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Natural Resources, Education and Economic Development

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Natural Resources, Education, and Economic Development

Thorvaldur Gylfason*

Abstract

Economic growth since 1965 has varied inversely with the share of natural capital in national wealth across countries. Four main channels of transmission from abundant natural resources to stunted economic development are discussed: (a) the Dutch disease, (b) rent seeking, (c) overconfidence, and (d) neglect of education. Public expenditure on education relative to national income, expected years of schooling for girls, and gross secondary-school enrolment are all shown to be inversely related to the share of natural capital in national wealth across countries. Natural capital appears to crowd out human capital, thereby slowing down the pace of economic development.

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> If ... oil revenue is managed well, it can educate, heal and provide jobs for ... the people. But oil brings risks as well as benefits. Rarely have developing countries used oil money to improve the lives of the majority of citizens or bring steady economic growth. More often, oil revenues have caused crippling economic distortions and been spent on showy projects, weapons and Paris shopping trips for government officials.
>
> *New York Times*, 1 August 2000.

1. Introduction

In most countries that are rich in oil, minerals, and other natural resources, economic growth over the long haul tends to be slower than in other countries that are less well endowed. For example, in Nigeria, with all its oil wealth, Gross National Product per capita today is no higher than at independence in 1966. Nigeria is not alone. From 1965 to 1998, per capita GNP growth in Iran and Venezuela was on average -1 percent per year, -2 percent in Libya, -3 percent in Iraq and Kuwait, and -6 percent in Qatar (1970-1995), to mention six other OPEC countries (World Bank, 2000). For OPEC as a whole, GNP per capita *decreased* by 1.3 percent on average during 1965-1998 compared with 2.2 percent average per capita growth in all lower- and middle-income countries. King Faisal of Saudi Arabia (1964-1975) would hardly have been surprised; he said (quoted from an interview with his oil minister, Shaikh Yamani): "In one generation we went from riding camels to riding Cadillacs. The way we are wasting money, I fear the next generation will be riding camels again."

These examples seem to reflect a consistent pattern. Of 65 countries that can be classified as natural-resource rich, only four managed to attain both (a) long-term investment exceeding 25 percent of Gross Domestic Product on average from 1970 to 1998, equal to that of various successful industrial countries lacking raw materials, and (b) per capita GNP growth exceeding 4 percent per year on average over the same period. These four countries are Botswana, Indonesia, Malaysia, and Thailand. The three Asian countries achieved this success by diversifying their economies and by industrializing; Botswana, rich in diamonds, without doing so. In East Asia, the countries with few raw materials (Hong Kong, Singapore, South Korea, and Taiwan) have done even better than the resource-rich ones (Indonesia, Malaysia, and Thailand).

Figure 1 shows a scatterplot of per capita economic growth from 1965 to 1998 and natural resource abundance as measured by the share of natural capital in national wealth (i.e., the share of natural capital in total capital, which comprises physical, human, and natural capital;[1] see World Bank, 1997). The 86 countries in the figure are represented by one dot each.[2] The regression line through the scatterplot suggests that an increase of about ten percentage points in the natural capital share from one country to another is associated with a decrease in per capita growth by one percentage point per year

[1] 1994 is the only year for which the data on natural capital are available. In most cases, the share of natural capital in national wealth in 1994 is probably a reasonable proxy for natural resource abundance in the period under review, 1965-1998. There are exceptions, however, such as Malaysia, Mauritius, and Mexico, whose share of primary (i.e., non-manufacturing) exports in merchandise exports decreased by roughly 60, 50, and 70 percentage points between 1980 and 1998. Even so, all the empirical results reported in the text, Figures 1-6, and Table 1, can be reproduced by using the average primary export share during 1980-1998 rather than the natural capital share in 1994 as a proxy for natural resource abundance.

[2] All countries for which the requisite data are available are included in Figures 1-6, with one exception. Saudi-Arabia has been left out because of problems with its growth data. This exclusion does not materially influence the patterns observed.

on average.[3] The relationship is statistically significant (Spearman rank correlation, r = -0.51), and conforms to the partial correlations that have been reported in multiple regression analyses where other relevant determinants of growth (initial income, saving rates, education, etc.) are taken into account. If rich countries and poor are viewed separately, a similar pattern is observed in both groups. Shaving one percentage point of any country's annual growth rate is a serious matter because the (weighted) average rate of per capita growth in the world economy since 1965 has been about 1½ percent per year. How can this pattern be explained?

