Natural Resources and Economic Growth: What Is the Connection?

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The structure of recent models of the relationship between natural resource abundance or intensity and economic growth is nearly always the same. An abundance of or heavy dependence on natural resources is taken to influence some variable or mechanism "X" which impedes growth. An important challenge for economic growth theorists and empirical workers in the field is to identify and map these intermediate variables and mechanisms.

To date, four main channels of transmission from natural resource abundance or intensity to slow economic growth have been suggested in the literature.[1] As we shall see, these channels can be described as crowding out: natural capital, it will be argued, tends to crowd out other types of capital and thereby inhibit economic growth.

Channel 1: The Dutch disease and foreign capital

An overvalued currency was the first symptom associated with the Dutch disease following the discovery of natural gas deposits within the jurisdiction of the Netherlands in the North Sea in the late 1950s and early 1960s, but subsequently several other symptoms came to light. Natural resource abundance is, as a rule, accompanied by booms and busts: the prices of raw materials fluctuate a great deal in world markets, and so do supplies. The resulting fluctuations in export earnings trigger exchange rate volatility, perhaps no less so under fixed exchange rates than under floating rates. Unstable exchange rates create uncertainty that can be harmful to exports and other trade, including foreign investment. Further, the Dutch disease can strike even in countries that do not have their own national currency. In this case, the natural-resource-based industry is able to pay higher wages and also higher interest rates than other export and import-competing industries, thus making it difficult for the latter to remain competitive at world market prices. This problem can become

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[1] This discussion draws on Gylfason and Zoega (2001).

particularly acute in countries with centralized wage bargaining (or with oligopolistic banking systems, for that matter) where the natural-resource industries set the tone in nation-wide wage negotiations and dictate wage settlements that other industries can ill afford.

In one or all of these ways, the Dutch disease tends to reduce the level of total exports or bias the composition of exports away from those kinds of manufacturing and service exports that may be particularly good for growth over time. Exports of capital – i.e., inward foreign direct investment – may also suffer in the same way. The mechanism is essentially the same. In other words, natural capital tends to crowd out foreign capital, broadly speaking.

Figure 1 presents relevant empirical evidence for two resource-rich European countries, Norway and the Netherlands, as well as for Ukraine for comparison. Figure 1a shows that the Netherlands recovered quickly from the Dutch disease, having seen a persistent upward trend in their total merchandise exports relative to GDP since the mid-1960s. Meanwhile, Norway's total exports have been stagnant relative to GDP at a level well below that of the Netherlands, even if the Dutch economy is almost three times as large as that of Norway. Figure 1b tells a similar story about foreign direct investment, which has increased relative to GDP in both countries since 1975, but less rapidly in Norway than in the Netherlands. Figure 1c shows that the share of manufacturing exports in total exports in the Netherlands increased from 50 percent in 1980 to 70 percent in 1998, while the same ratio has hovered around 30 percent in Norway without showing any tendency to rise over time. These things matter because exports and foreign investment are good for growth (see, for example, Frankel and Romer, 1999). Openness to trade and investment stimulates imports of goods and services, capital, technology, ideas, and know-how. Further, too much primary-export dependence and too little manufacturing may hurt economic growth over the long haul. The upshot is that the Dutch disease is a matter of concern mainly because of its potentially deleterious consequences for economic growth.

What is the empirical evidence? Figure 2a shows a scatterplot of natural resource abundance and openness to external trade around the world. Natural resource abundance or intensity, which is measured along the horizontal axis, is measured by the share of natural capital in national wealth in 1994 – i.e., the share of natural capital in total capital, which comprises physical, human, and natural capital (but not social capital; see World Bank, 1997). The natural capital share used here is close to

the source: it is intended to come closer to a direct measurement of the intensity of natural resources across countries than the various proxies that have been used in earlier studies, mainly the share of primary (i.e., nonmanufacturing) exports in total exports or in gross domestic product (GDP) and the share of the primary sector in employment or the labor force. Openness on the vertical axis is defined as the difference between the actual average ratio of exports to GDP over the period under review, 1965-1998, and the export ratio predicted by a linear regression of the average export ratio on the logarithm of the average population (in thousands) across countries to adjust for country size. This adjustment is made to reflect the fact that large countries are less dependent on foreign trade than smaller ones that need to extend their home markets beyond their national borders to make up for their small size. This indicator of openness is above zero for countries that are more open to trade than their size predicts, and below zero for countries that are less open to trade than their size predicts. The 91 countries in the sample are represented by one observation each for each variable under study.

The regression line through the scatterplot in Figure 2a suggests that an increase of ten percentage points in the natural capital share from one country to another is associated with a decrease in the openness indicator by about four percent of GDP on average. The relationship is economically as well as statistically significant (Spearman's rank correlation is -0.33).[2] Given existing evidence that foreign trade is good for growth, Figure 2a suggests that natural resource abundance may hurt growth by harming trade.

