as expected, while that of ln(PRIMUSD05STUD) is actually negative though statistically insignificant. The coefficient of TIMEA is also insignificant.

[Table 12 about here]

I next strip away the country dummy variables (column 2). In this case, the coefficient of ln(SCNDUSD05STUD) becomes positive and statistically significant, at the five percent level. The coefficient of ln(PRIMUSD05STUD) remains statistically insignificant, as does that of TIMEA. Moreover, the R^2 statistic now drops from 0.94 to 0.22. This implies that the vast majority of the variation in PISA math scores is explained by the country dummy variables (that is, country-specific effects). Moreover, the finding that the coefficient of ln(SCNDUSD05STUD) is positive and significant is due to the fact that the country dummy variables incorporate, among other effects, differences in educational spending between countries. Further elimination of ln(PRIMUSD05STUD) from the specification yields a positive coefficient for ln(SCNDUSD05STUD) of 0.082, significant at the one percent level (column 3). Indeed, this straightforward regression seems to resolve the “paradox” that test scores are unrelated to real educational spending, at least in the cross-section.

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[13] Because the PISA data are discontinuous over time, it is not possible to employ GMM as an estimator.

At first blush, it seems surprising that the coefficient of TIMEA is insignificant, since as we saw in Table 10 average real educational spending rose substantially over time while average PISA math scores actually went down a bit. If, in fact, educational spending in real terms, ES, increases proportionately over time for all countries while test scores results remain unchanged, then $ES_{c06} = a_1 ES_{c0}$, $ES_{c09} = a_2 ES_{c0}$, and $ES_{c11} = a_3 ES_{c0}$,where a_1, a_2 and a_3 are constants, 0 refers to base year 2003, subscript 06 refers to 2006, subscript 09 refers to 2009, and subscript 11 refers to 2011. Then, because of the log-log form used, it follows that:

$$\ln(PISA_{ct}) = \beta_0 + \beta_1 \ln(ES_{ct}) = \beta_0 + \beta_1 \ln(ES_{c0}) + \ln(a_1)\, TDUM_{06} + \ln(a_2)\, TDUM_{09} + \ln(a_3)\, TDUM_{11} + u_{ct}$$

where $TDUM_{06}$,$TDUM_{09}$ and $TDUM_{11}$ are time dummy variables for 2006, 2009, and 2011, respectively. However, a regression with time dummies for 2006, 2009, and 2011 failed to produce significant coefficients for these variables (in fact, the t-ratios were close to zero).[14]

The reason for this result can be seen in Figure 8 (in which countries are ordered by their educational spending in 2000). Changes over time in secondary educational spending is not a simple proportional outward shift over time. Indeed, growth rates in secondary spending vary considerably across countries (as well as over time). Moreover, there is actually a negative correlation between initial secondary educational spending and its rate of growth over time. If anything, these results indicate a *convergence* in educational spending over time, at least among OECD countries.

[Figure 8 about here]

In the last three columns of Table 11, the new educational spending deflator, s_{2c}, is now used to deflate both primary and secondary educational spending. The results are slightly weaker than those based on the original GDP deflator in terms of the t-ratios, the R^2, and the standard error of the regression, and the coefficient value of secondary spending is smaller. However, the significance levels of the the coefficients of ln(SCNDSTUDEDDEF) are the same using the new deflator for educational spending as with the standard deflator As before, time dummy variables for 2006, 2009, and 2011 are not significant (result not shown).

Results for PISALIT are shown in Table 13. In the first case, when the two educational variables are included as well as TIMEA, the coefficient of ln(SCNDUSD05STUD) is insignificant

[14] In another variant, time dummy variables were interacted with education spending in 2006, 2009, and 2011. Here, again, the coefficients on the interaction terms were statistically insignificant.

but that of ln(PRIMUSD05STUD) is positive and significant, at the five percent level. The coefficient of TIMEA, as in the case of PISAMATH, is insignificant. When ln(PRIMUSD05STUD) is excluded, the coefficient of ln(SCNDUSD05STUD) does become significant, at the one percent level. When ln(PRIMUSD05STUD) is included by itself, it is also significant at the one percent level. The results are actually stronger for primary school spending than for secondary school spending, at least in terms of the t-ratios, the R^2, and the standard error of the regression, and the coefficient value of ln(PRIMUSD05STUD) is larger than that of ln(SCNDSTUDEDDEF).[15] Also, as with PISAMATH, the results are slightly weaker on the basis of the new educational spending deflator, s_{2c}, than those based on the original GDP deflator in terms of the t-ratios, the R^2, and the standard error of the regression, and the coefficient values of both primary spending and secondary spending are somewhat smaller.

[Table 13 about here]

6. CONCLUDING REMARKS

The regression results provide strong confirmation of the unbalanced growth model. If we can interpret the coefficient of TIME as a measure of the cost disease, it averaged about one percent per year relative to constant prices as estimated using the GDP deflator for overall educational spending after controlling for the effects of the ratio of the number of students to the total population and employment as a share of the population. It is also positive significant at the one percent level for total educational spending, as well as for the compensation of educational personnel, and non-personnel educational spending as a share of GDP and primary school spending, secondary school spending, and tertiary school spending as a proportion of GDP, with the single exception of the GMM estimator for primary school spending (which is significant at the ten percent level). The cost disease appears most "severe" for non-personnel educational spending as a share of GDP (3.2 percent per year based on the GMM estimator), followed by spending on educational personnel as a share of GDP (1.0 percent per year). The cost disease does not appear to apply to capital spending in education, as expected. It is also most severe at the tertiary level (2.0 percent per year based on the GMM deflator), followed by secondary spending (1.6 percent per year) and then primary spending (1.0 percent per year). Zzz

My findings also indicate that U.S. total educational spending as a share of GDP averaged 37 percent higher than the average of other OECD countries after controlling for the effects of the

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[15] It would be preferable to use primary spending lagged about five years in the regressions. However, there are not enough data points to do this (the series begins in 1998). Instead, I have used primary spending lagged two years in the regressions. The results were not materially different (and not reported here).

ratio of the number of students to the total population and employment as a share of the population. The share of educational personnel compensation as a share of GDP was 38 percent higher in the U.S., the ratio of non-personnel costs to GDP was 62 percent higher, and the ratio of capital expenditures to GDP was 39 percent higher. Moreover, the share of tertiary school spending in GDP averaged 85 percent higher in the U.S and that of secondary school spending 23 percent higher. In contrast, the share of primary school spending to GDP was actually 7 percent lower than the OECD average.

Descriptive statistics show that real educational spending (as deflated by the GDP deflator) rose considerably over time while mean PISA math and literacy scores remained flat. Despite this, regression of log of PISA math scores on log of real secondary educational spending produces a positive and statistically significant coefficient. This result seems to resolve the so-called "education paradox" that while average educational spending has risen over time, test scores have not. Indeed, the time variable and time dummy variables are not significant.

In regressions of the log of PISA literacy scores, the coefficients of both secondary and primary educational spending are positive and significant at the one percent level. However, the results are actually stronger for primary school than for secondary school spending, at least in terms of the t-ratios, the R^2, and the standard error of the regression, and the coefficient value of primary spending is larger than that of secondary spending. It appears that (contemporaneous and lagged) primary school spending is more important than secondary school spending in explaining performance on the PISALIT exam among secondary school students. This probably makes sense since basic reading and writing skills are learned in primary school. On the other hand, secondary school spending is more important than primary spending in explaining math performance. This also makes sense since important math skills are acquired in secondary schooling. However, in all cases, the elasticity of PISA test performance with respect to educational spending is quite small – no higher than 0.08.

When educational spending is deflated by s_{2c}, the implicit educational price deflator estimated from the cost-disease model, "real" educational spending rises slower over time. Indeed, both "real" secondary school spending and "real" tertiary school spending show an actual decline on the basis of the new deflator from 1998 to 2011. However, regression results are somewhat weaker for the "corrected" educational deflator than those based on the original GDP deflator in terms of the t-ratios, the R^2, and the standard error of the regression, and the coefficient values of secondary and primary spending are smaller.

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Table 1. Descriptive Statistics of Key Regression Variables

Variables	Mean	Std. Dev.	No. of Observ.	Mean Value 1998	Mean Value 2011	Change, 1998-2011	% Change 1998-2011
EDUCGDP	0.0564	0.0106	352	0.0524	0.0588	0.0064	12.3
LP	70.18	25.49	420	62.07	75.59	13.52	21.8
STUDPOP	0.238	0.037	410	0.235	0.236	0.0004	--
EMPPOP	0.439	0.099	418	0.426	0.440	0.0141	--
COMPGDP	0.0384	0.0082	319	0.0361	0.0395	0.0034	9.4
NONPGDP	0.0125	0.0049	319	0.0108	0.0135	0.0028	25.6
CAPGDP	0.0049	0.0022	318	0.0049	0.0047	-0.0003	-5.4
PRIMGDP	0.0151	0.0046	359	0.0141	0.0155	0.0014	9.6
SCNDGDP	0.0213	0.0048	359	0.0202	0.0217	0.0015	7.6
TERTGDP	0.0141	0.0044	360	0.0126	0.0155	0.0028	22.4
PRIMCOMPGDP	0.0109	0.0034	328	0.0104	0.0108	0.0003	--
SCNDCOMPGDP	0.0152	0.0038	328	0.0146	0.0151	0.0005	--
TERTCOMPGDP	0.0085	0.0028	334	0.0077	0.0093	0.0016	--
PRIMSTUDPOP	0.076	0.026	416	0.0819	0.0708	-0.0111	--
SCNDSTUDPOP	0.091	0.020	416	0.0906	0.0881	-0.0025	--
TERTSTUDPOP	0.048	0.015	416	0.0478	0.0479	0.0002	--
PRIMUSD05STUD	6,092	2,583	358	4,852	7,447	--	53.5
SCNDUSD05STUD	7,041	2,653	358	5,673	7,982	--	40.7
TERTUSD05STUD	9,381	5,301	358	7,484	10,843	--	44.9

Key:

(1) EDUCGDP: Ratio of total educational expenditures in current prices to GDP in current prices.
(2) LP: Ratio of GDP in 2010 US dollars to hours worked.
(3) STUDPOP: Ratio of total number of students to the total population.
(4) EMPPOP: Ratio of total employment to the total population.
(6) COMPGDP: Ratio of total compensation of educational personnel to GDP in current prices.
(7) NONPGDP: Ratio of total non-personnel educational expenditures to GDP in current prices.
(8) CAPGDP: Ratio of total capital educational expenditures to GDP in current prices.
(9) PRIMGDP: Ratio of total primary school expenditures in current prices to GDP in current prices.
(10) SCNDGDP: Ratio of total secondary school expenditures in current prices to GDP in current prices.
(11) TERTGDP: Ratio of total tertiary school expenditures in current prices to GDP in current prices.
(12) PRIMCOMPGDP: Ratio of primary school compensation of educational personnel to GDP in current prices.
(13) SCNDCOMPGDP: Ratio of secondary school compensation of educational personnel to GDP in current prices.
(14) TERTCOMPGDP: Ratio of tertiary school compensation of educational personnel to GDP in current prices.
(15) PRIMSTUDPOP: Ratio of the number of primary school students to the total population.
(16) SCNDSTUDPOP: Ratio of the number of secondary school students to the total population.
(17) TERTSTUDPOP: Ratio of the number of tertiary school students to the total population.
(18) PRIMUSD05STUD: Ratio of total primary school expenditures in 2005 PPP$ to the number of primary school students.
(19) SCNDUSD05STUD: Ratio of total secondary school expenditures in 2005 PPP$ to the number of secondary school students.
(20) TERTUSD05STUD: Ratio of total tertiary school expenditures in 2005 PPP$ to the number of tertiary school students.

Table 2. Labor Productivity and Total Educational Expenditures in Current Prices and National Currency at All Levels of Schooling by OECD Country, 2011

Country	Labor Productivity[a]	Ratio of Educ. Expend. to GDP In Current Prices[b]	Ratio of Educ. Expend. per Student to GDP per Capita In Current Prices[b]	Educ. Expend. per Student in PPP$[b]
Australia	47.9	0.052	0.189	5,313
Austria	50.0	0.057	0.277	11,674
Belgium	58.6	0.066	0.249	9,636
Canada	45.6	0.063	0.312	12,612
Czech Republic	27.4	0.050	0.243	6,389
Denmark	50.8	0.080	0.301	12,344
Finland	48.1	0.065	0.250	9,359
France	55.5	0.061	0.258	9,407
Germany	54.5	0.052	0.259	10,237
Greece	30.1	0.043	0.222	5,414
Hungary	26.1	0.057	0.267	4,843
Iceland	39.1	0.076	0.241	8,780
Ireland	60.6	0.063	0.238	10,083
Italy	43.7	0.046	0.248	8,112
Japan	39.4	0.049	0.292	10,080
Korea	28.9	0.068	0.288	8,538
Luxembourg	81.1	0.041	0.221	19,823
Mexico	20.3	0.062	0.197	3,142
Netherlands	60.1	0.062	0.245	10,498
New Zealand	34.4	0.076	0.261	7,888
Norway	74.8	0.057	0.220	13,410
Poland	25.5	0.058	0.257	5,451
Portugal	32.6	0.055	0.251	6,384
Slovak Republic	34.4	0.044	0.212	5,078
Spain	48.1	0.054	0.252	8,091
Sweden	50.1	0.063	0.239	9,924
Switzerland	48.4	0.046	0.241	12,330
Turkey	26.6	0.043	0.155	2,640
United Kingdom	47.2	0.063	0.278	9,818
United States	59.6	0.071	0.279	13,416
Correlation with labor Productivity		0.056	0.092	0.844

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. Labor productivity is defined as the ratio of GDP in 2011 PPP$ to hours worked.
b. Year 2005 for Australia and Greece and year 2006 for Hungary.

Table 3. Labor Productivity and Current Educational Expenditures in Current Prices and National Currency at All Levels of Schooling by OECD Country, 2011

Country	Labor Productivity[a]	Ratio of Educ. Expend. to GDP In Current Prices[b]	Ratio of Educ. Expend. per Student to GDP per Capita In Current Prices[b]	Educ. Expend. per Student in PPP$[b]
Australia	47.9	--	--	--
Austria	50.0	0.054	0.266	11,210
Belgium	58.6	0.064	0.242	9,334
Canada	45.6	0.057	0.281	11,365
Czech Republic	27.4	0.044	0.213	5,621
Denmark	50.8	0.077	0.289	11,855
Finland	48.1	0.060	0.232	8,697
France	55.5	0.056	0.235	8,583
Germany	54.5	0.047	0.234	9,220
Greece	30.1	0.030	0.154	3,321
Hungary	26.1	--	--	--
Iceland	39.1	0.072	0.229	8,337
Ireland	60.6	0.059	0.223	9,423
Italy	43.7	0.043	0.235	7,700
Japan	39.4	0.043	0.257	8,877
Korea	28.9	0.059	0.250	7,395
Luxembourg	81.1	0.036	0.195	17,431
Mexico	20.3	--	--	--
Netherlands	60.1	0.055	0.218	9,346
New Zealand	34.4	--	--	--
Norway	74.8	0.051	0.198	12,080
Poland	25.5	0.053	0.234	4,965
Portugal	32.6	0.054	0.244	6,208
Slovak Republic	34.4	0.040	0.192	4,602
Spain	48.1	0.050	0.231	7,410
Sweden	50.1	0.059	0.225	9,341
Switzerland	48.4	0.042	0.219	11,220
Turkey	26.6	0.036	0.130	2,213
United Kingdom	47.2	0.058	0.258	9,115
United States	59.6	0.064	0.251	12,101
Correlation with labor Productivity		0.190	0.132	0.846

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. Labor productivity is defined as the ratio of GDP in 2011 PPP$ to hours worked.

b. Year 2003 for Greece.