2. Four Channels of Transmission

Four main channels of transmission from abundant natural resources to sluggish economic growth have been identified in recent literature.

First, natural resource abundance often results in an overvaluation of the national currency. This is a symptom of the Dutch disease: a natural resource boom and the associated surge in raw-material exports drive up the real exchange rate (or real wages), thus hurting other exports (Corden, 1984). Moreover, recurrent booms and busts tend to increase exchange rate volatility (Gylfason, Herbertsson, and Zoega, 1999; Herbertsson, Skúladóttir, and Zoega, 1999). Sometimes this is enough to reduce total exports.[4] Sometimes it just skews the composition of exports away from high-tech and other manufacturing and service exports that are particularly conducive to economic growth. In either case, economic growth is likely to slow down because exports and, generally, openness to all kinds of trade with the rest of the world are good for growth (Frankel and Romer, 1999).

Second, natural-resource-rich economies seem especially prone to socially damaging rent-seeking behavior on the part of producers. This can take many forms. For example, the government may be tempted to offer tariff protection to domestic producers, among other privileges. Rent seeking may also breed corruption in business and government, thereby distorting the allocation of resources and reducing both economic efficiency and social equity. Empirical evidence suggests that import protection and corruption both tend to impede economic growth (Bardhan, 1997).

Third, natural resource abundance may imbue people with a false sense of security and lead governments to lose sight of the need for good and growth-friendly economic management, including free trade, bureaucratic efficiency, and institutional quality (Sachs and Warner, 1999). Incentives to create wealth tend to become too blunted by the ability to extract wealth from the soil or the sea. Rich parents sometimes spoil their kids. Mother Nature is no exception.

Fourth, nations that are confident that their natural resources are their most important asset may inadvertently — and perhaps even deliberately! — neglect the development of their human resources, by devoting inadequate attention and expenditure to education. Their natural wealth may blind them to the need for educating their children. Therefore, it is perhaps no coincidence that school enrolment at all

[3] There is admittedly an element of statistical bias in Figure 1 in that increased education increases human capital, thereby reducing the share of natural capital in national wealth *and* increasing economic growth. This bias, however, is probably not serious because Figure 1 can be reproduced by using different measures of natural resource abundance, such as the share of the primary sector in the labor force (as in Gylfason, Herbertsson, and Zoega, 1999) or the share of primary exports in total exports or GDP (as in Sachs and Warner, 1999).

[4] For example, the average share of exports of goods and services in GDP in the OPEC countries in 1998 was 31 percent, compared with 38 percent in 1972, the year before the first oil price hike. In the same period, the

levels tends to be inversely related to natural resource abundance, as measured by the share of the labor force engaged in primary production, across countries (Gylfason, Herbertsson, and Zoega, 1999). For example, the OPEC countries send 57 percent of their youngsters to secondary school compared with 64 percent for the world as a whole and they spend less than 4 percent of their GNP on education on average compared with almost 5 percent for the world as a whole (the figures refer to 1997). Blessed by an unusually rich and reliable rent stream, Botswana is an exception: its expenditure on education relative to income continues to be among the largest in the world.

It needs to be emphasized that it is not the existence of natural wealth as such that seems to be the problem, but rather the failure of public authorities to avert the dangers that accompany the gifts of nature. Good policies can turn abundant natural resource riches into an unmitigated blessing. Norway, the world's second largest oil exporter (after Saudi-Arabia), is a case in point. As Norway's oil wealth is a common-property resource by law, the Norwegian government takes in about 80 percent of the oil rent through taxes and fees. The government invests the revenues from oil in foreign securities in order to divide the oil receipts fairly between the present generation and future generations as well as to shield the domestic economy from too much income too quickly. The Norwegians show no signs of neglecting education, on the contrary, as the proportion of each cohort attending colleges and universities in Norway rose from 26 percent in 1980 to 62 percent in 1997. (It is not certain, however, whether the average quality of college education in Norway has changed in tandem with — or perhaps, as some fear, in inverse proportion to — the huge increase in enrolment since 1980.) Economic policies are generally sound. Yet, Norway's total exports of goods and services are no larger in proportion to national income than they were before the oil fields were discovered in the North Sea. In other words, Norway's oil exports have crowded out its non-oil exports krone for krone, leaving total exports stagnant relative to national income for a generation. Only one other OECD country has had a stagnant export ratio since 1970 — actually, since 1870. That country is Iceland, which derives almost half its export earnings and one-ninth of its national income from fish.