It needs to be understood that no conclusions are being drawn here as to cause and effect. Figure 2a is only intended to display the data in a way that accords with the results of multivariate regression analyses that can help account for more potential determinants of exports (Gylfason, 1999), and where the attempt was made to distinguish cause from effect. The same disclaimer applies to all the figures that follow. Even so, the study of bivariate cross-sectional relationships has many shortcomings. For one thing, such studies bypass the diversity of individual country experiences. For another, they do not account for economic developments over time, as panel studies are designed to do.

Figure 2b shows a scatterplot of openness as defined above and economic growth

[2] Gylfason (forthcoming) presents corresponding scatterplots of exports and natural capital and of foreign direct investment and natural capital.

per capita from 1965 to 1998. The figure covers 87 countries. The growth rate has been adjusted for initial income: the variable on the vertical axis is that part of economic growth that is not explained by the country's initial stage of development, obtained from a regression of growth during 1965-1998 on initial GNP per capita (i.e., in 1965) as well as natural capital. The regression line through the scatterplot in Figure 2b suggests that an increase of 14 percentage points in the openness indicator from one country to another is associated with an increase in per capita growth by one percentage point per year on average. The relationship is thus economically as well as statistically significant; Spearman's rank correlation is 0.40. The data thus seem to support the view that openness is good for growth.

Taking Figures 2a and 2b together, we see that an increase in the natural capital share by ten percentage points goes along with a four point decrease in the openness index which, in turn, goes hand in hand with a decrease in annual per capita growth by about 0.3 percentage points.

Channel 2: Rent seeking and social capital

In second place, huge natural resource rents, especially in conjunction with ill-defined property rights, imperfect or missing markets, and lax legal structures in many developing countries and emerging market economies, may lead to rampant rent-seeking behavior on the part of producers, thus diverting resources away from more socially fruitful economic activity (Auty, 2001; Gelb, 1988). The combination of abundant natural resources, missing markets, and lax legal structures may have quite destructive consequences. In extreme cases, civil wars break out – such as Africa's diamond wars – which not only divert factors of production from socially productive uses but also destroy societal institutions and the rule of law. In other, less extreme cases, the struggle for huge resource rents may lead to a concentration of economic and political power in the hands of elites that, once in power, use the rent to placate their political supporters and thus secure their hold on power, with stunted or weakened democracy and slow growth as a result (Karl, 1997).

Rent seeking can also take other, more subtle forms. For example, governments may be tempted to thwart markets by granting favored enterprises or individuals privileged access to common-property natural resources or they may offer tariff protection or other favors to producers at public expense, creating competition for

such favors among the rent seekers. Extensive rent seeking – i.e., seeking to make money from market distortions – can breed corruption in business and government, thus distorting the allocation of resources and reducing both economic efficiency and social equity. Empirical evidence and economic theory suggest that import protection (which is often extended to foreign capital as well as goods and services), cronyism, and corruption all tend to impede economic efficiency and growth (Bardhan, 1997; Mauro, 1995).

Furthermore, abundant natural resources 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). Put differently, abundant natural capital may crowd out social capital, by which is meant the infrastructure and institutions of a society in a broad sense: its culture, cohesion, law, system of justice, rules and customs and so on, including trust (Woolcock, 1998; Paldam and Svendsen, 2000). Incentives to create wealth through good policies and institutions may wane because of the relatively effortless ability to extract wealth from the soil or the sea. Manna from heaven can be a mixed blessing. The argument can be extended to unconditional foreign aid. There are indications that natural-resource-rich countries are more dependent than others on foreign aid, which may actually exacerbate their economic predicament.

Now consider corruption, to take but one aspect of social capital corrosion into account. Insofar as natural resource abundance involves public allocation of access to scarce common-property resources to private parties without payment, thereby essentially leaving the resource rent up for grabs, it is only to be expected that resource-rich countries may be more susceptible to corruption than others. What do the data say?

In Figure 3a, which covers 60 countries, the share of natural capital in national wealth is plotted along the horizontal axis as before and the corruption perceptions index for the year 2000 along the vertical axis.[3] The corruption perceptions index (from Transparency International, Berlin) is constructed from information obtained from businessmen who are willing to report how often and how forcefully bribes and the like are demanded of them in various countries, and how high these are. The index

[3] Corruption rankings for earlier years (1995-1999) give similar results.

extends from zero, in countries where corruption is greatest, to ten, where corruption is practically nonexistent (as, for example, in Finland and Denmark). The picture shows a clear and statistically significant relationship: corruption, as measured by this index, increases from one country to the next in accordance with the increase in natural resource abundance or intensity. When the share of natural capital in national wealth goes up by 15 percentage points, the corruption perceptions index drops (i.e., corruption increases) by two points. The rank correlation is -0.52.[4]

Similar results obtain when natural resource abundance or intensity is instead measured by the share of the primary sector in the labor force, 1965-1990 (Figure 3b). Now we have data for many more countries, or 88 rather than 60. The correlation is again quite significant; the Spearman rank correlation is -0.67.