Table 4. Labor Productivity and Compensation of Educational Personnel at All Levels of Schooling in Current Prices and National Currency by OECD Country, 2011

Country	Labor Productivity[a]	Ratio of Educ. Expend. to GDP In Current Prices[b]	Ratio of Educ. Expend. per Student to GDP per Capita In Current Prices[b]	Educ. Expend. per Student in PPP$[b]
Australia	47.9	0.035	0.127	2,871
Austria	50.0	0.039	0.192	8,105
Belgium	58.6	0.055	0.210	8,097
Canada	45.6	0.041	0.204	8,251
Czech Republic	27.4	0.025	0.120	3,168
Denmark	50.8	0.057	0.215	8,795
Finland	48.1	0.039	0.149	5,589
France	55.5	0.045	0.189	6,879
Germany	54.5	0.036	0.182	7,177
Greece	30.1	0.025	0.129	2,791
Hungary	26.1	--	--	--
Iceland	39.1	0.054	0.170	6,216
Ireland	60.6	0.045	0.171	7,235
Italy	43.7	0.033	0.176	5,760
Japan	39.4	0.031	0.189	6,524
Korea	28.9	0.037	0.157	4,661
Luxembourg	81.1	0.031	0.166	14,848
Mexico	20.3	0.042	0.135	1,028
Netherlands	60.1	0.044	0.173	7,422
New Zealand	34.4	--	--	--
Norway	74.8	0.040	0.154	9,397
Poland	25.5	0.036	0.161	3,419
Portugal	32.6	0.046	0.210	5,334
Slovak Republic	34.4	0.025	0.122	2,929
Spain	48.1	0.039	0.181	5,811
Sweden	50.1	0.040	0.151	6,277
Switzerland	48.4	0.035	0.180	9,244
Turkey	26.6	0.028	0.099	1,691
United Kingdom	47.2	0.036	0.162	5,470
United States	59.6	0.048	0.189	9,080
Correlation with labor Productivity		0.315	0.403	0.859

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. Labor productivity is defined as the ratio of GDP in 2011 PPP$ to hours worked.

b. Year 2002 for Australia and Mexico; year 2003 for Greece; and year 2010 for the U.K.

Table 5. Labor Productivity and Total Primary Educational Expenditures by OECD Country, 2011

Country	Labor Productivity[a]	Ratio of Educ. Expend. to GDP In Current Prices[b]	Ratio of Educ. Expend. per Student to GDP per Capita In Current Prices[b]	Educ. Expend. per Student in PPP$[b]
Australia	47.9	0.018	0.198	8,389
Austria	50.0	0.010	0.252	10,658
Belgium	58.6	0.016	0.233	9,018
Canada	45.6	0.022	0.341	13,783
Czech Republic	27.4	0.008	0.170	4,484
Denmark	50.8	0.019	0.226	9,254
Finland	48.1	0.014	0.212	7,942
France	55.5	0.012	0.185	6,735
Germany	54.5	0.007	0.186	7,332
Greece	30.1	0.013	0.230	5,594
Hungary	26.1	0.011	0.275	5,001
Iceland	39.1	0.025	0.268	9,781
Ireland	60.6	0.023	0.200	8,468
Italy	43.7	0.011	0.237	7,741
Japan	39.4	0.013	0.236	8,151
Korea	28.9	0.015	0.245	7,257
Luxembourg	81.1	0.018	0.262	23,433
Mexico	20.3	0.021	0.154	2,458
Netherlands	60.1	0.014	0.185	7,900
New Zealand	34.4	0.020	0.259	7,856
Norway	74.8	0.017	0.204	12,436
Poland	25.5	0.016	0.276	5,876
Portugal	32.6	0.014	0.203	5,163
Slovak Republic	34.4	0.009	0.226	5,400
Spain	48.1	0.014	0.220	7,071
Sweden	50.1	0.016	0.227	9,424
Switzerland	48.4	0.014	0.221	11,327
Turkey	26.6	0.011	0.075	1,275
United Kingdom	47.2	0.020	0.288	10,151
United States	59.6	0.018	0.228	10,958
Correlation with labor Productivity		0.190	0.097	0.769

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. Labor productivity is defined as the ratio of GDP in 2011 PPP$ to hours worked.

b. Year 2005 for Greece and year 2006 for Hungary.

Table 6. Labor Productivity and Total Secondary Educational Expenditures by OECD Country, 2011

Country	Labor Productivity[a]	Ratio of Educ. Expend. to GDP In Current Prices[b]	Ratio of Educ. Expend. per Student to GDP per Capita In Current Prices[b]	Educ. Expend. per Student in PPP$[b]
Australia	47.9	0.019	0.188	7,967
Austria	50.0	0.026	0.300	12,679
Belgium	58.6	0.028	0.260	10,055
Canada	45.6	0.015	0.184	7,458
Czech Republic	27.4	0.021	0.265	6,971
Denmark	50.8	0.025	0.253	10,367
Finland	48.1	0.027	0.263	9,850
France	55.5	0.027	0.286	10,447
Germany	54.5	0.023	0.252	9,960
Greece	30.1	0.015	0.236	5,756
Hungary	26.1	0.022	0.234	4,247
Iceland	39.1	0.024	0.200	7,292
Ireland	60.6	0.020	0.269	11,375
Italy	43.7	0.019	0.249	8,158
Japan	39.4	0.016	0.286	9,853
Korea	28.9	0.022	0.288	8,529
Luxembourg	81.1	0.015	0.175	15,676
Mexico	20.3	0.019	0.174	2,782
Netherlands	60.1	0.026	0.273	11,676
New Zealand	34.4	0.032	0.275	8,323
Norway	74.8	0.021	0.233	14,235
Poland	25.5	0.018	0.232	4,932
Portugal	32.6	0.022	0.264	6,705
Slovak Republic	34.4	0.019	0.193	4,626
Spain	48.1	0.019	0.268	8,601
Sweden	50.1	0.022	0.232	9,598
Switzerland	48.4	0.018	0.235	12,044
Turkey	26.6	0.017	0.258	4,389
United Kingdom	47.2	0.026	0.275	9,701
United States	59.6	0.021	0.264	12,731
Correlation with labor Productivity		0.122	0.014	0.905

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. Labor productivity is defined as the ratio of GDP in 2011 PPP$ to hours worked.

b. Year 2005 for Greece and year 2006 for Hungary.

Table 7. Labor Productivity and Total Tertiary Educational Expenditures by OECD Country, 2011

Country	Labor Productivity[a]	Ratio of Educ. Expend. to GDP In Current Prices[b]	Ratio of Educ. Expend. per Student to GDP per Capita In Current Prices[b]	Educ. Expend. per Student in PPP$[b]
Australia	47.9	0.016	0.344	14,544
Austria	50.0	0.015	0.329	13,903
Belgium	58.6	0.014	0.183	7,052
Canada	45.6	0.026	0.448	18,097
Czech Republic	27.4	0.014	0.335	8,820
Denmark	50.8	0.019	0.354	14,497
Finland	48.1	0.019	0.285	10,673
France	55.5	0.015	0.355	12,955
Germany	54.5	0.013	0.397	15,681
Greece	30.1	0.014	0.448	10,917
Hungary	26.1	0.011	0.209	3,794
Iceland	39.1	0.012	0.146	5,321
Ireland	60.6	0.015	0.446	18,868
Italy	43.7	0.010	0.204	6,687
Japan	39.4	0.014	0.488	16,839
Korea	28.9	0.023	0.592	17,535
Luxembourg	81.1	--	--	--
Mexico	20.3	0.013	0.336	5,369
Netherlands	60.1	0.017	0.351	15,024
New Zealand	34.4	0.015	0.258	7,811
Norway	74.8	0.013	0.258	15,734
Poland	25.5	0.016	0.358	7,606
Portugal	32.6	0.014	0.330	8,394
Slovak Republic	34.4	0.010	0.205	4,900
Spain	48.1	0.013	0.500	16,038
Sweden	50.1	0.017	0.294	12,186
Switzerland	48.4	0.012	0.305	15,638
Turkey	26.6	0.014	0.211	3,588
United Kingdom	47.2	0.012	0.216	7,639
United States	59.6	0.028	0.730	35,177
Correlation with labor Productivity		0.178	0.113	0.563

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. Labor productivity is defined as the ratio of GDP in 2011 PPP$ to hours worked.

b. Year 2005 for Greece and year 2006 for Hungary.

Table 8. Regressions of Educational Expenditures in Total and By Component as a Percent of GDP

Independent Variables	Dependent Variable							
	ln(EDUCGDP)	ln(EDUCGDP)	ln(COMPGDP)	ln(COMPGDP)	ln(NONPGDP)	ln(NONPGDP)	ln(CAPGDP)	ln(CAPGDP)
Constant	-2.979**		-3.655		-4.073**		-5.620**	
	(17.96)		(19.48)		(9.96)		(9.84)	
ln(STUDPOP)	0.291**	-0.015	0.128	-0.218	0.883**	-0.437	-0.591#	-1.923
	(3.14)	(0.02)	(1.26)	(0.22)	(3.97)	(0.27)	(1.92)	(1.47)
ln(EMPPOP)	-0.471**	-0.529	-0.577**	-0.591	-1.064**	-0.915	0.718#	-1.004
	(3.97)	(1.41)	(4.54)	(1.37)	(3.84)	(1.29)	(1.80)	(1.22)
TIME	0.01059**	0.01208**	0.00866**	0.01016**	0.02467**	0.03187**	-0.00069	0.00444
	(11.17)	(5.63)	(8.86)	(4.08)	(11.58)	(7.78)	(0.22)	(1.06)
Country Dummies Included[a]	Yes	No	Yes	No	Yes	No	Yes	No
U.S. Coeff. minus the mean value of the other 29 countries	0.365		0.383		0.619		0.392	
R^2	0.911		0.930		0.926		0.825	
Adjusted R^2	0.901		0.922		0.917		0.805	
Standard Error	0.0641		0.0639		0.1393		0.2033	
Sargan Test		296059**		533649**		3129784**		8885032**
Estimation Method	OLS	GMM[b]	OLS	GMM[c]	OLS	GMM[c]	OLS	GMM[c]
Sample Size	343	343	310	296	310	296	309	295

Note: The sample consists of panel data, with observations on each of 31 countries by year from from 1998 to 2011. Robust standard errors are used. The absolute value of the t-statistic is shown in parentheses below the coefficient estimate. See notes to Table 1 for the key. In addition,
TIME: Calendar year minus 1997.
a. Australia is the excluded country
b. The GMM instrument is ln(COMPGDP).
c. The GMM instrument is ln(EDUCGDP). New Zealand is excluded because of missing values.
Significance levels: # - 10%. * - 5%. ** - 1%.

Table 9. Regressions of Educational Expenditures By Level of Schooling As a Percent of GDP

Independent Variables	Dependent Variable					
	ln(PRIMGDP)	ln(PRIMGDP)	ln(SCNDGDP)	ln(SCNDGDP)	ln(TERTGDP)	ln(TERTGDP)
Constant	-3.141**		-3.640**		-4.906**	
	(10.17)		(16.57)		(25.74)	
ln(STUDPOP)[b]	0.509**	0.166	0.367**	1.700#	-0.040	0.760*
	(4.76)	(0.51)	(5.18)	(1.77)	(0.94)	(2.03)
ln(EMPPOP)	-0.263	-0.454	-0.580**	-0.677	-0.585**	-0.289
	(1.47)	(1.30)	(3.24)	(1.54)	(3.62)	(1.17)
TIME	0.0094**	0.0099#	0.0115**	0.0162**	0.0194**	0.0200**
	(5.23)	(1.94)	(7.78)	(5.46)	(14.83)	(11.94)
Country Dummies Included[a]	Yes	No	Yes	No	Yes	No
U.S. Coeff. minus the mean value of the other 29 countries	-0.069		0.230		0.849	
R^2	0.914		0.885		0.910	
Adjusted R^2	0.906		0.874		0.901	
Standard Error	0.0989		0.1008		0.0888	
Sargan Test		544134**		129662**		91499**
Estimation Method	OLS	GMM[c]	OLS	GMM[c]	OLS	GMM[d]
Sample Size	357	357	357	357	357	343

Note: The sample consists of panel data, with observations on each of 31 countries by year from from 1998 to 2008. Robust standard errors are used. The absolute value of the t-statistic is shown in parentheses below the coefficient estimate. See notes to Table 1 for the key. In addition,
TIME: Calendar year minus 1997.
a. Australia is the excluded country
b. Primary students only, secondary students only, and tertiary students only used, respectively, in the three regression equations.
c. The GMM instrument is ln(EDUCGDP).
d. The GMM instrument is ln(EDUCGDP). Luxembourg is excluded because of missing values.
Significance levels: # - 10%. * - 5%. ** - 1%.

Table 10. PISA Math and Literacy Scores and Total Secondary Educational Expenditures By OECD Country, 2011

Country	PISA Math Scores, 2012[a]	PISA Literacy Scores, 2012[a]	Ratio of Educ. Expend. to GDP In Current Prices, 2011[b]	Ratio of Educ. Expend. per Student to GDP per Capita in Current Prices, 2011[b]	Educ. Expend. per Student in PPP$, 2011[b]
Australia	504	512	0.019	0.188	7,967
Austria	506	490	0.026	0.300	12,679
Belgium	515	509	0.028	0.260	10,055
Canada	518	523	0.015	0.184	7,458
Czech Republic	499	493	0.021	0.265	6,971
Denmark	500	496	0.025	0.253	10,367
Finland	519	524	0.027	0.263	9,850
France	495	505	0.027	0.286	10,447
Germany	514	508	0.023	0.252	9,960
Greece	453	477	0.015	0.236	5,756
Hungary	477	488	0.022	0.234	4,247
Iceland	493	483	0.024	0.200	7,292
Ireland	501	523	0.020	0.269	11,375
Italy	485	490	0.019	0.249	8,158
Japan	536	538	0.016	0.286	9,853
Korea	554	536	0.022	0.288	8,529
Luxembourg	490	488	0.015	0.175	15,676
Mexico	413	424	0.019	0.174	2,782
Netherlands	523	511	0.026	0.273	11,676
New Zealand	500	512	0.032	0.275	8,323
Norway	489	504	0.021	0.233	14,235
Poland	518	518	0.018	0.232	4,932
Portugal	487	488	0.022	0.264	6,705
Slovak Republic	482	463	0.019	0.193	4,626
Spain	484	488	0.019	0.268	8,601
Sweden	478	483	0.022	0.232	9,598
Switzerland	531	509	0.018	0.235	12,044
Turkey	448	475	0.017	0.258	4,389
United Kingdom	494	499	0.026	0.275	9,701
United States	481	498	0.021	0.264	12,731
Correlation with PISA math scores			0.242	0.381	0.439
Correlation with PISA literacy scores			0.181	0.451	0.434

Source: OECD StatExtracts at: http://stats.oecd.org/Index.aspx?DataSetCode=RFIN2

a. PISA source: http://nces.ed.gov/surveys/pisa/. Note that the U.S. literacy score is for 2009.

b. Year 2005 for Greece and year 2006 for Hungary.

Table 11. Real Educational Spending per Student and PISA Test Scores
(Unweighted means)

Variable	2000	2003	2006	2009	2012[a]	Annual Rate of Change (%) 2003-2011	Annual Rate of Change (%) 2000-2011
1. PISAMATH	--	500	498	499	500	0.00	
2. PISALIT	491	495	492	496	497		0.10
3. Primary school spending per student, deflated by:							
(a) PPP GDP deflator	$5,175	$5,604	$6,051	$7,167	$7,447	3.16	3.03
(b) s_{2c} estimated from TIME coefficient in Table 9[b]	$6,169	$6,137	$6,051	$6,978	$7,061	1.56	1.12
4. Secondary school spending per student, deflated by:							
(a) PPP GDP deflator	$6,081	$6,855	$7,173	$8,056	$7,982	1.69	2.27
(b) s_{2c} estimated from TIME coefficient in Table 9[b]	$7,528	$7,650	$7,173	$7,746	$7,380	-0.40	-0.17
5. tertiary school spending per student, deflated by:							
(a) PPP GDP deflator	$8,236	$9,000	$9,680	$10,668	$10,843	2.07	2.29
(b) s_{2c} estimated from TIME coefficient in Table 9[b]	$10,431	$10,159	$9,680	$10,180	$9,873	-0.32	-0.46

Key: PISAMATH: PISA math score. PISALIT: PISA literacy score.
a. Note that educational spending is for 2011 instead of 2012.
b. Based on cross-country average labor productivity growth for the period. Normalized to 2006 prices.