3. More on Education

More and better education is a prerequisite for rapid economic development around the world. Education stimulates economic growth and improves people's lives through many channels: by increasing the efficiency of the labor force, by fostering democracy (Barro, 1997) and thus creating better conditions for good governance, by improving health, by enhancing equality (Aghion, Caroli, and García-Peñalosa, 1999), and so on. But what determines a nation's commitment to education? Let us now consider three different measures of education inputs, outcomes, and participation and how they vary with the share of natural capital in national wealth.

First, Figure 2 shows a scatterplot of public expenditure on education from 1980 to 1997 and natural resource abundance measured as in Figure 1. Public expenditure on education varies a great deal from country to country. In the 1990s, some countries have spent as little as 1 percent of their GNP on education (Haiti, Indonesia, Myanmar, Nigeria, and Sudan). Others have spent between 8 percent and 10 percent of their GNP on education, including St. Lucia (whose $100 bill is adorned by a picture of

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(unweighted) average export ratio in the world as a whole increased from 28 percent to 38 percent.

Sir Arthur Lewis, an ardent advocate of education and economic growth), Namibia, Botswana, and Jordan (which, by the way, has no oil). Public expenditure is admittedly an imperfect measure of a nation's commitment to education, not least because some nations spend more on private education than others. Moreover, public expenditure on education may be supply-led and of mediocre quality, and may thus fail to foster efficiency, equality, and growth, in contrast to private expenditure on education, which is generally demand-led and thus, perhaps, likely to be of a higher quality. Even so, this yardstick should reflect at least to some extent the government's commitment to education. The regression line through the 90 observations suggests that an increase of 18 percentage points in the natural capital share from one country to the next is associated with a decrease in public expenditure on education by one percent of GNP. The relationship is statistically significant ($r = -0.32$).

Second, Figure 3 shows a scatterplot of the expected number of years of schooling for females from 1980 to 1997 and natural resource abundance. This indicator of schooling is intended to reflect the total education resources, measured in school years, that a girl will acquire over her lifetime in school or as an indicator of an education system's overall state of development. The regression line through the 52 observations, one per country, suggests that an increase in the natural capital share by five percentage points is associated with a decrease by one year of the schooling that an average girl at the age of school entry can expect to receive. The relationship is statistically significant ($r = -0.57$). Sen (1999), among others, has stressed the importance of educating girls in developing countries. The corresponding relationship for males (not shown) is virtually the same as for females.

Third, Figure 4 shows a scatterplot of secondary-school enrolment for both genders from 1980 to 1997 and natural resource abundance. The regression line through the 91 observations suggests that an increase in the natural capital share by five percentage points goes along with a decrease by ten percentage points in the secondary-school enrolment rate from one country to another. The regression is statistically significant ($r = -0.66$). Unlike the relationships in Figures 2 and 3, the one in Figure 4 is significantly nonlinear (not shown), possibly indicating increasing returns to diversification away from primary production. Secondary-school enrolment is probably the most commonly used indicator of education in empirical growth research. Of the three indicators used here, it is the one that is most closely correlated with economic growth.

At last, Figure 5 shows that a 40 percentage point increase in secondary-school enrolment goes along with a one percentage point rise in the annual rate of growth of GNP per capita. The number of observations is 86. The relationship is statistically significant ($r = 0.53$) and, moreover, significantly nonlinear (not shown), indicating decreasing returns to education. The nonlinearities implicit in Figures 4 and 5 tend to offset one another, so that no nonlinearity can be detected in Figure 1. Like the other two indicators, school enrolment reflects, at best, the quantity of education provided rather than the quality of education received. Public expenditure on education (as in Figure 2) and expected years of schooling (as in Figure 3) are also positively correlated with economic growth across countries in our sample (not shown), but only the latter correlation is significant in a statistical sense.