Figure 3c shows the cross-sectional relationship between corruption and economic growth. The figure suggests that an increase in the corruption perceptions index (i.e., a decrease in corruption) by one point from one place to another goes along with an increase per capita growth by almost one percentage point per year on the average, for given initial income.[5] This is not a small effect – if it is an effect, that is, as opposed to a mere correlation.[6] The pattern is quite significant; the rank correlation is 0.78. The number of countries is 64.

Taking Figures 3b and 3c together, we see that an increase in the primary labor share by 16 percentage points goes hand in hand with a decrease in the corruption perceptions index by one point (Figure 3b), which in turn goes along with a decrease in per capita growth by one percentage point per year on the average, for given initial income (Figure 3c). Here we have another possible reason why natural resource abundance or intensity appears to inhibit economic growth across countries.

Channel 3: Education and human capital

Third, natural resource abundance or intensity may reduce private and public incentives to accumulate human capital due to a high level of non-wage income – e.g.,

[4] When the corruption index is purged of that part which is caused by initial income, the results remain unchanged.

[5] Notice that the growth measures are slightly different in Figures 2b and 3c. The reason is that the adjustment for initial income in the two figures is based on different measures of natural resource abundance, the natural capital share in Figure 2b and the primary labor share in Figure 3c. This difference has no material effect on the patterns displayed in the figures.

[6] For comparison, Mauro (1995) presents econometric evidence that suggests that a decrease in the corruption index by one point (i.e., increased corruption) from one country to the next is associated with a reduction in per capita growth of one-quarter a percentage point per year on the average.

dividends, social spending, low taxes. Awash in cash, natural-resource-rich nations may be tempted to underestimate the long-run value of education. Of course, the rent stream from abundant natural resources may enable nations to give a high priority to education – as in Botswana, for instance, where government expenditure on education relative to national income is among the highest in the world. Even so, empirical evidence shows that, across countries, school enrolment at all levels is inversely related to natural resource abundance or intensity, as measured by the share of the labor force engaged in primary production (Gylfason, Herbertsson, and Zoega, 1999). There is also evidence that, across countries, public expenditures on education relative to national income, expected years of schooling, and school enrolment are all inversely related to natural resource abundance (Gylfason, 2001; see also Temple, 1999). Once again, abundant natural capital appears to crowd out human capital. This matters because more and better education is good for growth.

As far as economic growth is concerned, however, the supply of education may matter less than demand. This is relevant here because public expenditure on education tends to 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-determined and thus, perhaps, likely to be of a higher quality and more conducive to growth. For this reason, I prefer to use school enrolment rates rather than public expenditures on education as a measure of education in the empirical analysis to follow.

Figure 4a shows a scatterplot of secondary-school enrolment as a percentage of each cohort from 1980 to 1997 on the vertical axis and, on the horizontal axis, the natural capital share measured as in Figures 2a and 3a. Imperfect though it is, secondary-school enrolment is the most commonly used yardstick for education in the empirical growth literature. Even so, other measures of education such as primary-enrolment rates, tertiary-enrolment rates, public expenditures on education, and years of schooling for girls or boys yield similar results (Gylfason, 2001). The regression line through the 91 observations suggests that an increase of ten percentage points in the natural capital share from one country to the next is associated with a decrease in secondary-school enrolment by 18 percentage points. The relationship is also statistically significant: the Spearman rank correlation is -0.66.

Figure 4b shows a scatterplot of secondary-school enrolment for both genders from 1980 to 1997 and economic growth. If we fit a straight line through the scatter (not

shown), the figure shows that a 25 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. In fact, the relationship is significantly nonlinear, indicating decreasing returns to education, and it is, moreover, statistically significant (the rank correlation is 0.62). The number of observations is 87. It needs to be emphasized that school enrolment reflects, at best, the quantity of education provided rather than the quality of education received. Public expenditure on education is also positively correlated with economic growth across countries in our sample (not shown), but the correlation is not significant in a statistical sense.

Taking Figures 4a and 4b together, we see that, across countries, secondary-school enrolment is inversely related to natural resource abundance and directly related to economic growth. Specifically, an increase in the natural capital share by 25 percentage points goes along with a decrease in secondary-school enrolment by 45 percentage points according to Figure 4a, which, in turn, goes along with a decrease in economic growth by almost two percentage points by Figure 5b. Therefore, natural resource abundance seems capable of reducing economic growth significantly, not only through the Dutch disease, rent seeking, and overconfidence that tends to reduce the quality of economic policy and structure, 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 the effect of education on growth.

How can we interpret these results? 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 (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, indeed, in 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.

Channel 4: Saving, investment, and physical capital

Fourth, natural resource abundance may blunt private and public incentives to save and invest and thereby impede economic growth. Specifically, when the share of output that accrues to the owners of natural resources rises, the demand for capital falls, and this leads to lower real interest rates and less rapid growth (Gylfason and Zoega, 2001). Moreover, if mature institutions are conducive to an efficient use of resources, including natural resources, and if poorly developed institutions are not, then natural resource abundance may also retard the development of financial institutions in particular and hence discourage saving, investment, and economic growth through that channel as well. As in the case of education, it is not solely the volume of investment that counts because quality – i.e., efficiency – is also of great importance. Unproductive investments may seem unproblematic to governments or individuals who are flush with cash thanks to nature's bounty.