Table 12. Regressions of PISA Math Scores on Educational Expenditures

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Constant	**6.354****	**5.482****	**5.484****	**5.626****	**5.622****	**5.626****
	(26.16)	**(51.96)**	**(52.03)**	**(54.69)**	**(54.83)**	**(55.69)**
ln(PRIMUSD05STUD)	**-0.0482**	**0.0241**				
	(1.61)	**(1.09)**				
ln(SCNDUSD05STUD)	**0.0359#**	**0.0606***	**0.0821****			
	(1.77)	**(2.45)**	**(6.91)**			
TIMEA	**0.0001**	**-0.0050**		**0.0006**	**0.0015**	
	(0.06)	**(1.02)**		**(0.11)**	**(0.29)**	
ln(PRIMDSTUD2SC)				**0.0186**		
				(0.80)		
ln(SCNDSTUD2SC)				**.0498#**	**0.0684****	**0.0685****
				(1.91)	**(5.76)**	**(5.80)**
Country Dummies Included[b]	**Yes**	**No**	**No**	**No**	**No**	**No**
R^2	**0.944**	**0.336**	**0.323**	**0.257**	**0.252**	**0.252**
Adjusted R^2	**0.919**	**0.316**	**0.316**	**0.235**	**0.237**	**0.244**
Standard Error	**0.0184**	**0.0535**	**0.0535**	**0.0566**	**0.0565**	**0.0562**
Estimation Method	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**
Sample Size	**102**	**102**	**102**	**102**	**102**	**102**

Note: The sample consists of panel data, with observations on each of 31 countries by year for years 2003, 2006, 2009, and 2011. The dependent variable is ln(PISAMATH).
The Slovak Republic and Turkey are excluded from the regressions because of missing values.
Robust standard errors are used. The absolute value of the t-statistic is shown in parentheses below the coefficient estimate. See notes to Table 1 for the key. In addition,
PISAMATH: PISA math score. Note that PISA scores for 2012 are used instead of 2011.
TIMEA: =1 for 2000; =2 for 2003; =3 for 2006; =4 for 2009; and =5 for 2011.
PRIMDSTUDS2C: Primary spending per student deflated by s_{2c} (estimated from Table 9 regressions).
SCNDSTUDS2C: Secondary spending per student deflated by s_{2c} (estimated from Table 9 regressions).
b. Australia is the excluded country
Significance levels: # - 10%. * - 5%. ** - 1%.

Table 13. Regressions of PISA Literacy Scores on Educational Expenditures

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	**5.571****	**5.587****	**5.584****	**5.609****	**5.699****	**5.704****	**5.722****	**5.721****
	(49.42)	**(48.71)**	**(49.34)**	**(56.98)**	**(52.77)**	**(52.11)**	**(52.37)**	**(59.88)**
ln(PRIMUSD05STUD)	**0.0545***			**0.0686****				
	(2.38)			**(6.05)**				
ln(SCNDUSD05STUD)	**0.0181**	**0.0696****	**0.0702****					
	(0.72)	**(5.24)**	**(5.48)**					
TIMEA	**-0.0001**	**0.0009**			**0.0048**	**0.0063**		
	(0.03)	**(0.21)**			**(1.11)**	**(1.48)**		
ln(PRIMDSTUD2SC)					**0.0490***			**0.0572****
					(2.07)			**(5.06)**
ln(SCNDSTUD2SC)					**0.0089**	**0.0562****	**0.0563****	
					(0.34)	**(4.42)**	**(4.41)**	
R^2	**0.236**	**0.199**	**0.199**	**0.232**	**0.183**	**0.154**	**0.138**	**0.175**
Adjusted R^2	**0.216**	**0.186**	**0.192**	**0.226**	**0.163**	**0.140**	**0.131**	**0.168**
Standard Error	**0.0638**	**0.0650**	**0.0648**	**0.0634**	**0.0659**	**0.0668**	**0.0672**	**0.0657**
Estimation Method	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**	**OLS**
Sample Size	**123**	**123**	**123**	**123**	**123**	**123**	**123**	**123**

Note: The sample consists of panel data, with observations on each of 31 countries by year for years 2003, 2006, 2009, and 2011. The dependent variable is ln(PISALIT).
The Slovak Republic and Turkey are excluded from the regressions because of missing values.
Robust standard errors are used. The absolute value of the t-statistic is shown in parentheses below the coefficient estimate. Country dummy variables are not included. See notes to Table 1 for the key. In addition,
PISALIT: PISA literacy score. Note that PISA scores for 2012 are used instead of 2011.
TIMEA: =1 for 2000; =2 for 2003; =3 for 2006; =4 for 2009; and =5 for 2011.
PRIMDSTUDS2C: Primary spending per student deflated by s_{2c} (estimated from Table 9 regressions).
SCNDSTUDS2C: Secondary spending per student deflated by s_{2c} (estimated from Table 9 regressions).
Significance levels: # - 10%. * - 5%. ** - 1%.

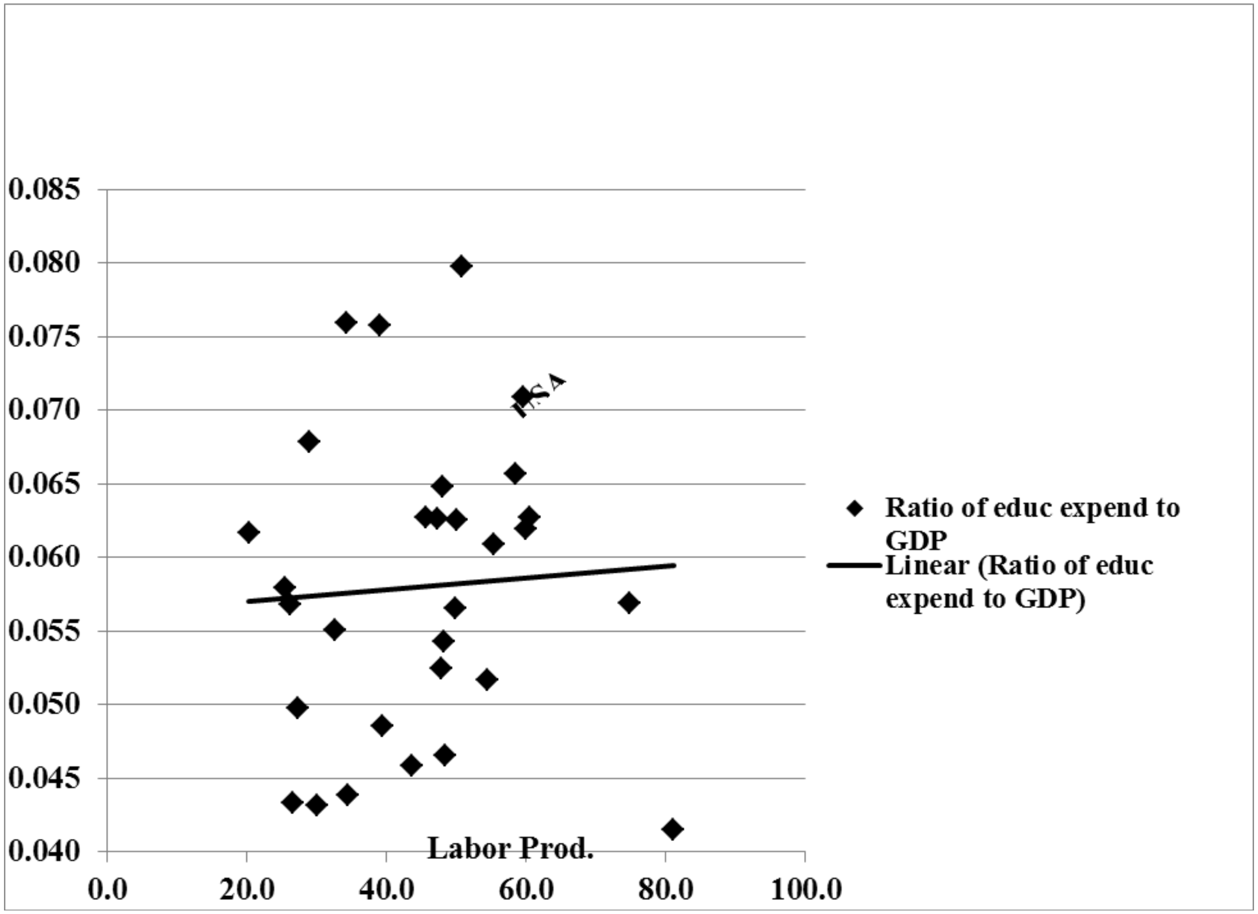

Figure 1a. Labor Productivity and Ratio of Total Educational Expenditures in Current Prices and National Currency to GDP, 2011.

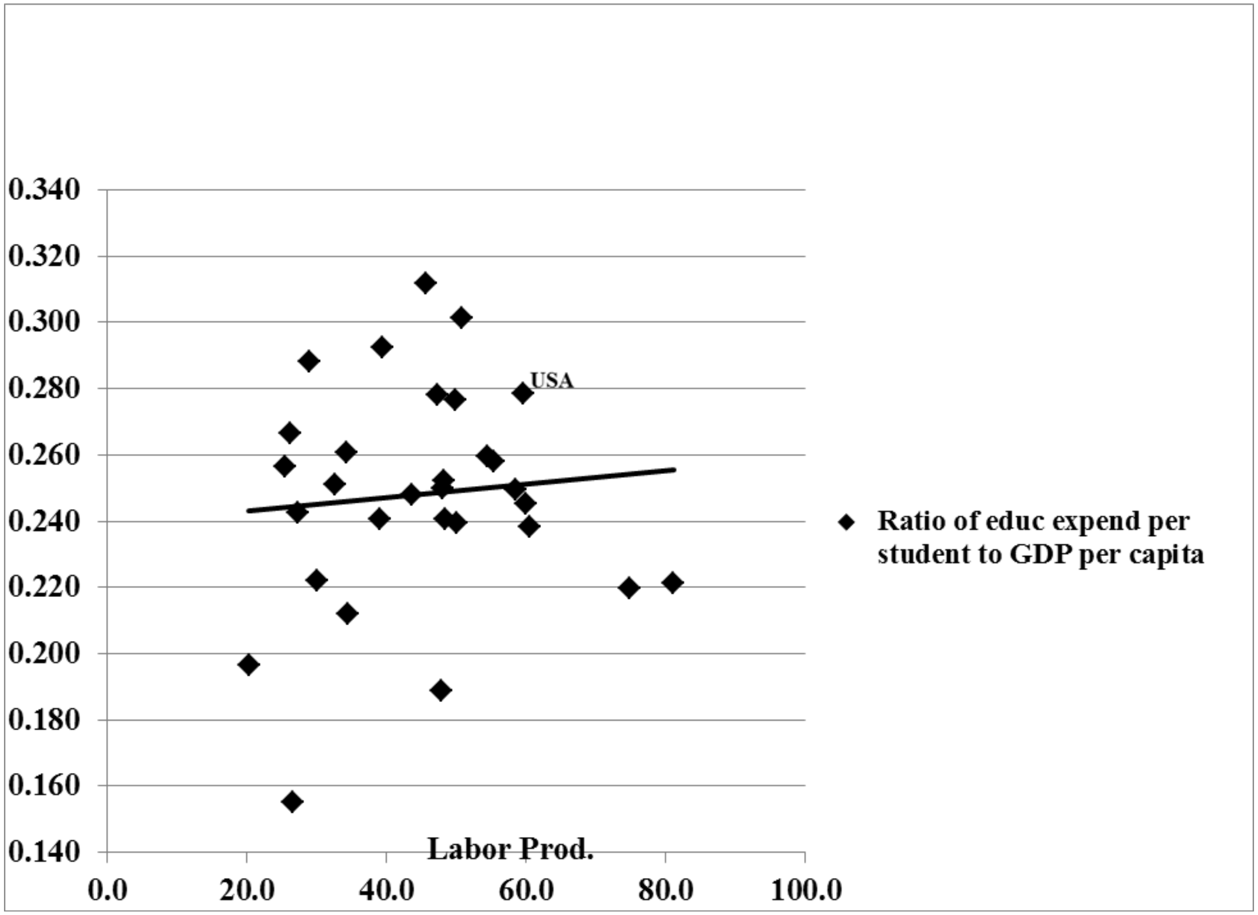

Figure 1b. Labor Productivity and Ratio of Total Educ. Expend. in Current Prices and National Currency per Student to GDP per Capita, 2011

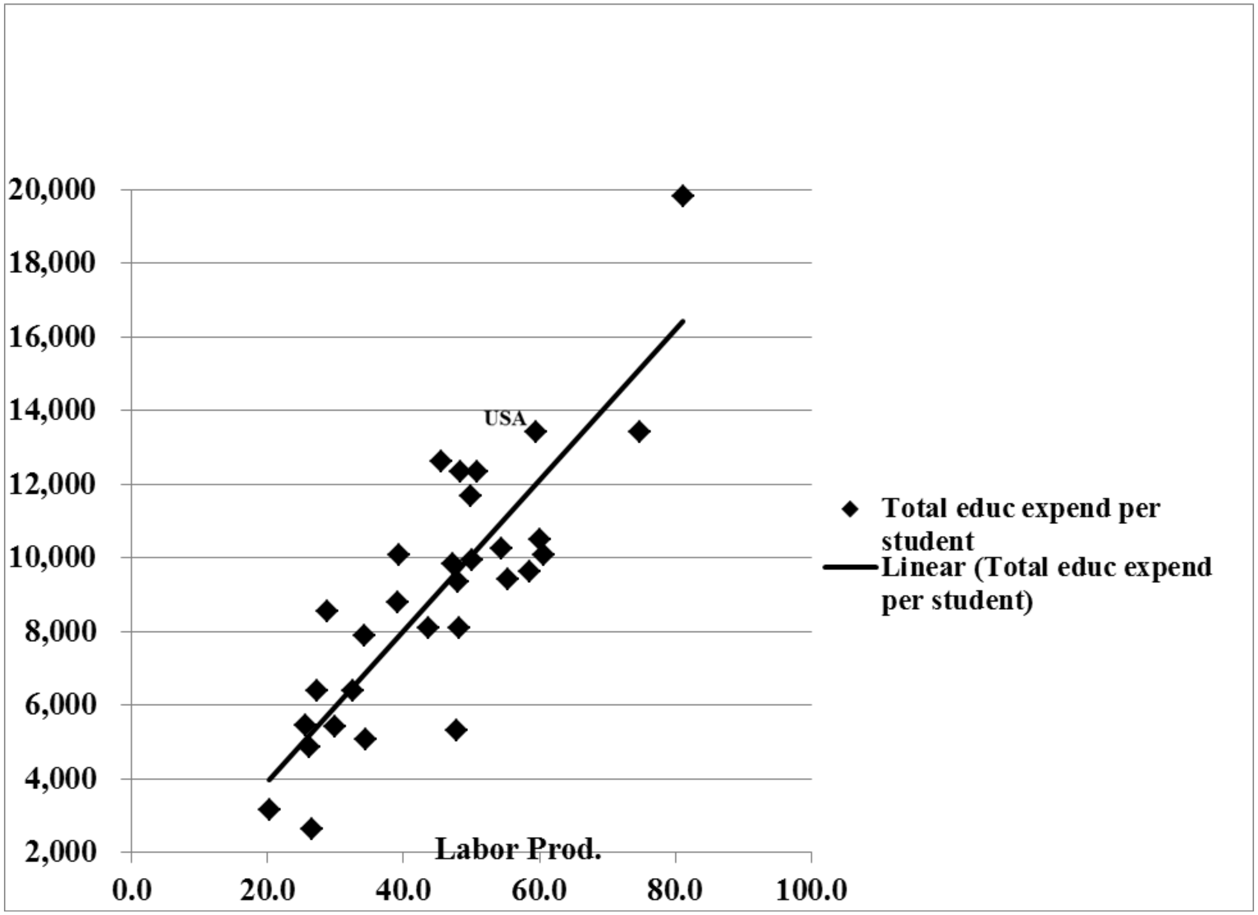

Figure 1c. Labor Productivity and Total Educational Expenditures per Student in PPP$, 2011