To summarize, we have seen that, across countries, (a) economic growth varies inversely with natural resource abundance, (b) three different measures of education intended to reflect education inputs, outcomes, and participation are all inversely related to natural resource abundance, and (c)

economic growth varies directly with education. Therefore, natural resource abundance seems likely to deter economic growth not only through the Dutch disease, rent seeking, and overconfidence that tends to reduce the quality of economic policy and structure as suggested by Sachs and Warner (1999) and various authors in Auty (forthcoming), among others, but also by weakening public and private incentives to accumulate human capital. If so, the adverse effects of natural resource abundance on economic growth since the 1960s that have been reported in the literature may in part reflect, and possibly displace, the effect of education on growth.

Table 1. Regression results

Dependent variable	*Constant*	*Natural capital*	*Enrolment rate*	*Investment*	*Initial income*	R^2
Economic growth	9.35 (6.0)	-0.06 (4.3)	0.04 (5.9)	0.07 (3.1)	-1.40 (7.0)	0.64
Enrolment rate	-96.5 (5.4)	-0.94 (4.6)			20.3 (9.7)	0.68
Economic growth	3.87 (2.5)	-0.09 (5.7)		0.13 (4.5)	-0.51 (3.2)	0.49

Note: t-statistics are shown within parentheses.

The first two rows in Table 1 report seemingly unrelated regression (SUR) estimates of a system of two equations for 85 countries in our sample where (a) economic growth depends on the natural capital share, the secondary-school enrolment rate, the share of gross domestic investment in GDP 1965-1998, and the logarithm of initial per capita income (i.e., in 1965), defined as income in 1998 divided by an appropriate growth factor, and (b) the enrolment rate in turn depends on the natural capital share and initial income. The recursive nature of the system and the conceivable correlation of the error terms in the two equations make SUR an appropriate estimation procedure (Lahiri and Schmidt, 1978). However, the fact that ordinary least squares (OLS) estimates of the system (not shown) are almost the same as the SUR estimates shown in the table indicates that the correlation of errors terms across equations is of minor consequence. All the coefficient estimates in Table 1 are economically and statistically significant. The coefficient on initial income in the growth equation indicates a convergence speed of 1.4 percent per year. The direct effect of natural capital on growth is -0.06 and the indirect effect through education is $-0.94 \cdot 0.04 \approx -0.04$. The total effect of natural capital on growth is thus about -0.10 (for given initial income), which is very close to the value of the regression coefficient in Figure 1. The bottom row in the table shows the OLS estimate of the reduced-from equation for growth implied by the equation system above. Like Figure 1, Table 1 indicates that an increase in the natural capital share by ten percentage points is associated with a decrease in growth by roughly one percentage point. Of the total effect of natural capital on growth, almost a half can thus be attributed to education according to this interpretation.

How can these results be explained? Natural-resource-based industries as a rule are less high-skill labor intensive and perhaps also less high-quality capital intensive than other industries, and thus confer relatively few external benefits on other industries (Gylfason, Herbertsson, and Zoega, 1999; Wood,

1999). Moreover, workers released from primary industries, such as agriculture, fisheries, forestry, or mining, generally have relatively limited general, labor-market relevant education to offer new employers in other industries. There are exceptions, though, such as in modern agriculture and high-tech oil-drilling operations. But insofar as high-skill labor and high-quality capital are less common in primary production than elsewhere, this may help explain why natural resource abundance and the associated preponderance of primary production and primary exports tend to impede learning by doing, technological advance, and economic growth. This linkage reinforces the case for investment in education and training as an engine of growth: more and better education tends to shift comparative advantage away from primary production towards manufacturing and services, and thus to accelerate learning by doing and growth.

Before concluding, let us take a look at the cross-sectional relationship between natural resource abundance and the stage of economic development in our sample. Figure 6, which covers 90 countries, shows that the share of natural capital in national wealth is inversely related to per capita GNP (in US dollars, adjusted for purchasing power parity). The link is statistically significant ($r = -0.70$). The corresponding relationship (not shown) between the natural capital share and initial per capita income as defined above is weaker ($r = -0.50$). Moreover, economic growth is uncorrelated with initial income in the sample (there is no sign of either absolute convergence or absolute divergence, a common result also in larger samples), even if Table 1 indicates conditional convergence. Therefore, while low initial incomes tend to go along with abundant natural resources and low secondary-school enrolment, which may in part explain the observed inverse relationship between natural capital and education shown in Figure 4, the inverse cross-sectional relationship between natural capital and growth in Figure 1 cannot be so explained because there is no evidence of divergence (i.e., for poor countries to grow less rapidly than rich) in the sample. As real per capita GNP in 1998 can be viewed as an indicator of past economic growth, the pattern shown in Figure 6 accords with the inverse relationship between natural capital and growth shown in Figure 1.