Figure 5a shows a scatterplot of the average ratio of gross domestic investment to GDP in 1965-1998 and natural resource abundance or intensity measured as in Figures 2a, 3a, and 4a. The regression line through the 87 observations, one per country, suggests that an increase of about ten percentage points in the natural capital share from country to country is associated with a decrease in investment by two percent of GDP. The relationship is statistically significant: the rank correlation -0.37.

Figure 5b shows a scatterplot of economic growth as measured in Figures 2b, 3c, and 4b and the average investment ratio over the same period, 1965-1998. The regression line through the 85 observations suggests that an increase in the investment ratio by about five percentage points is associated with an increase in annual economic growth by one percentage point. The relationship is highly significant: the rank correlation is 0.65. The slope of the regression line is consistent with the regression coefficients on investment in cross-country growth equations reported in recent literature (Levine and Renelt, 1992).

In sum, an increase in the natural capital share by 25 percentage points goes along with a decrease in the investment ratio by five percentage points by Figure 5a, which in turn goes along with a decrease in economic growth by one percentage point by

Figure 5b. Thus, empirical evidence seems consistent with the idea that an abundance of or heavy dependence on natural resources may erode or reduce the quality of foreign, social, human, and physical capital, and thus stand in the way of rapid economic growth on a significant scale.[7] It is a matter of taste and classification whether the some or even all the mechanisms reviewed above are regarded as additional symptoms of the Dutch disease or as separate channels of transmission from resource dependence to slow growth.

Natural capital and economic growth

To conclude the story, Figure 6a shows a scatterplot of economic growth per capita from 1965 to 1998 and natural resource abundance as measured in Figures 2a, 3a, 4a, and 5a. The figure covers 85 countries. The growth rate has been adjusted for initial income as before. The regression line through the scatterplot in Figure 6a 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 on average. The relationship is also significant in a statistical sense (Spearman's rank correlation is -0.64), and conforms to the partial correlations that have been reported in multiple regression analyses where other relevant determinants of growth (investment, education, etc., as well as initial income to account for catch-up and convergence) are taken into account. A relationship of this kind has been reported in a number of recent studies (Sachs and Warner, 1995, 1999; Gylfason, Herbertsson, and Zoega, 1999).

At last, Figure 6b shows that a similar inverse relationship between natural resources and economic growth emerges when natural resource abundance or intensity is measured by the share of the primary sector in total employment as in Figure 3b. There are now 105 countries in the sample. The relationship is significant. The rank correlation is -0.85. The adjustment for initial income entails a speed of convergence of about 2 percent a year (not shown), a common result in empirical growth research. An increase of 11 or 12 percentage points in the primary labor share from one country to the next is associated with a decrease in per capita growth by one percentage point per year on average, for given initial income. A reduction by one percentage point in any country's annual growth rate is a serious matter because the

[7] There is also evidence that natural capital may crowd out financial capital. See Gylfason and Zoega (2001).

(weighted) average rate of per capita growth in the world economy since 1965 has been about 1½ percent per year.

Concluding remarks

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 and institutions as well as for good education and good investments. 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 foreign, social, human, and physical capital. Indeed, resource-rich nations can live well of their natural resources over extended periods, even with poor economic policies and institutions and a weak commitment to education. Awash in easy cash, they may find that difficult reforms do not pay. Nations without natural resources have a smaller margin for error, and are less likely to make this mistake. In resource-rich countries, awareness of these risks, as well as a conscious effort and ability to contain them, is perhaps the best insurance policy against them.

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Figure 1a. Exports of goods and services 1960-1998 (% of GDP)

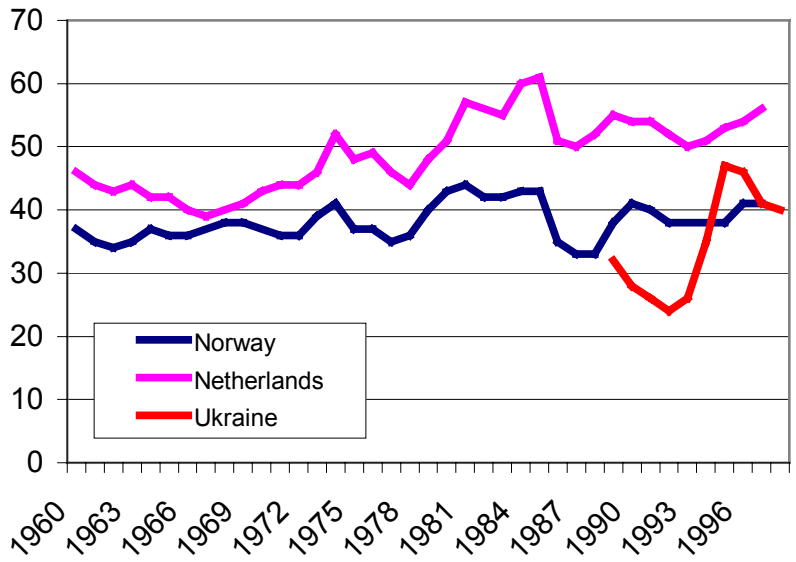

Figure 1b. Foreign direct investment 1975-1998 (% of GDP, ppp)