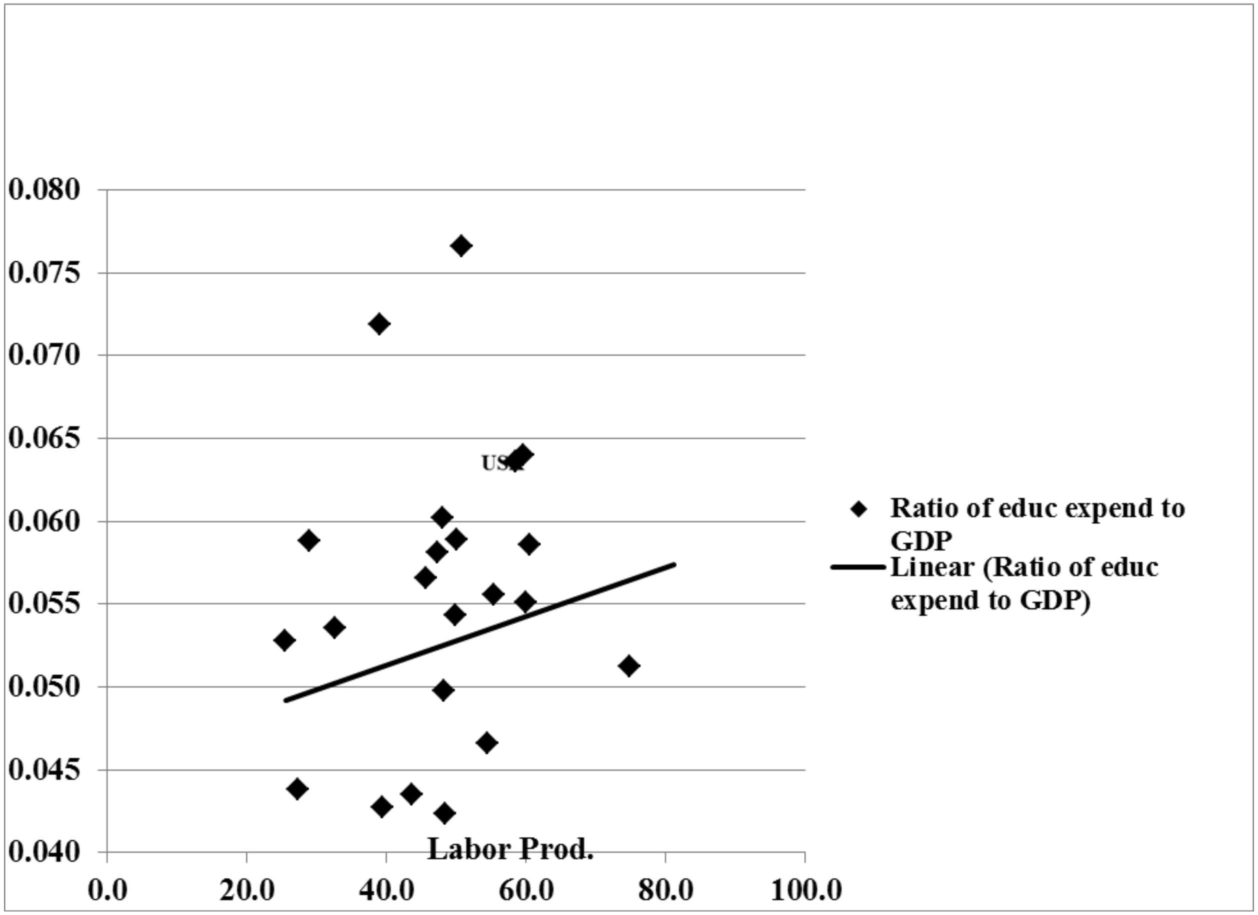

Figure 2a. Labor Productivity and Ratio of Current Educational Expenditures in Current Prices and National Currency to GDP, 2011

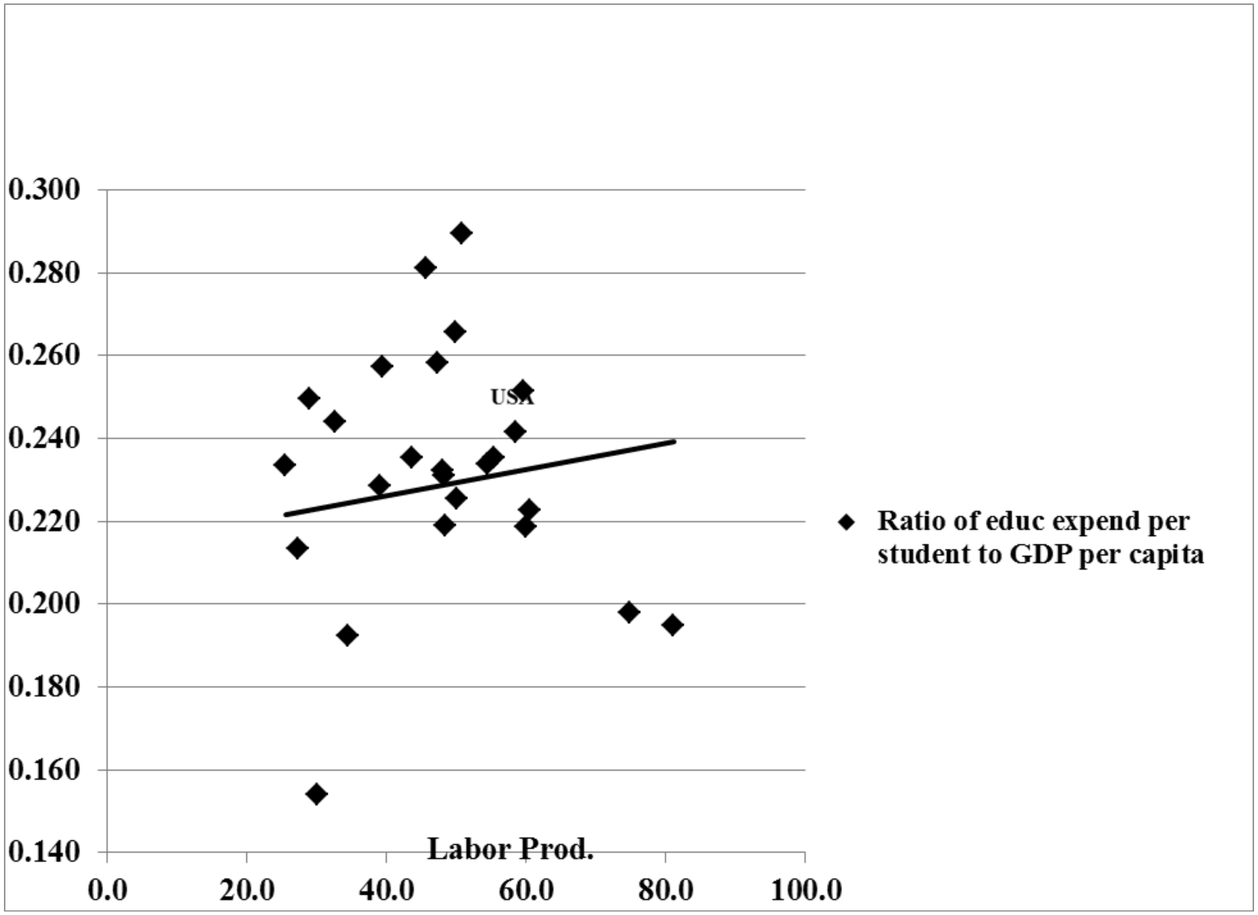

Figure 2b. Labor Productivity and Ratio of Current Educ. Expend. in Current Prices and National Currency per Student to GDP per Capita, 2011

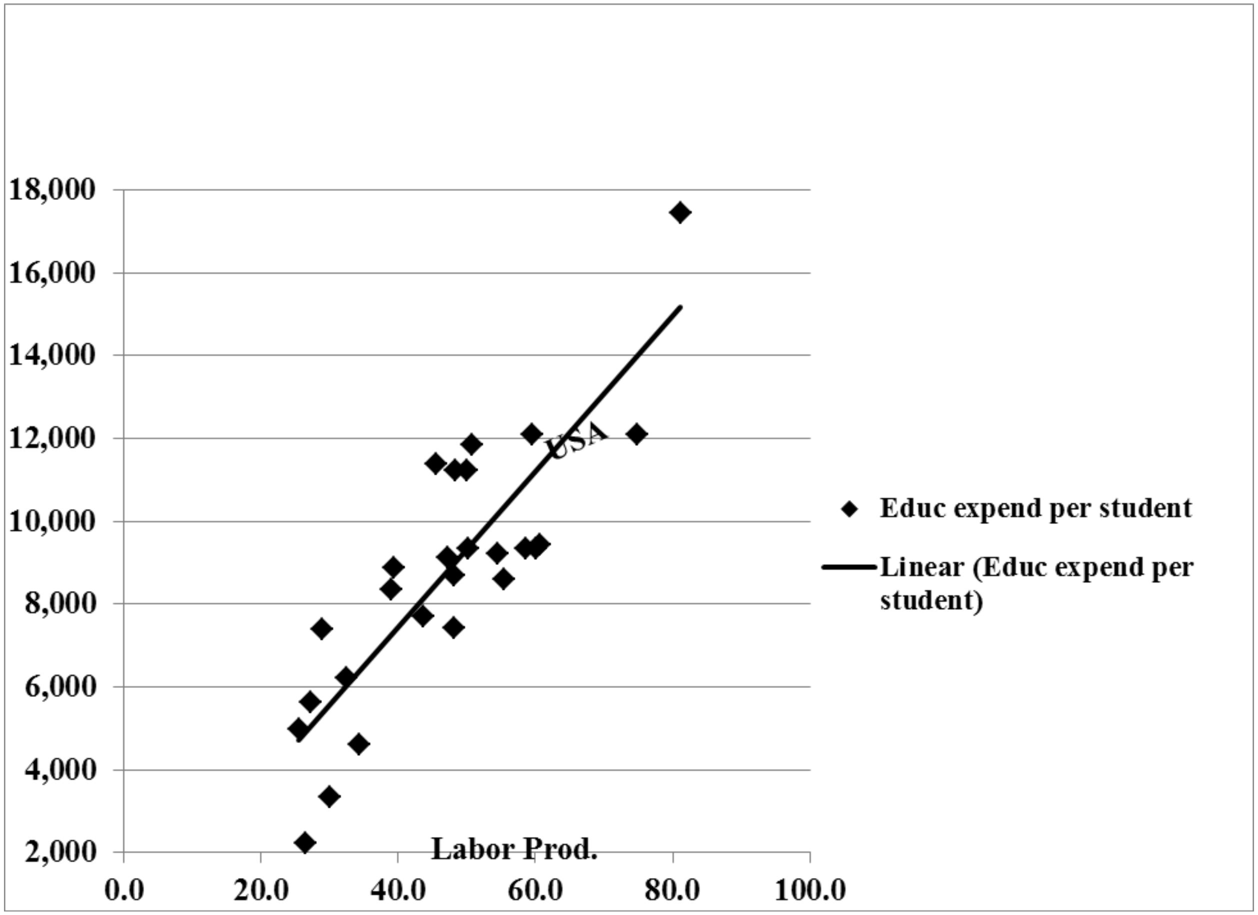

Figure 2c. Labor Productivity and Current Educational Expenditures per Student in PPP$, 2011

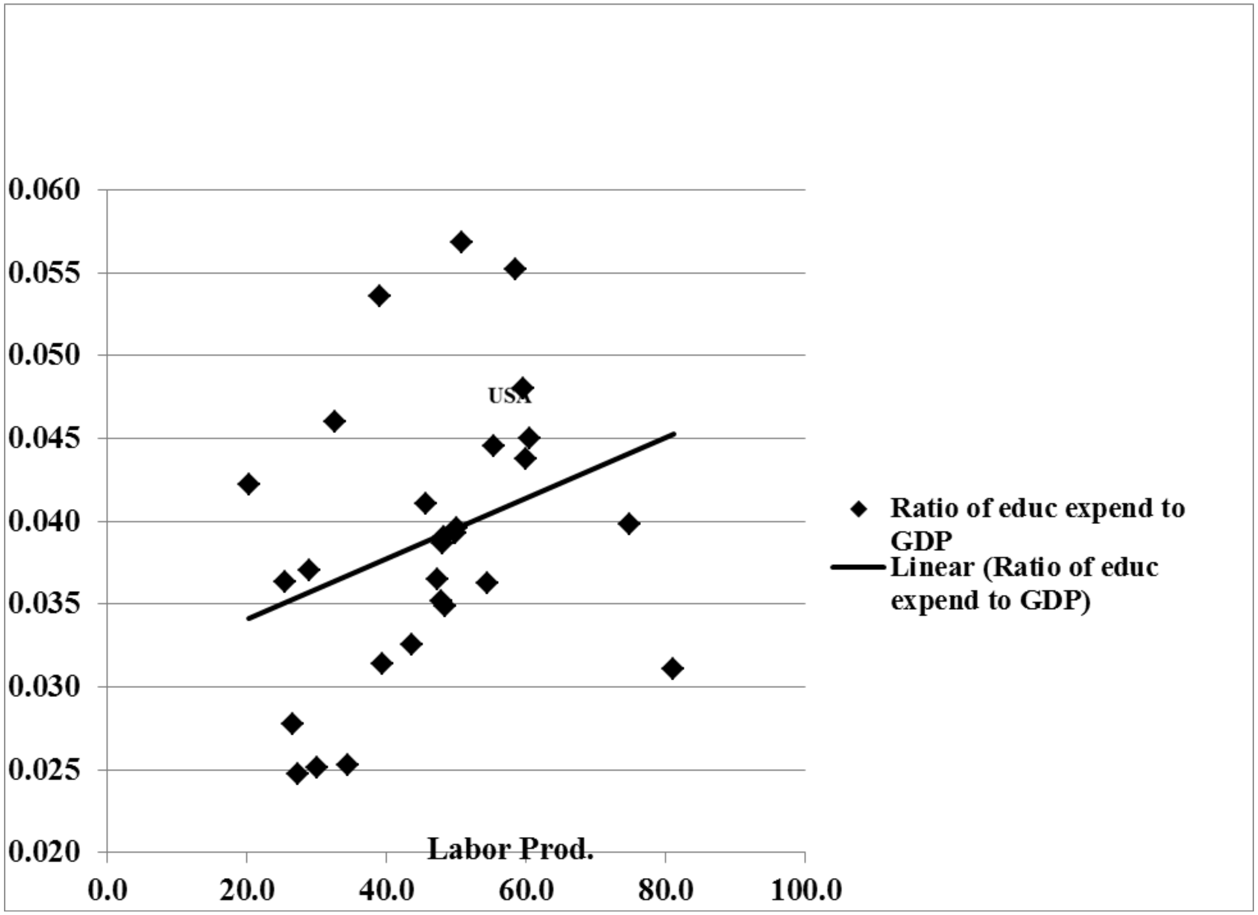

Figure 3a. Labor Productivity and Ratio of Compensation of Educational Personnel in Current Prices and National Currency to GDP, 2011