4. Conclusion

Education is good for growth, as Adam Smith, John Stuart Mill, and Alfred Marshall knew. Listen, for example, to Marshall (1920, p. 176):

> There is no extravagance more prejudicial to growth of national wealth than that wasteful negligence which allows genius that happens to be born of lowly parentage to expend itself in lowly work. No change would conduce so much to a rapid increase of material wealth as an improvement in our schools, and especially those of the middle grades, provided it be combined with an extensive system of scholarships, which will enable the clever son of a working man to rise gradually from school to school till he has the best theoretical and practical education which the age can give.

Natural resources bring risks. One is that too many people become locked in low-skill intensive natural-resource-based industries, including agriculture, and thus fail through no fault of their own to advance their own or their children's education and earning power. Another risk is that the authorities and other inhabitants of resource-rich countries become overconfident and therefore tend to underrate or overlook the need for good economic policies as well as for good education. In other words, nations that believe that natural capital is their most important asset may develop a false sense of security and

become negligent about the accumulation of human capital. Indeed, resource-rich nations can live well of their natural resources over extended periods, even with poor economic policies and a weak commitment to education. Awash in easy cash, they may find that education does not pay. Nations without natural resources have a smaller margin for error, and are less likely to make this mistake.

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Figure 1. Economic growth and natural capital