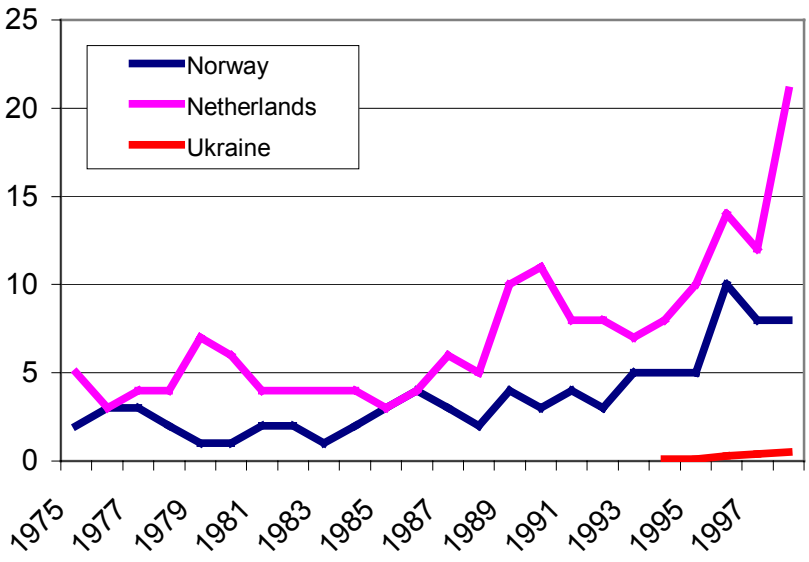

Figure 1c. Manufacturing exports 1980-1998 (% of total exports)