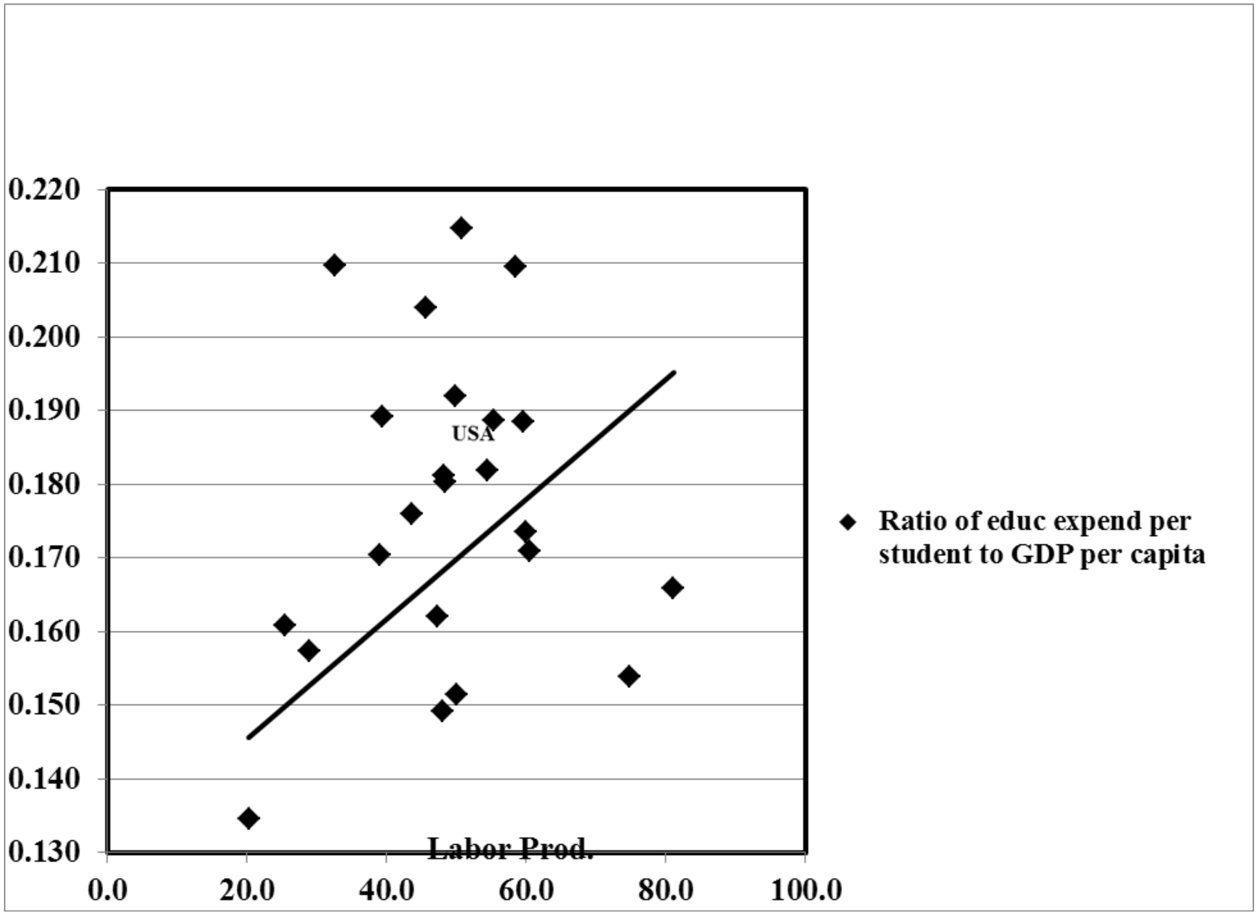

Figure 3b. Labor Productivity and Ratio of Compensation of Educational Personnel per Student to GDP per Capita, 2011

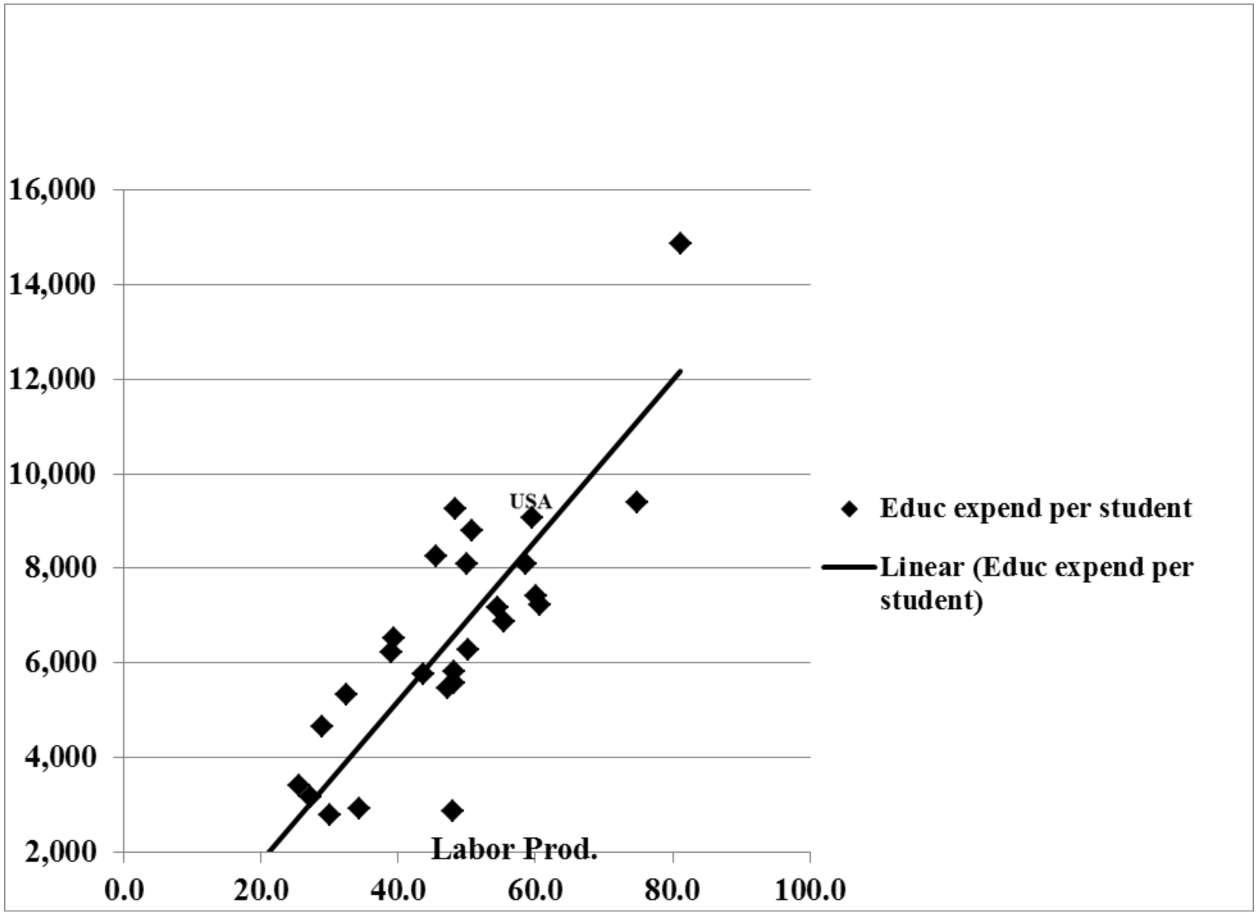

Figure 3c. Labor Productivity and Compensation of Educational Personnel per Student in PPP$, 2011

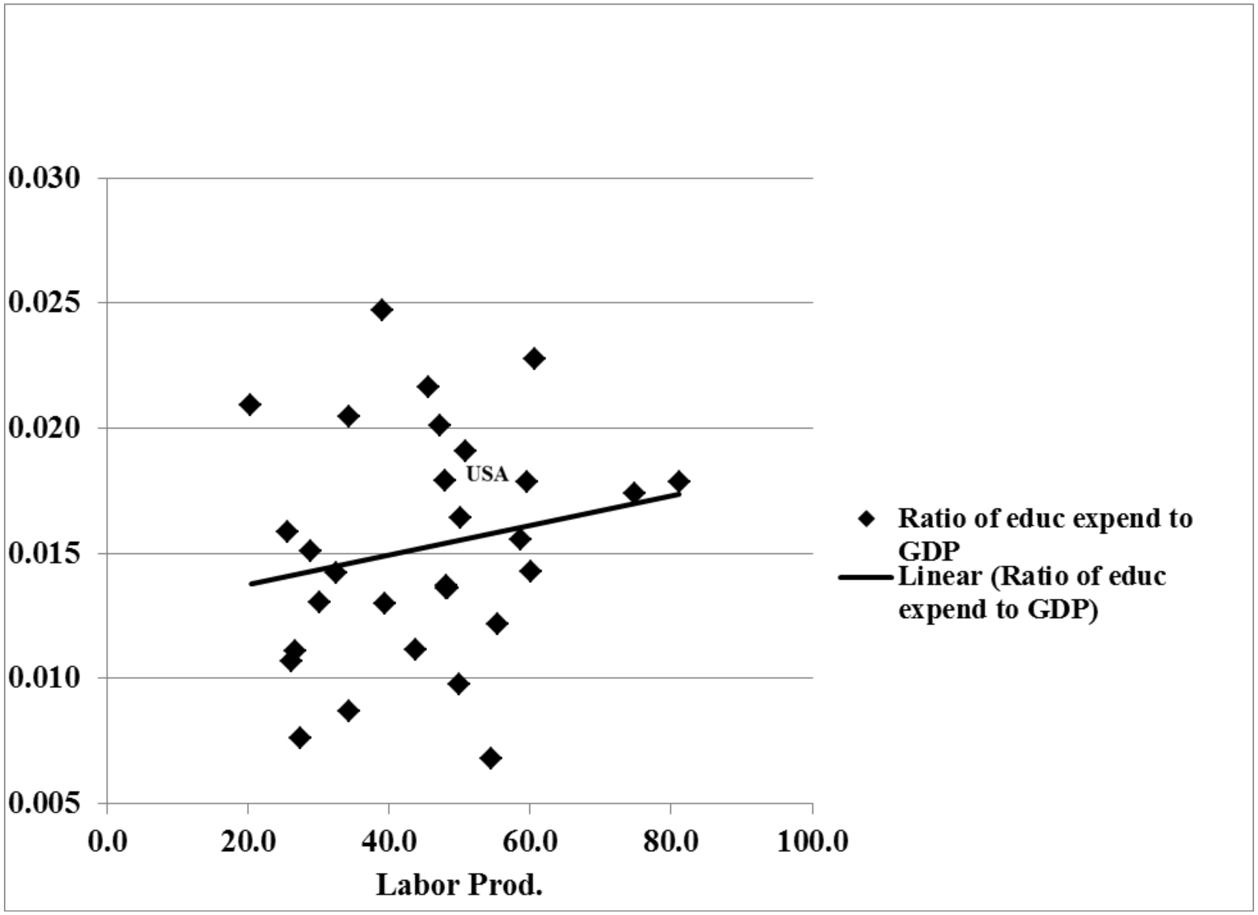

Figure 4a. Labor Productivity and Ratio of Total Primary Educational Expenditures to GDP, 2011

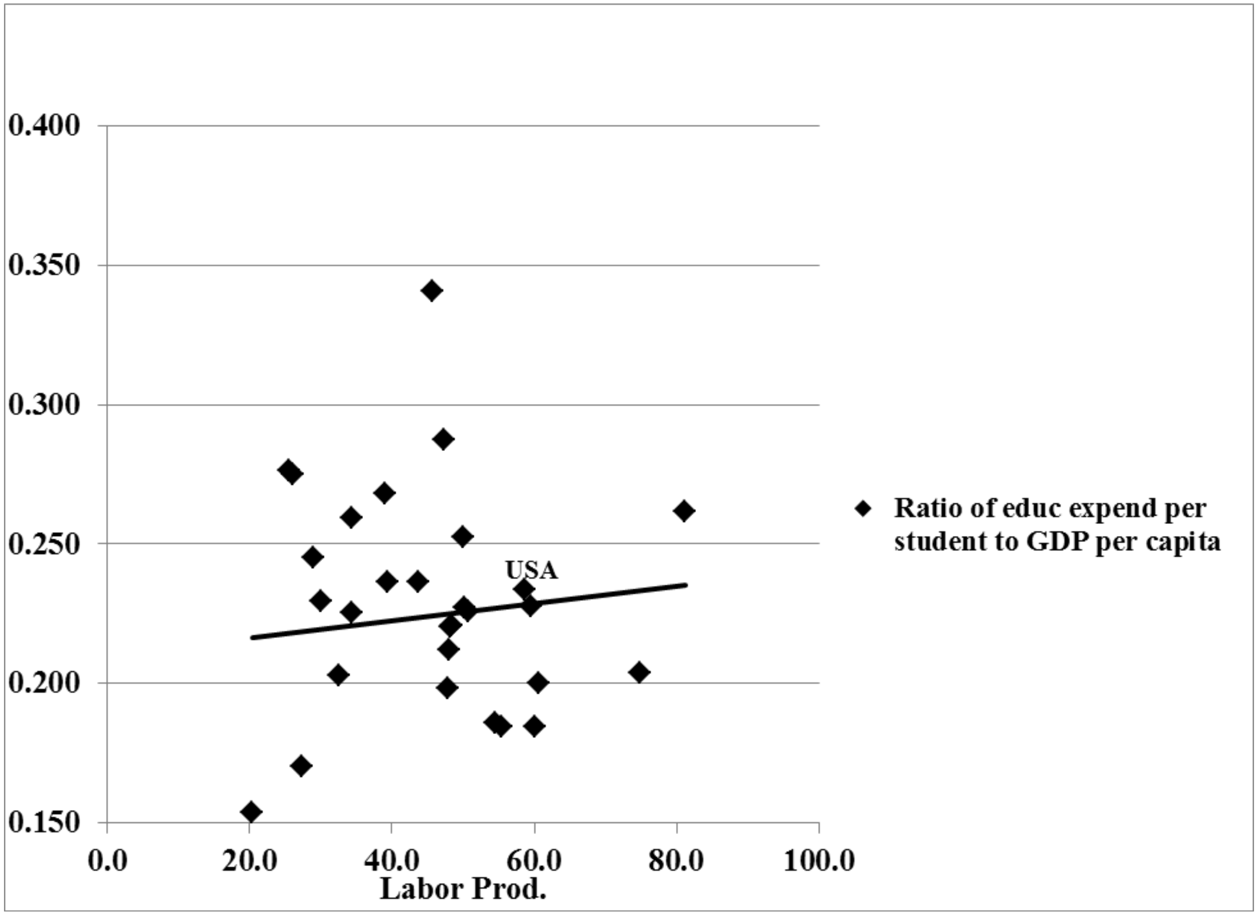

Figure 4b. Labor Productivity and Ratio of Total Primary Educational Expenditures per Student to GDP per Capita, 2011

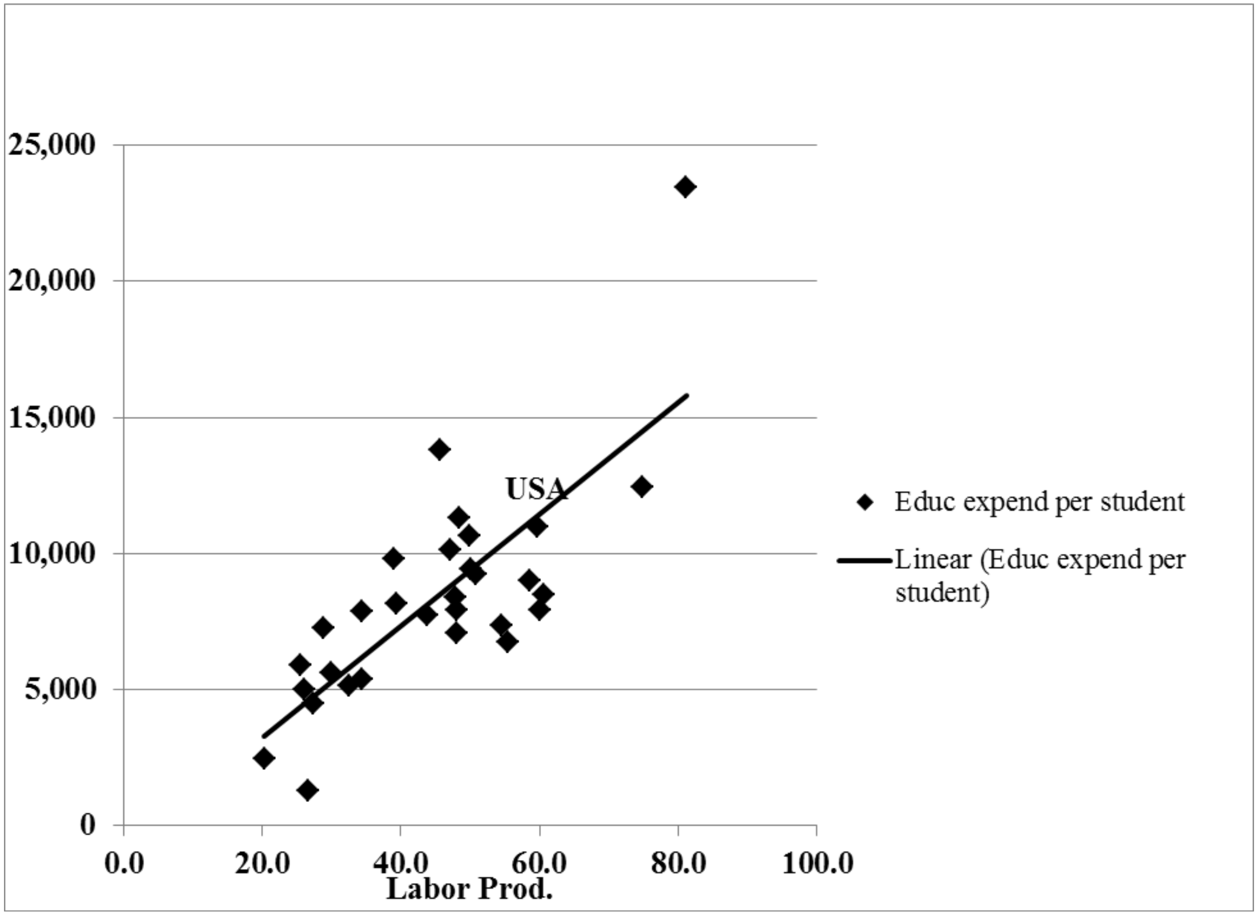

Figure 4c. Labor Productivity and Total Primary Educational Expenditures per Student in PPP$, 2011