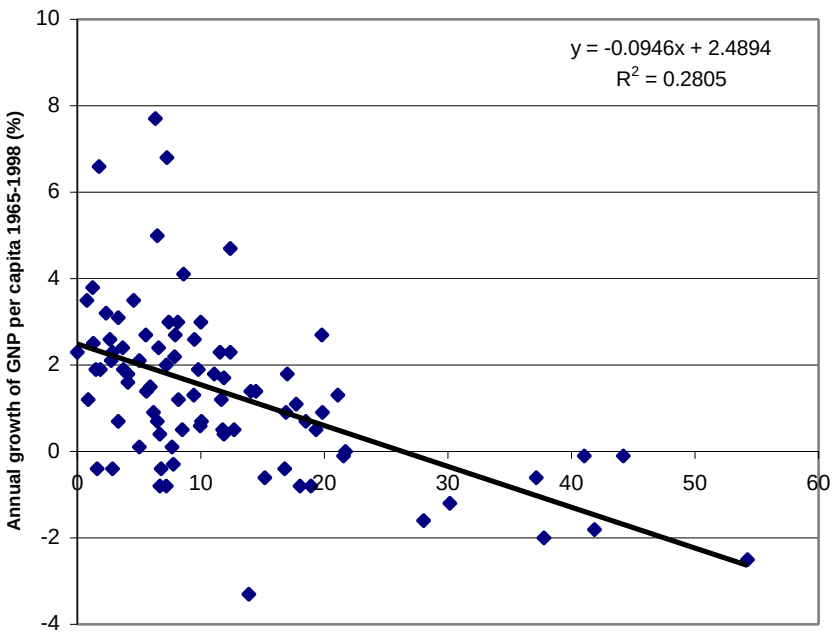


Figure 2. Expenditure on education and natural capital

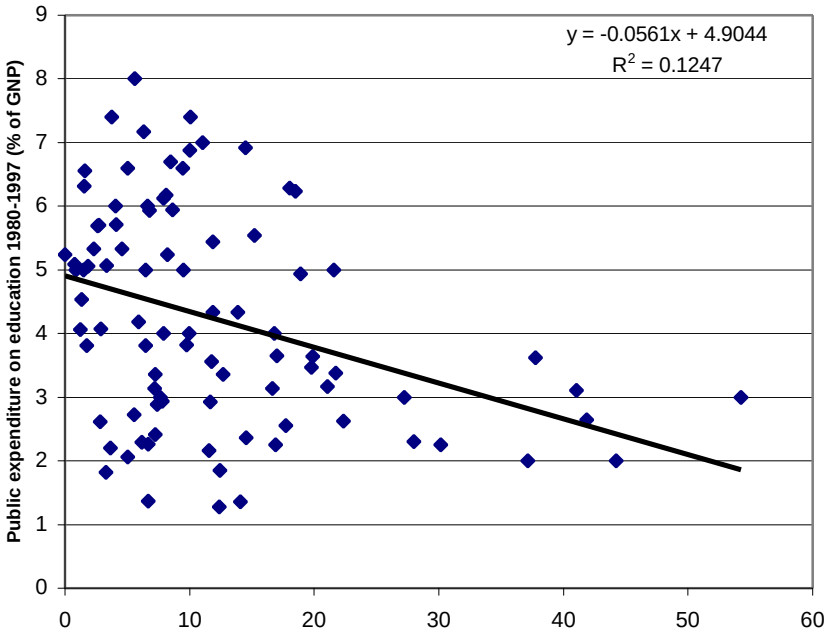


Figure 3. Years of schooling and natural capital

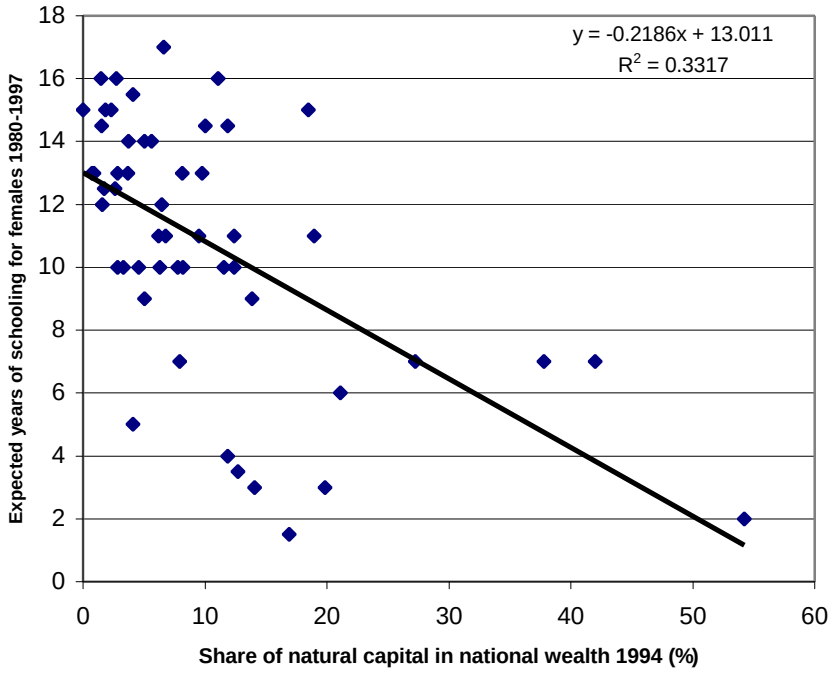


Figure 4. Secondary enrolment and natural capital