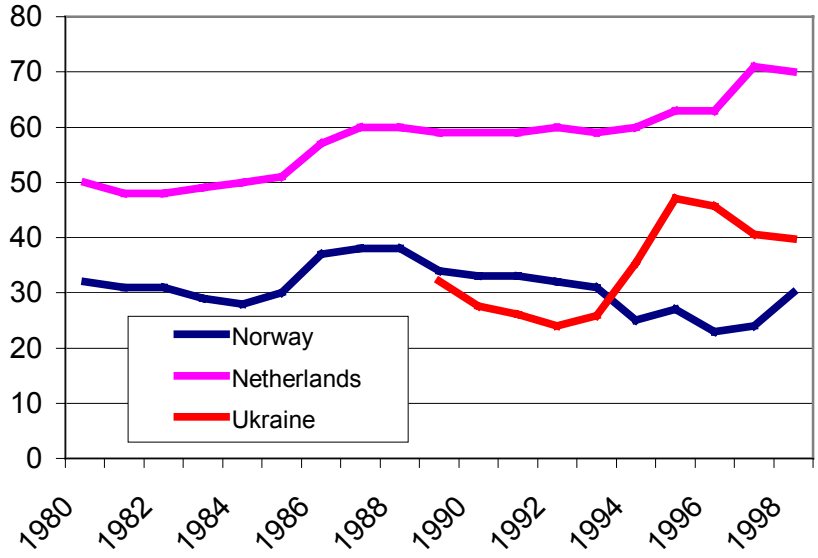

Figure 2a. Natural capital and openness 1965-1998

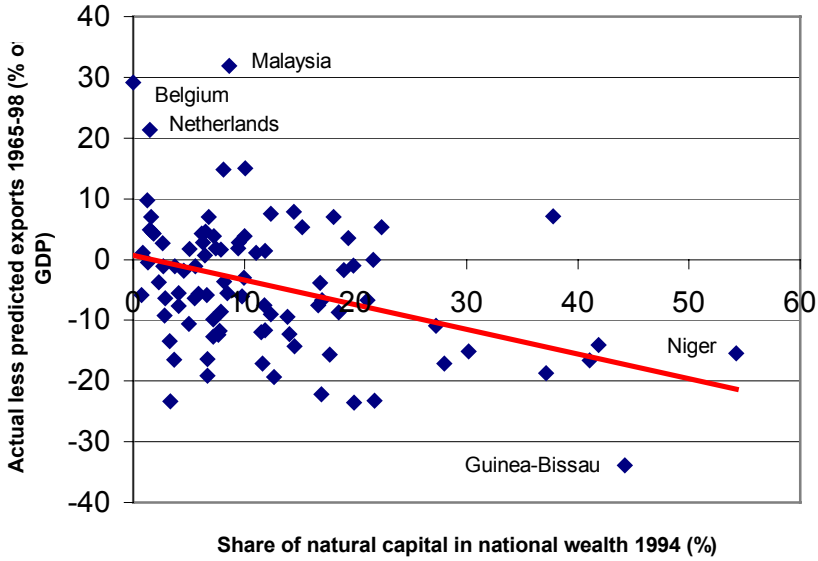

Figure 2b. Openness and economic growth 1965-1998

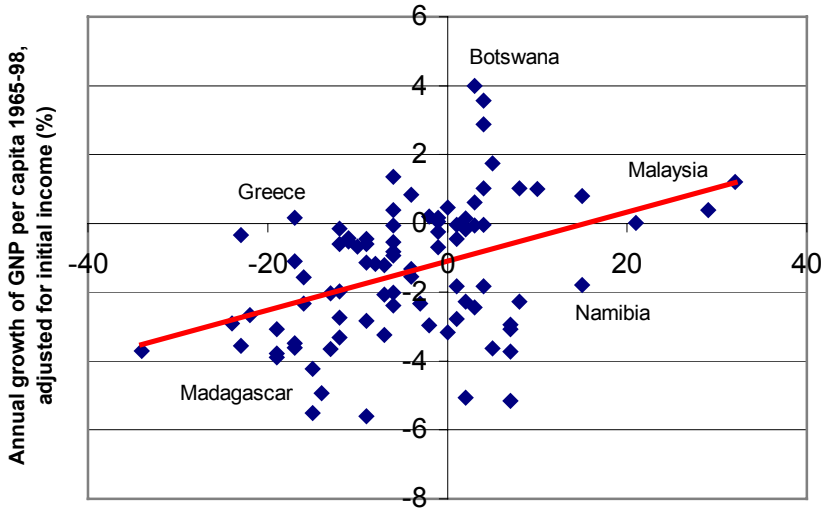

Figure 3a. Corruption and natural capital 1994-2000

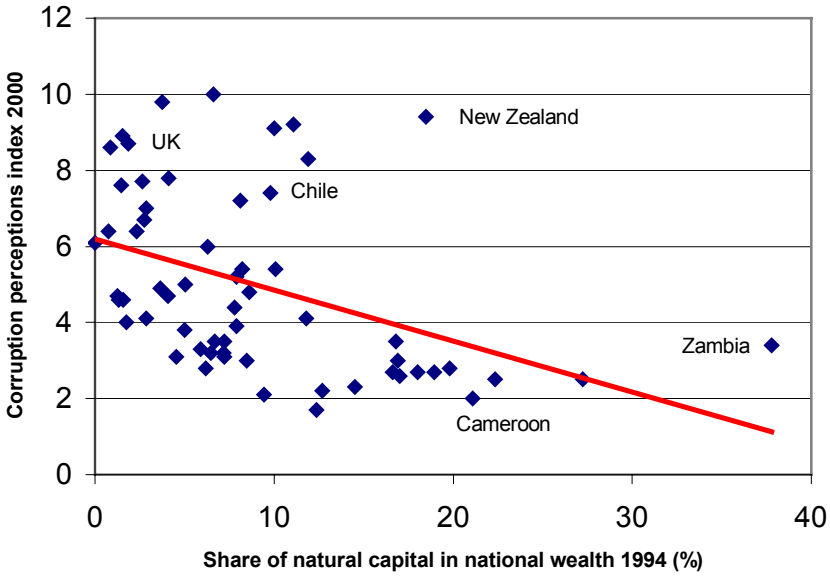

Figure 3b. Corruption and employment in primary sector 1965-1990 (% of labor force)