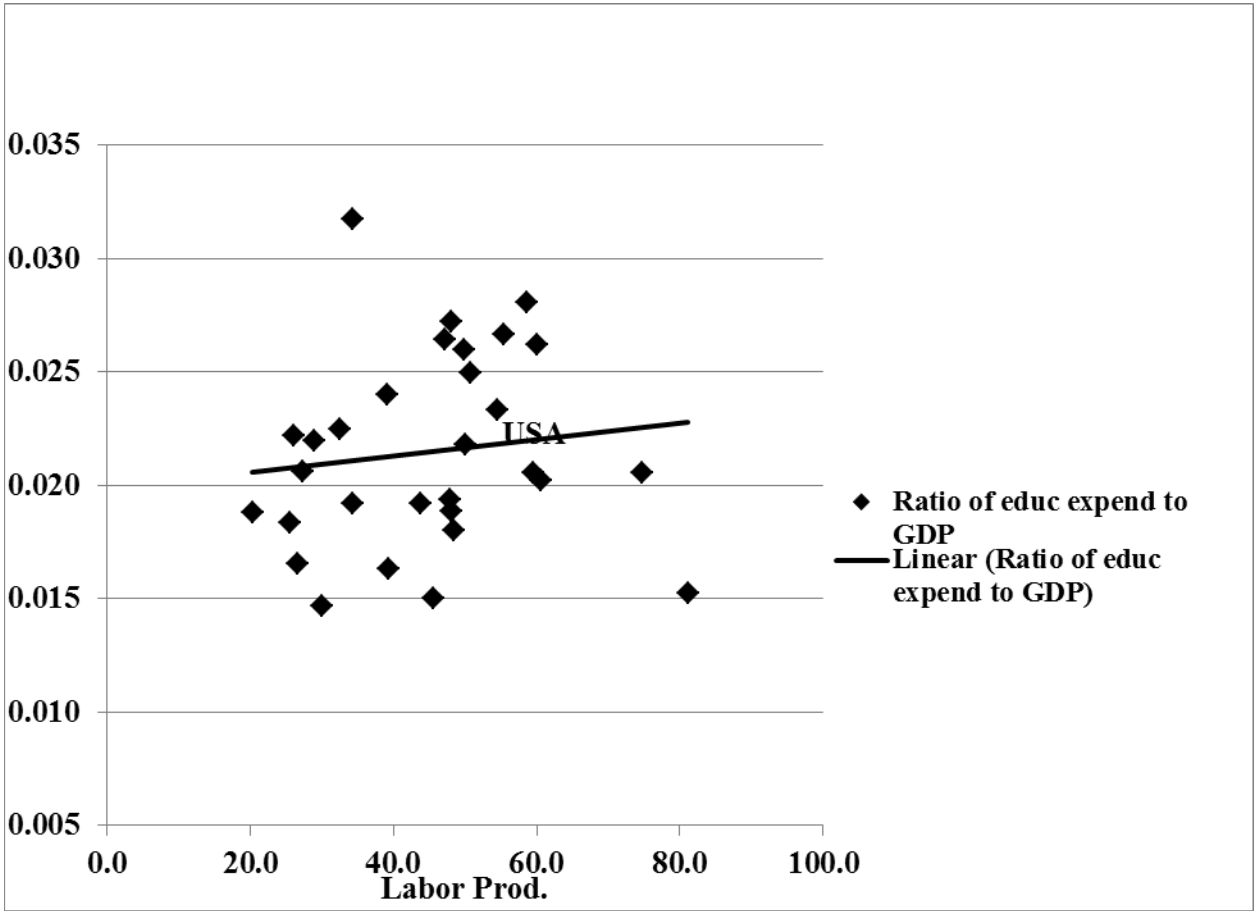

Figure 5a. Labor Productivity and Ratio of Total Secondary Educational Expenditures to GDP, 2011

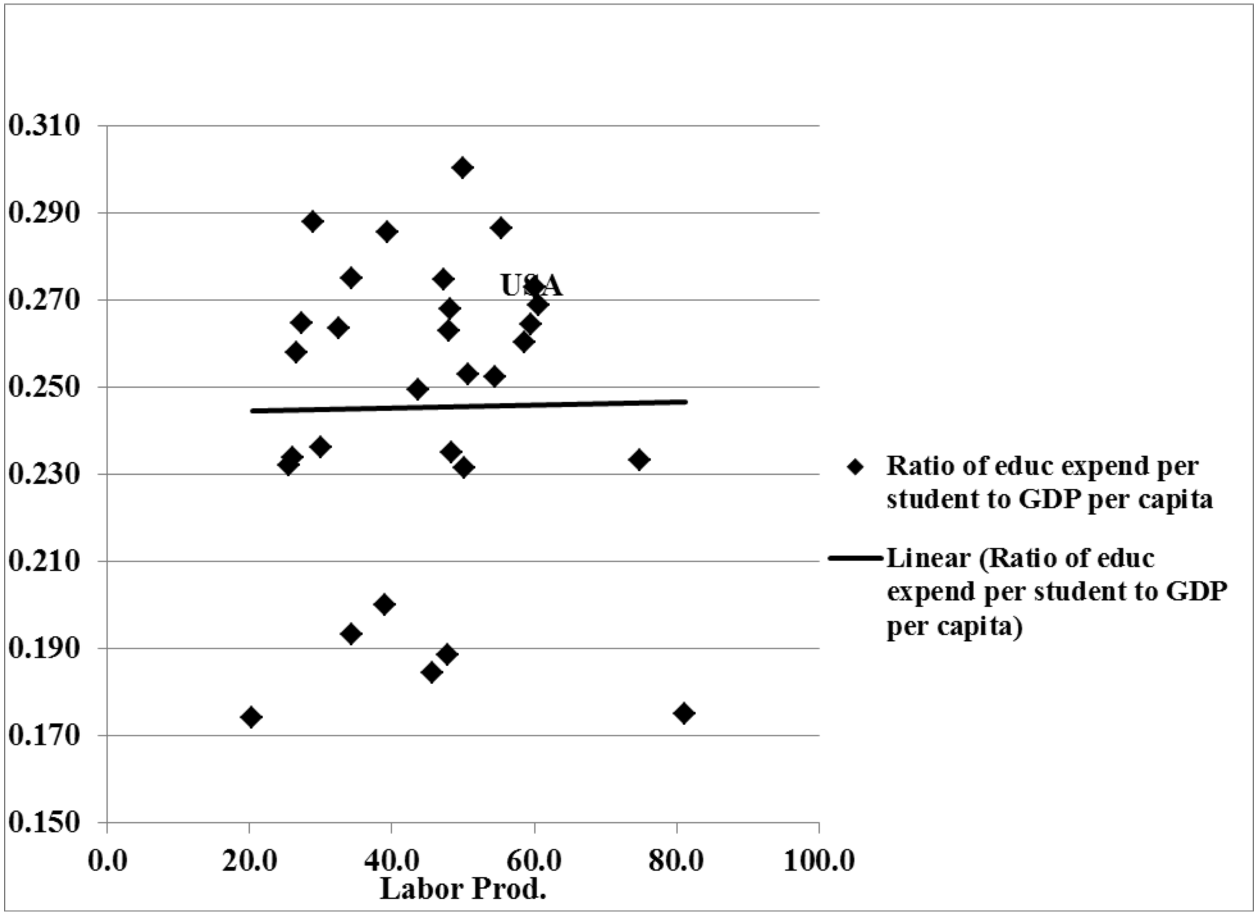

Figure 5b. Labor Productivity and Ratio of Total Secondary Educational Expenditures per Student to GDP per Capita, 2011

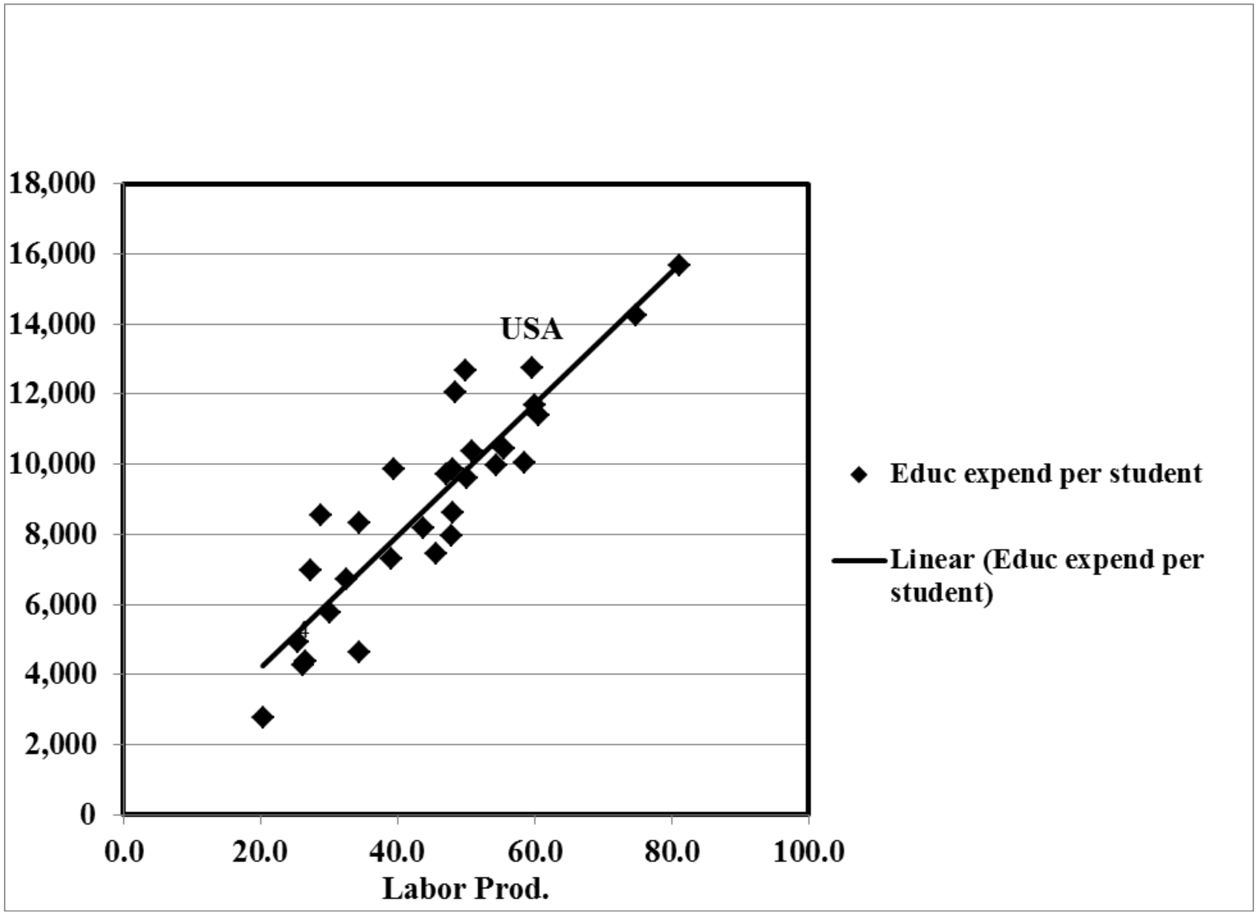

Figure 5c. Labor Productivity and Total Secondary Educational Expenditures per Student in PPP$, 2011

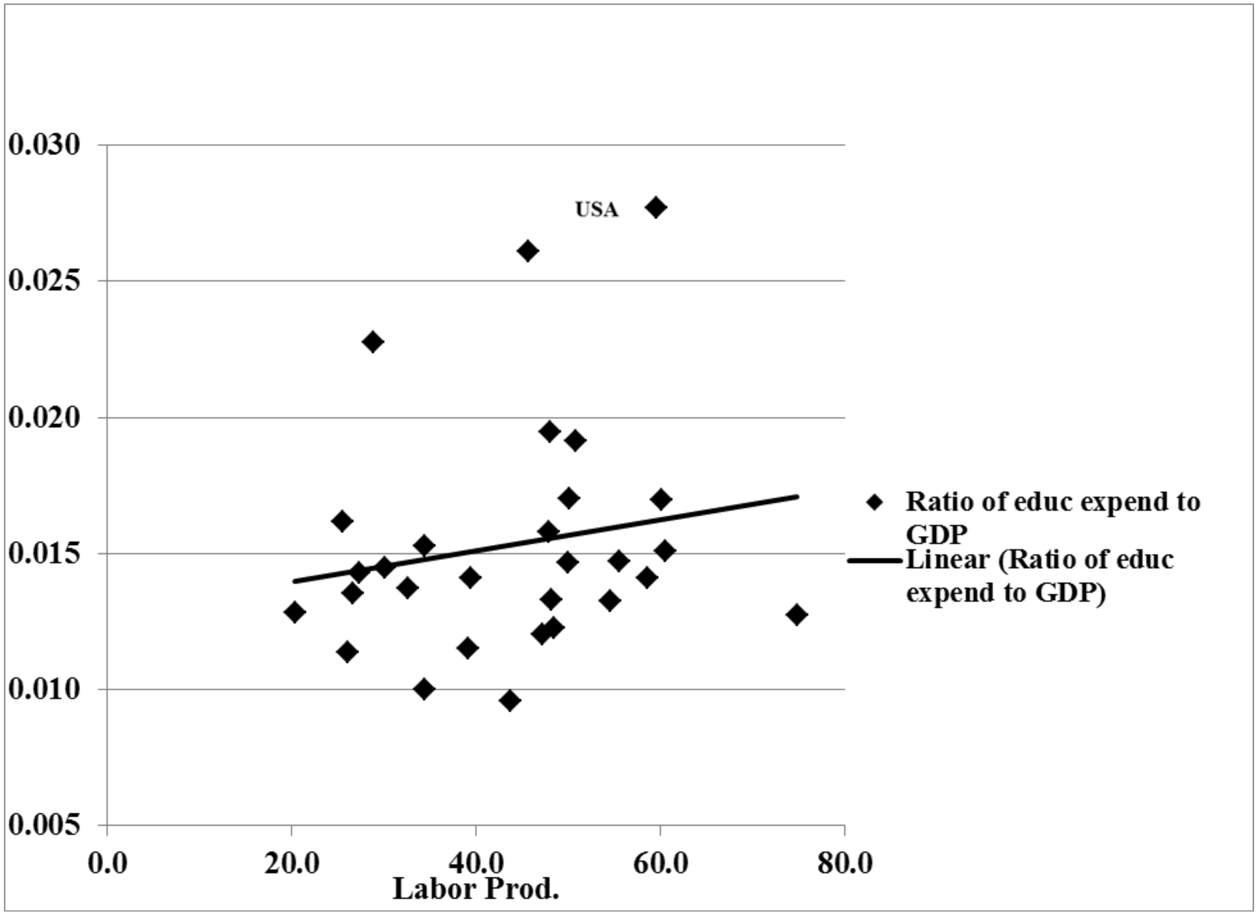

Figure 6a. Labor Productivity and Ratio of Total Tertiary Educational Expenditures to GDP, 2011