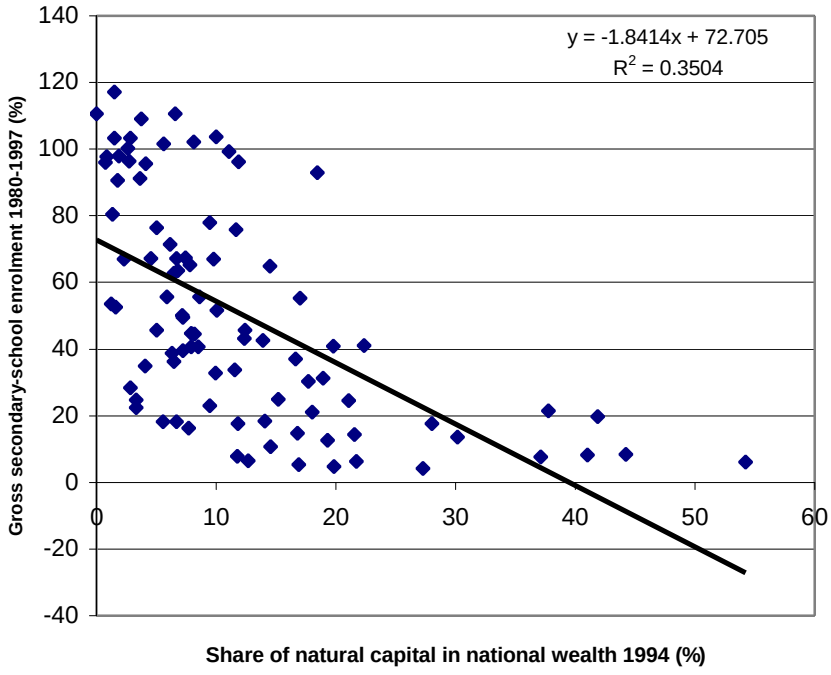


Figure 5. Economic growth and education

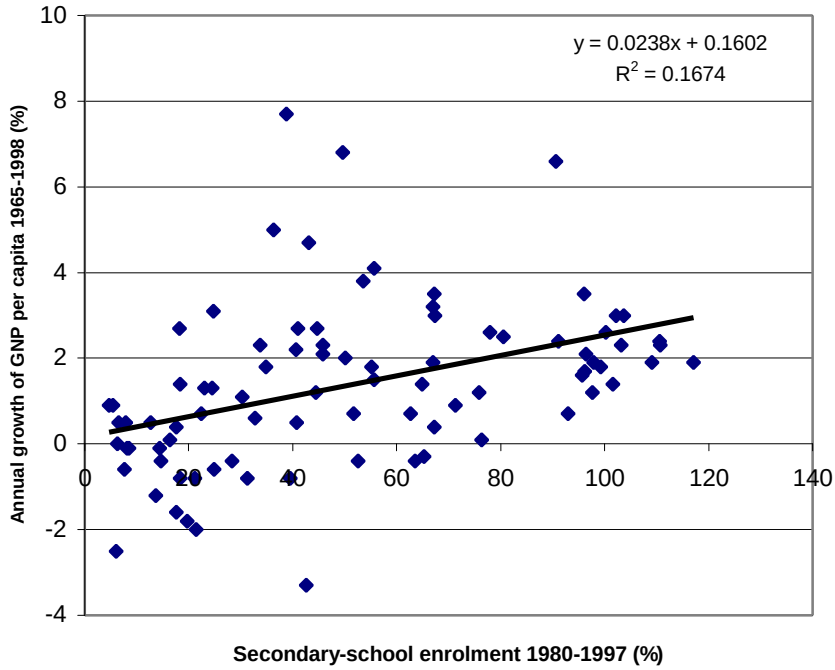
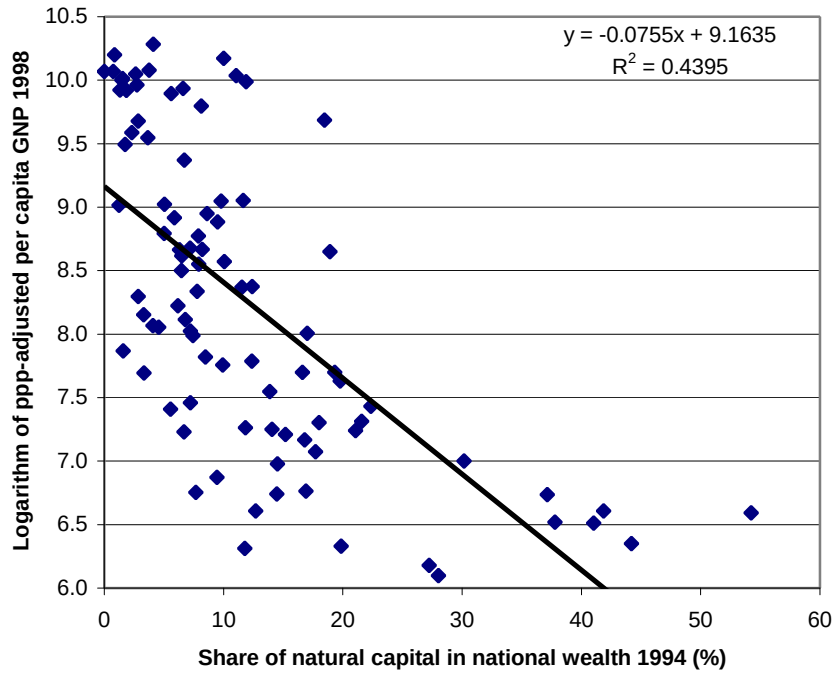


Figure 6. Per capita income and natural capital



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