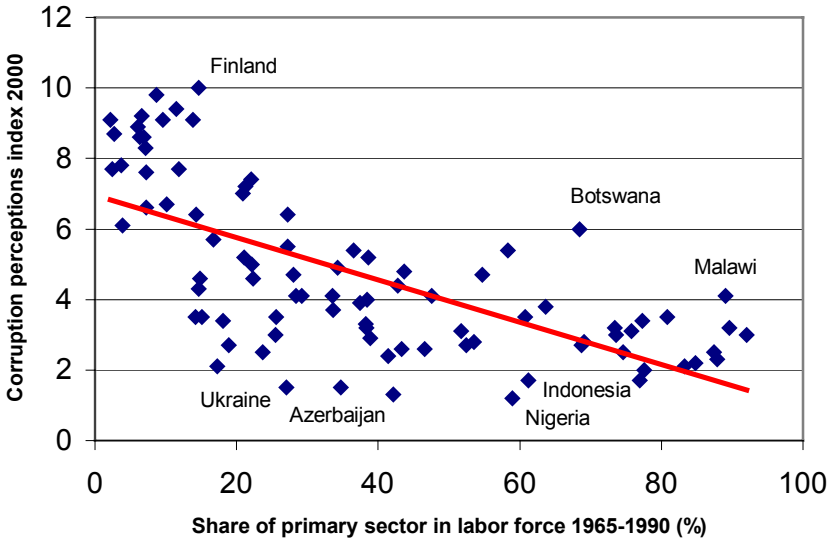

Figure 3c. Corruption and economic growth 1965-1998

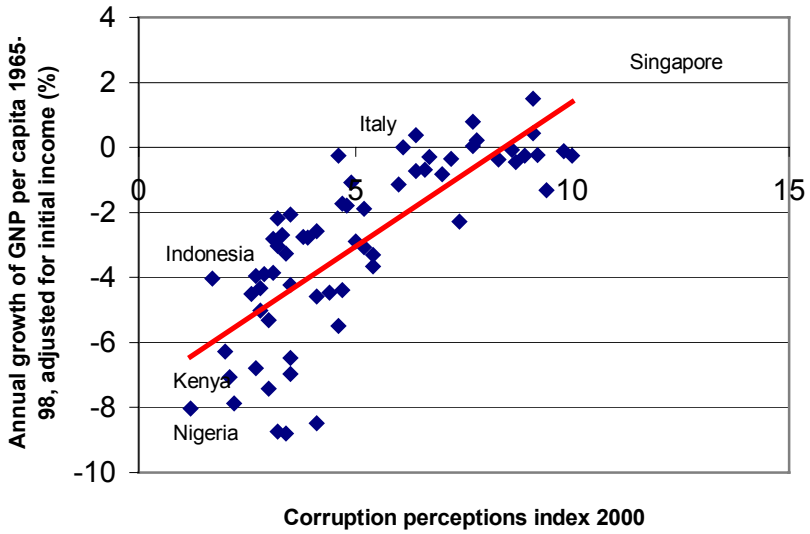

Figure 4a. Education and natural capital 1980-1997

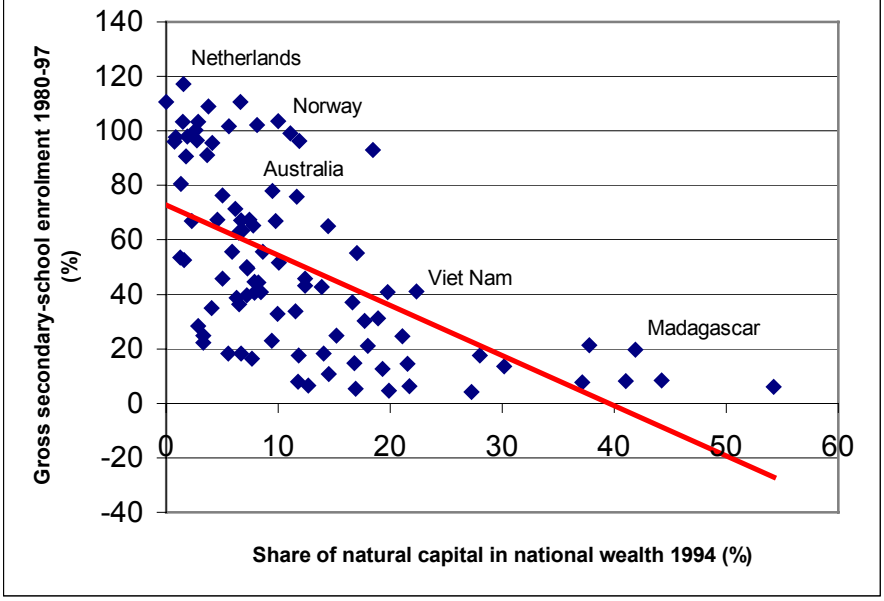

Figure 4b. Education and economic growth 1965-1998

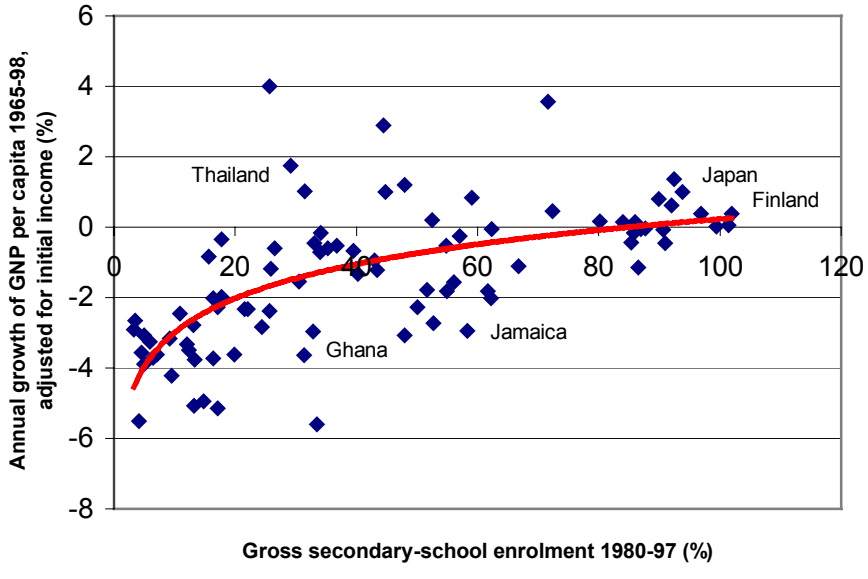