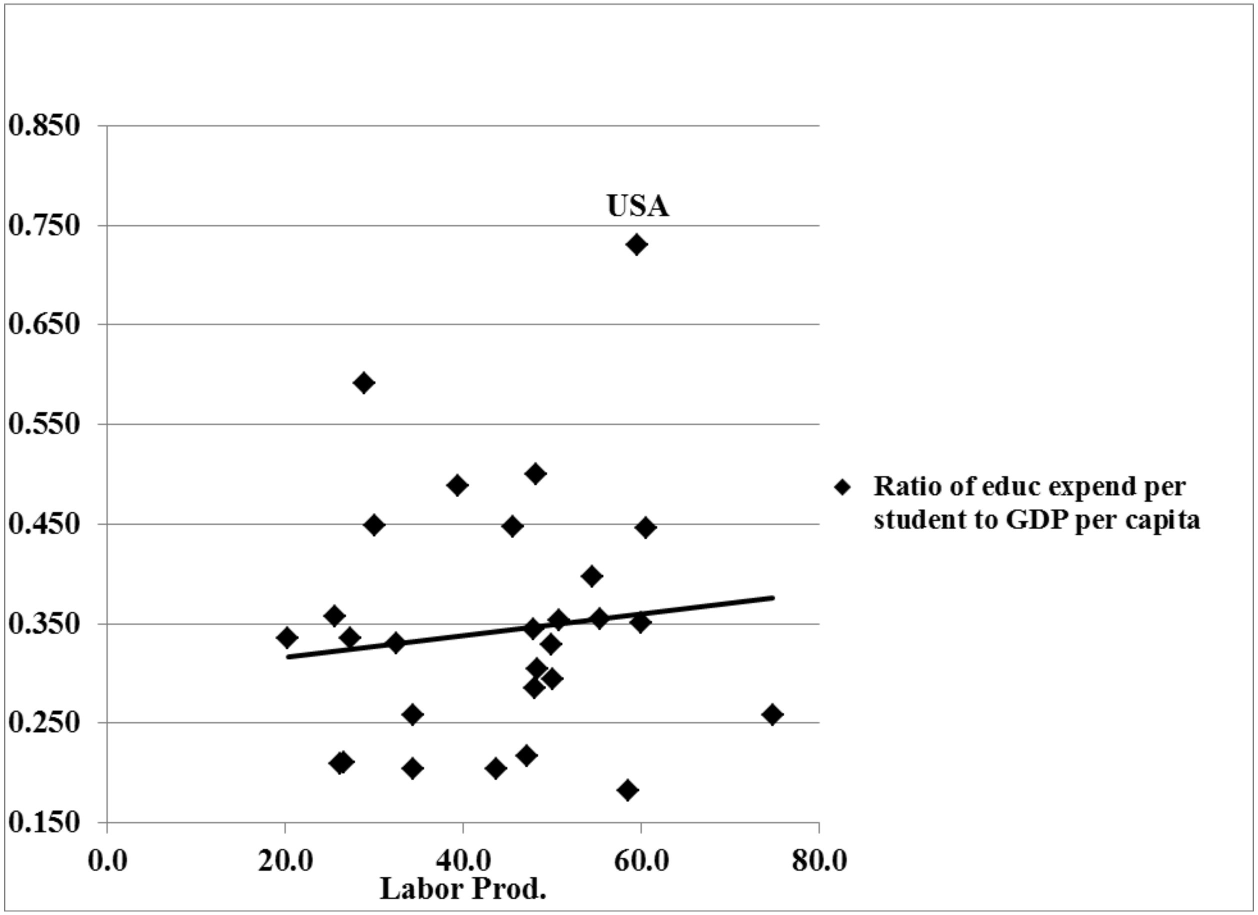

Figure 6b. Labor Productivity and Ratio of Total Secondary Educational Expenditures per Student to GDP per Capita, 2011

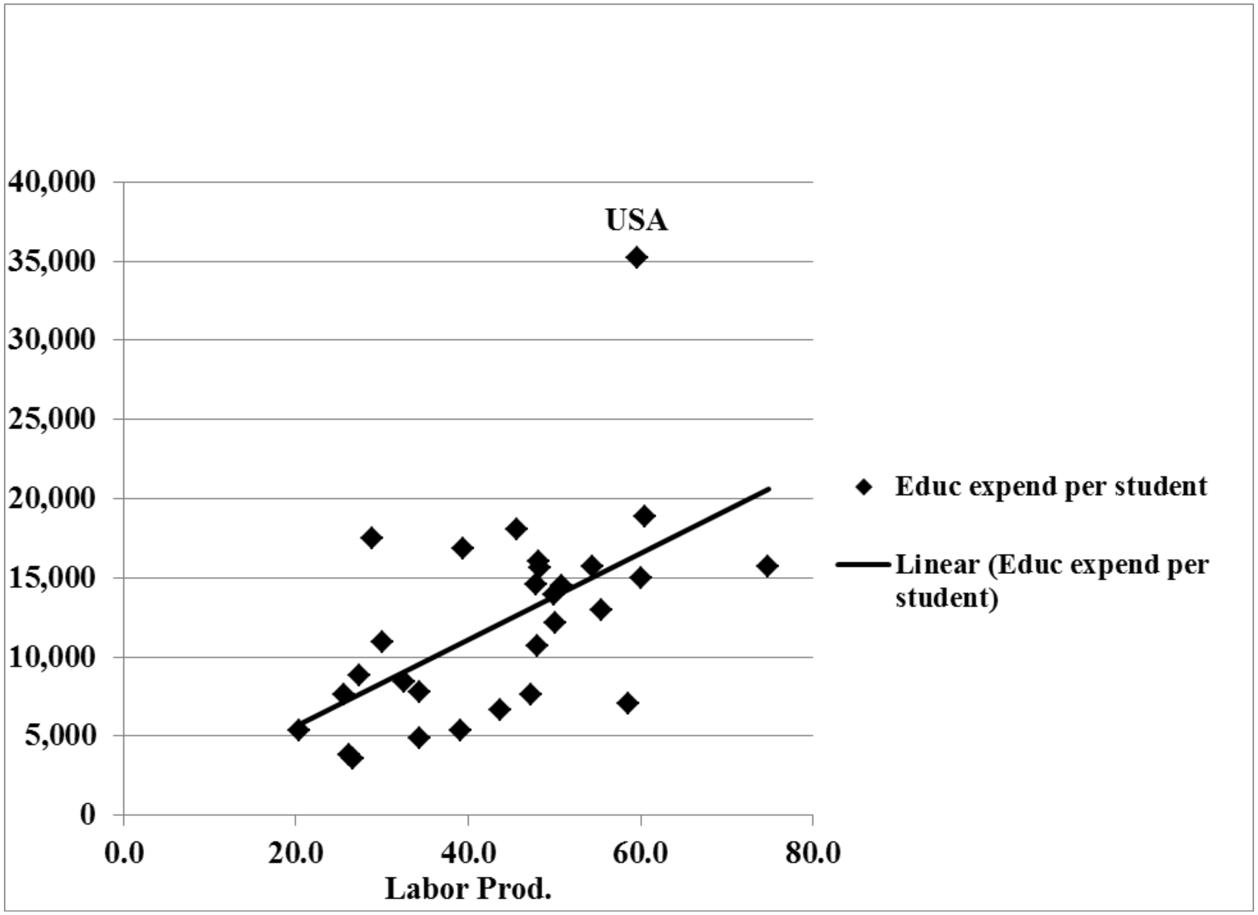

Figure 6c. Labor Productivity and Total Tertiary Educational Expenditures per Student in PPP$, 2011

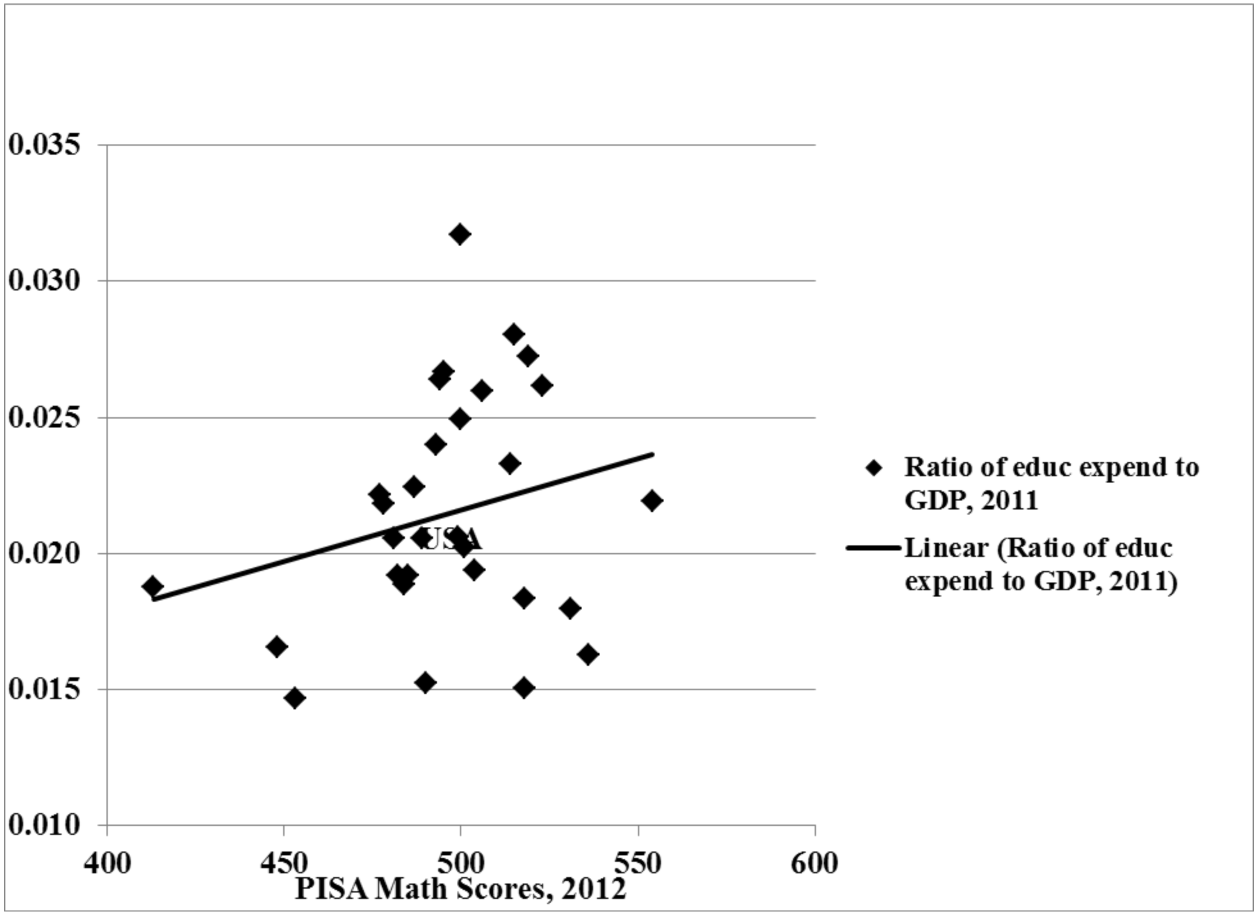

Figure 7a. PISA Math Scores and Ratio of Total Secondary Educational Expenditures to GDP, 2011

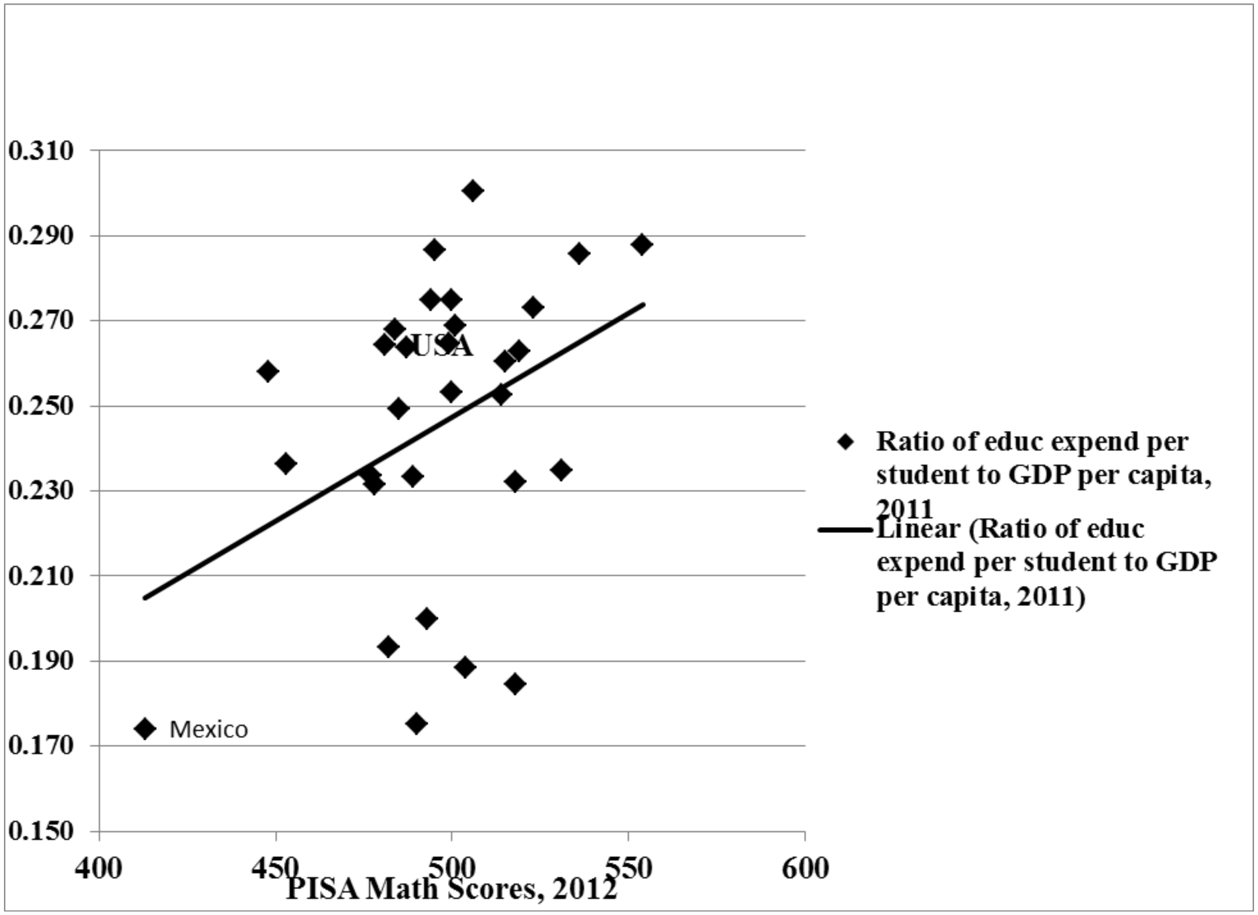

Figure 7b. PISA Math Scores and Ratio of Total Secondary Educational Expenditures per Student to GDP per Capita, 2011

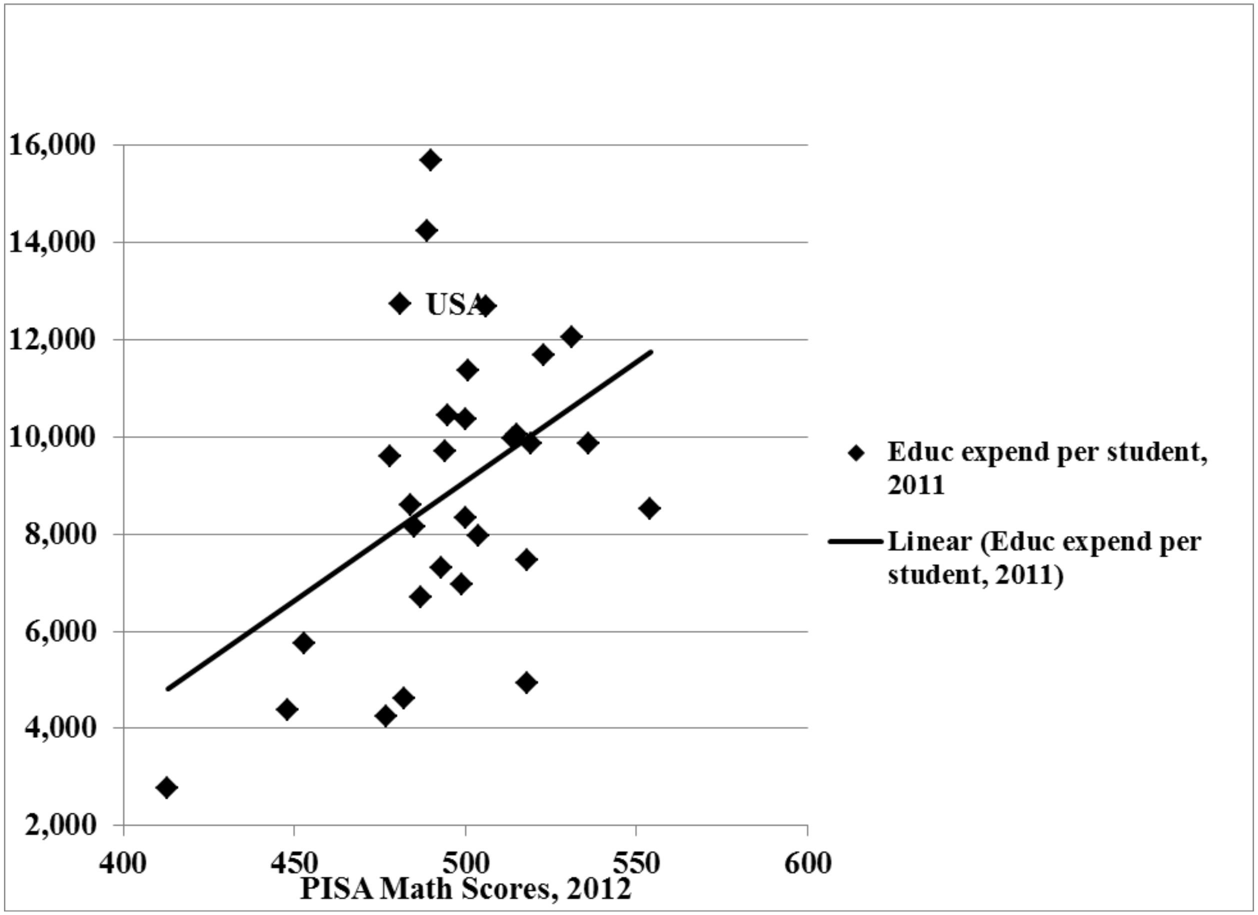

Figure 7c. PISA Math Scores and Total Secondary Educational Expenditures per Student in PPP$, 2011

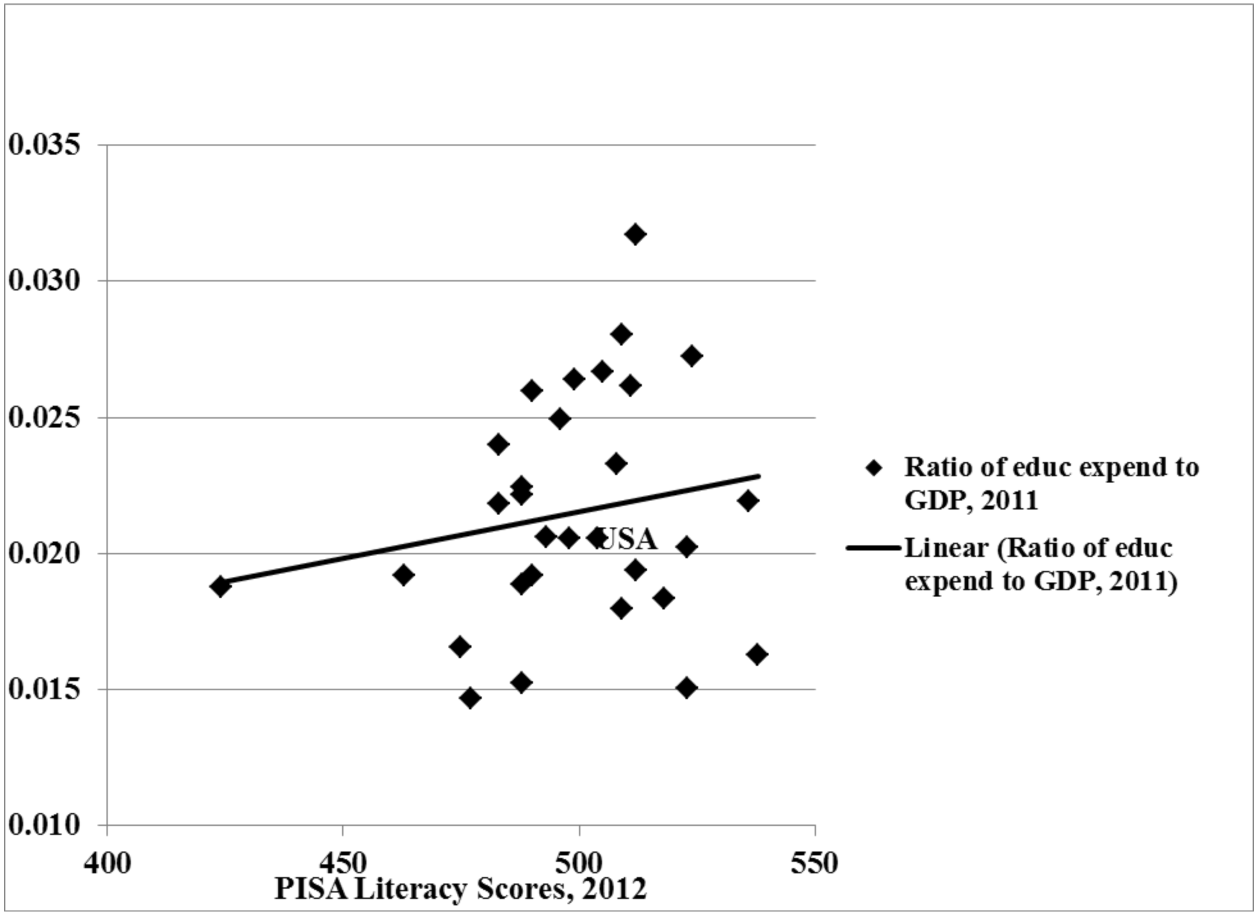

Figure 7d. PISA Literacy Scores and Ratio of Total Secondary Educational Expenditures to GDP, 2011

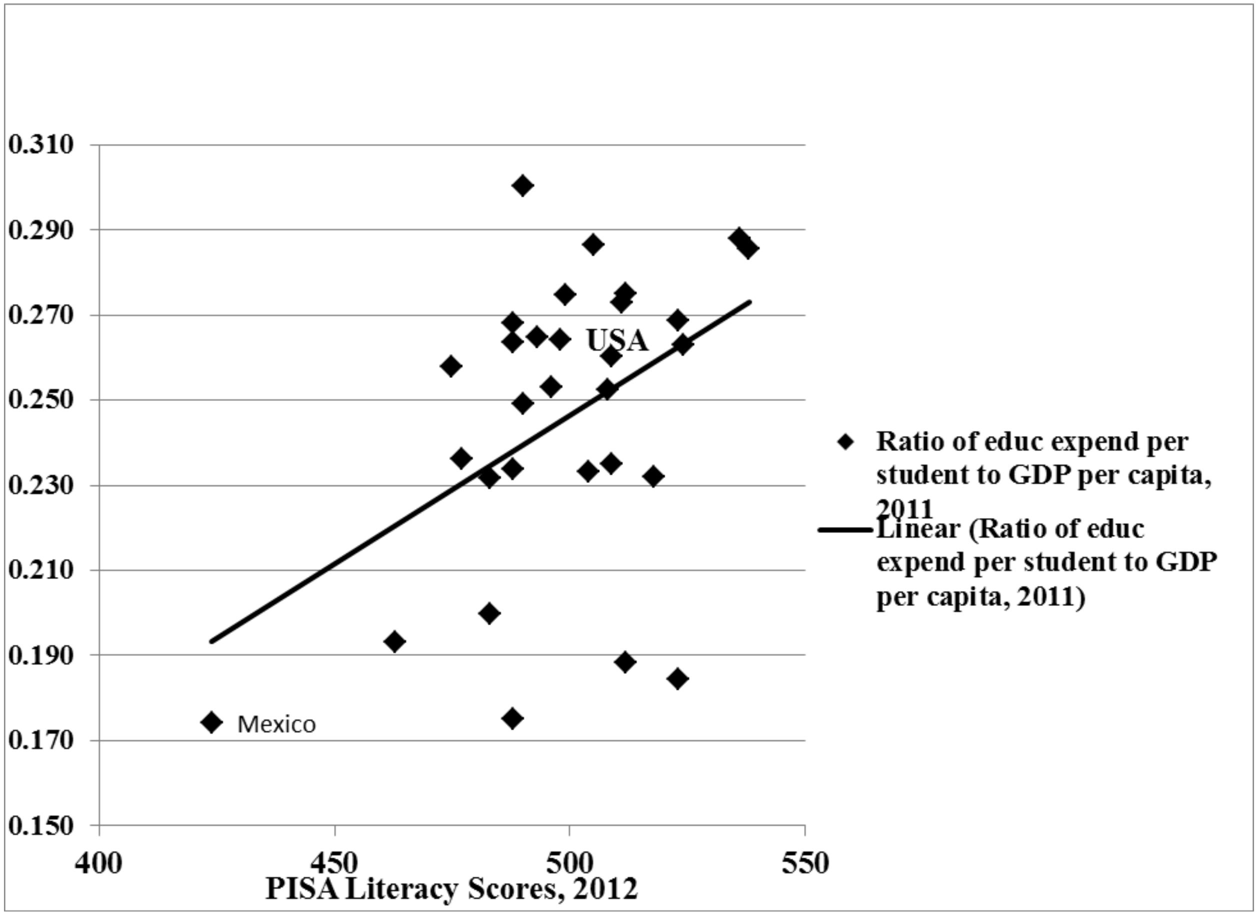

Figure 7e. PISA Literacy Scores and Ratio of Total Secondary Educational Expenditures per Student to GDP per Capita, 2011

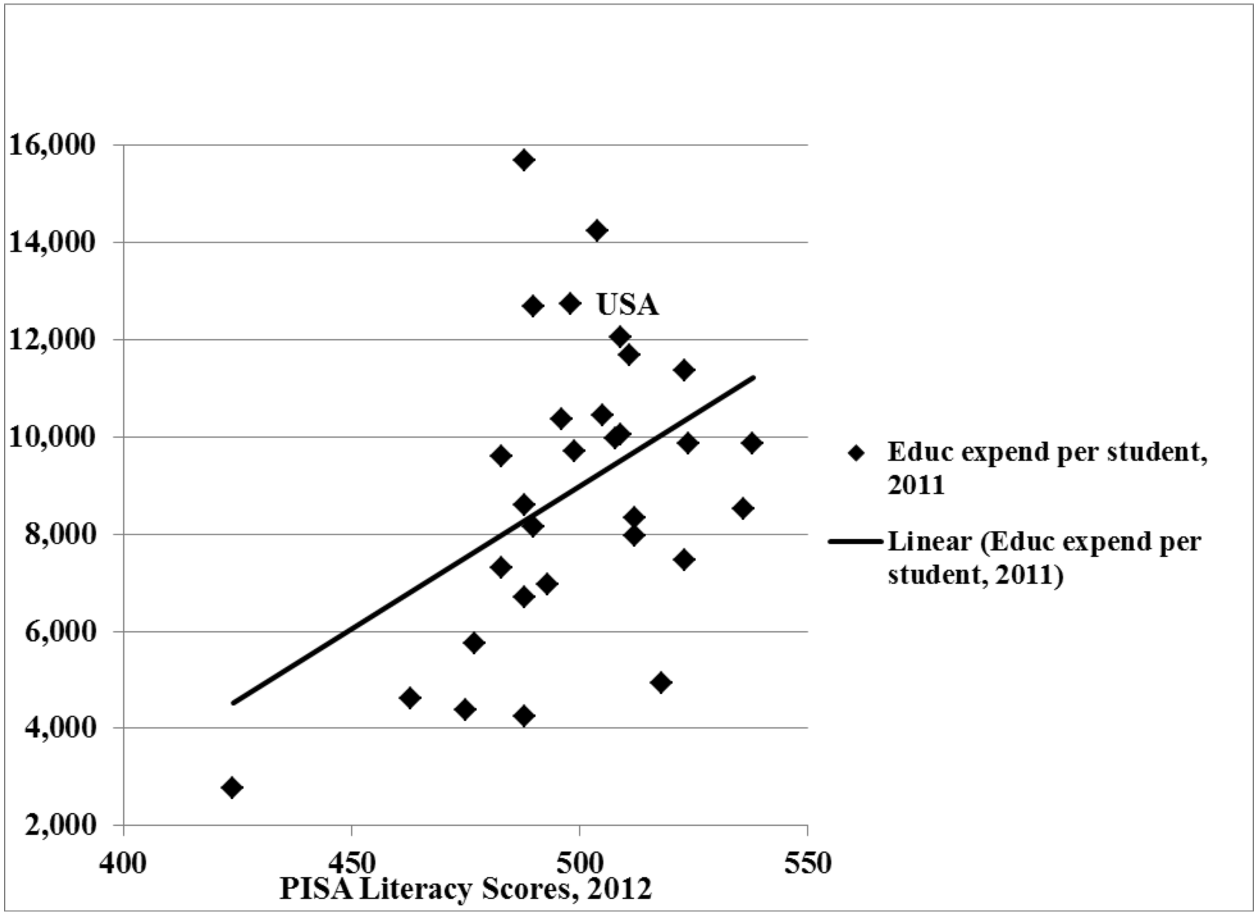

Figure 7f. PISA Lieracy Scores and Total Secondary Educational Expenditures per Student in PPP$, 2011

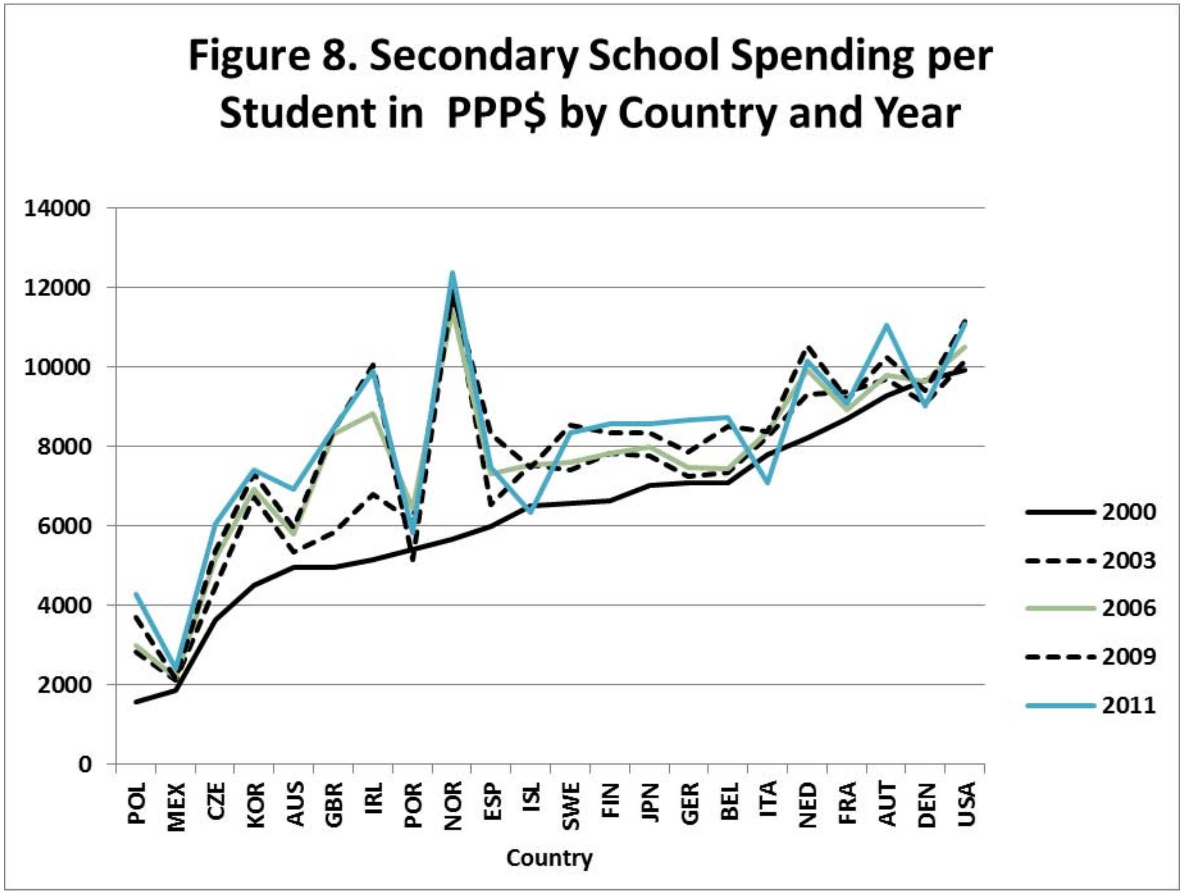

Figure 8. Secondary School Spending per Student in PPP$ by Country and Year