Figure 5a. Investment and natural capital 1965-1998

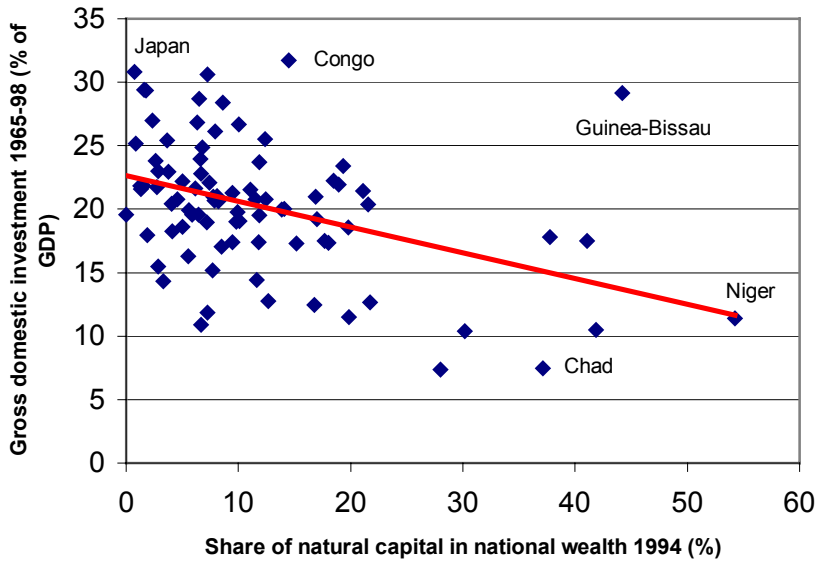

Figure 5b. Investment and economic growth 1965-1998

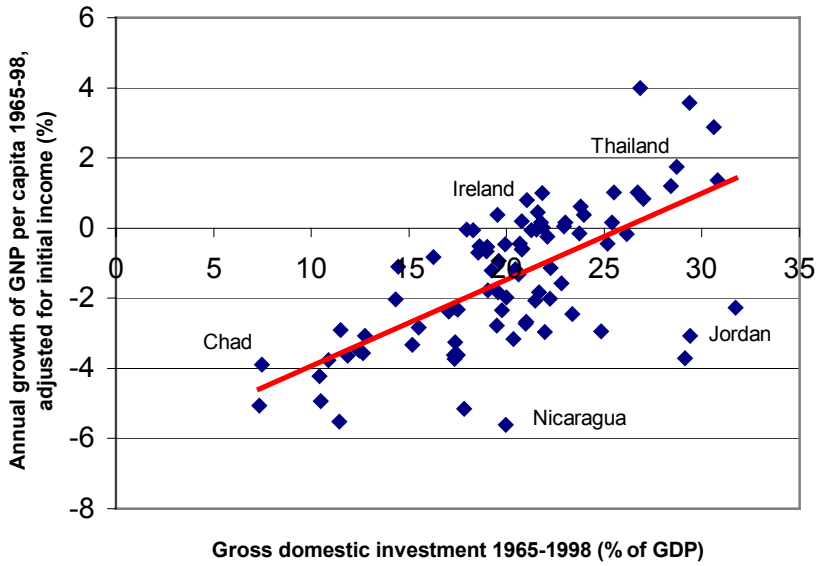

Figure 6a. Natural capital and economic growth 1965-1998

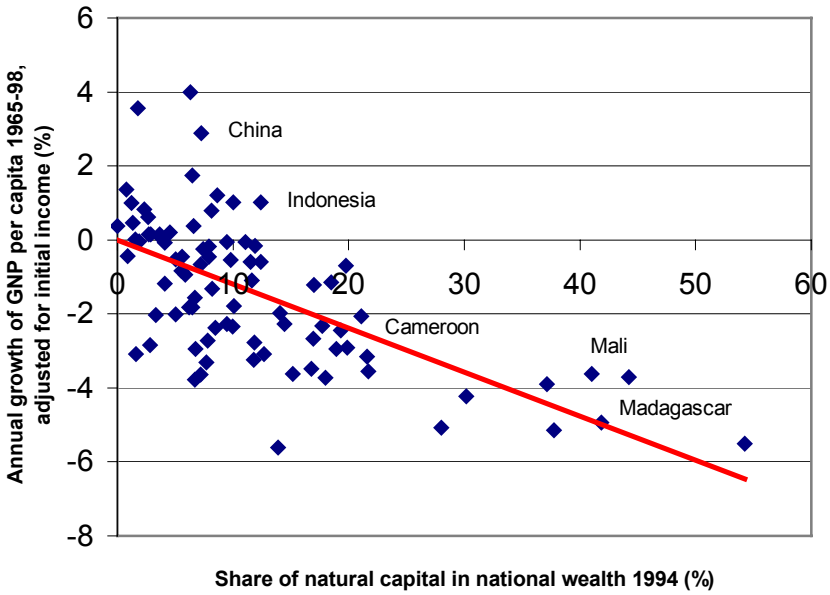

Figure 6b. Natural resources and economic growth 1965-1998, again