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The Curse Of Natural Resources In The Transition Economies

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Abstract

The curse of natural resources is a well-documented phenomenon in developing countries: Economies that are richly endowed with natural resources tend to grow slowly. Among the transition economies of the former "Eastern Bloc", a similar pattern can be observed. In the first years of transition, output fell in all the former communist countries, but the Central European countries, which are rather poorly endowed with natural resources, recovered quickly and have enjoyed rather strong economic growth thereafter. The oil-rich economies of Eastern Europe and Asia have been less successful. This paper shows that a large part of the variation in growth rates among the transition economies can be attributed to the curse of natural resources. After controlling for numerous other factors, there is still a strong negative correlation between natural resource abundance and economic growth.

Among the transition economies the prime reason for the curse of natural resource is corruption. The revenues from natural resource abundance induce rent-seeking behaviour and corruption across the bureaucracy and the business elite. This increased corruption slows down economic growth. Other reasons for the curse of natural resources may be Dutch disease effect and a neglect of education, but the evidence is not very strong.

These findings stress the importance of fighting corruption, especially in natural resource abundant countries. An efficient bureaucracy is a necessary requirement for sustained economic growth. Investment in education is also crucial, but more in the long run. Economic policies that promote export growth, especially in the manufacturing sector, may also raise growth.

1 Introduction

1.1 The Topic Of This Paper

The topic of this paper is how the curse of natural resources affected the transition economies of Eastern Europe and Central Asia during the 1990s, when they were making the transition from centrally planned economies to market economies.

The curse of natural resources is a well-documented phenomenon. Numerous studies have found a significant negative correlation between natural resource abundance and economic growth. This finding seemed puzzling at first, because classical economic theory would predict that abundant natural resources should be good for the economy.

After all, natural resources like iron, coal, and oil are used as an input in many industries. Thus, they are a production factor. One should expect that the abundance of one production factor should raise the marginal product of other factors, say labour and capital, and thus contribute to economic growth.

As a matter of fact, economic theory in the 19th and early 20th century often regarded land as an important production factor, and land is a natural resource. In his famous pessimistic prediction that economic growth could not be sustained forever, Thomas Malthus argued that since land was a limited resource that does not grow, all other production factors would eventually run into diminishing returns, and thus economic growth would stop.

Thus, a classical economist would conclude that if one country has more natural resources than another otherwise similar country, the former would enjoy higher output per worker. Unless all countries in the world are in a steady state, this would translate into higher growth rates in countries that are relatively abundant in natural resources.

Empirical studies have shown that reality contradicted theory: The richest countries today are in general rather poorly endowed with natural resources. Among them are the Western European countries, whose economies are based on manufacturing and services, because they have little natural resources. One might argue that Western Europe's wealth dates back to the 19th century, and that the industrial revolution was based on natural resources such as iron and coal, which were abundant in Western Europe at that time. Habakkuk (1962) argues that it was the relative abundance of natural resources in sparsely populated North America that enabled the US to overtake the United Kingdom's position as economic leader.

However, the stunning success of several Asian economies, notably Japan, South Korea and Taiwan, has shown that natural resources are not a necessary condition for rapid and sustained economic growth. None of the Asian tiger economies possesses significant natural resource endowments, but their average growth rates during the second half of the twentieth century have been higher than anywhere else in the world. South Korea and Taiwan achieved this even under difficult political circumstances.

Among the poor countries of today are countries, especially in Africa, that are richly endowed with oil, gold, minerals and other natural resources. It seems puzzling that they have not managed to turn this natural endowment into a revenue-generating mechanism with which they could achieve sustained economic growth. Especially wealthy oil countries have not accomplished serious economic progress in the way of creating a diversified market economy. They are still reliant on their natural resources to a great extent and do not enjoy sustained growth. Gylfason (2001) mentions that "for OPEC as a whole, GNP per capita decreased by 1.3 percent per year on average during 1965-1998", while the industrial countries enjoyed rather stable positive growth rates, except during the years of turmoil following the oil crisis and the break-up the Bretton Woods exchange rate system.

These stylised facts have been supported by empirical analyses. Confronted with these empirical results, economists have developed theories that can explain the curse of natural resources. Some have argued that the findings might result from a bias in the indicator used, but Sachs and Warner (2001) test for possible bias and find that the indicator they use, the share of primary exports in GDP, is unlikely to be biased.

Most economists agree that there must be some sort of crowding out: If natural resources crowd out some activity X, and X is important for growth, then natural resources slow down growth. Plausible candidates for X include education, manufacturing, and sound government policy.

The transition economies in Eastern Europe and Central Asia provide an interesting case: They began their transition period under similar circumstances around 1990: In all of them, communist regimes had ruled for decades and were now thrown over and replaced by (more or less) democratically elected governments. All of them faced similar difficulties: They had to make the transition from centrally planned economies to market economies.

Although the initial conditions were rather similar in these countries, their growth rates diverged dramatically during the 1990s: Some of them recovered quickly from the initial shock and have enjoyed positive growth rates for the last few years. Others have seen their output drop to less than half of the level of 1989 and still have not recovered.

It is possible that these tremendous differences in economic performance can be partly explained by the curse of natural resources, because natural resource abundance is one characteristic in which the transition countries differed strongly from the onset on: Some have oil and ores, some have not.

In this paper, I am going to examine the effect of natural resource abundance on the growth performance in the transition economies during the 1990s. I will look whether the curse of natural resource also exists in the transition countries, and how powerful it is in explaining the variation in growth rates among countries. I will also examine whether the existing explanations for the Curse also hold in the transition economies.

1.2 The Structure Of This Paper

This paper consists of six sections, divided into several subsections, and an appendix.

In Section 1, I point out what the topic of this paper is, why it is interesting and important, and how I am going to elaborate on it.

In Section 2, I give an overview of the existing literature on the curse of natural resources in general. Citing from several sources, I provide evidence for the Curse that has been found in cross-country datasets containing mostly developed and developing countries.

I also summarise the most plausible explanations for the curse of natural resources and show that they have been proven to be credible.

In Section 3, I provide a short history of the transition countries. I define explicitly which countries I regard as transition economies and describe the set of reforms and stabilisation policies which they have implemented.

In Section 4, the empirical analysis begins. This section is devoted to finding evidence for the curse of natural resources in the transition economies. I introduce two different, but related, indicators for natural resource abundance, and show that they are not biased. I also show that both indicators are strongly correlated with economic growth, and this provides first evidence for the Curse.

Next, I test whether this result is robust. Performing a stepwise regression, I introduce a wide range of variables that could plausibly explain growth. I find that the inclusion of other variables does not eliminate the evidence for the curse of natural resources. In fact, natural resource abundance even appears to be the most important factor explaining growth.

In Section 5, I try to find out how the Curse works in the transition economies: Does it lead to higher corruption, lower growth in manufacturing, and lower investment in human capital? And do these variables in turn affect growth? If so, how large is the effect?

Section 6 forms the conclusion of this paper and summarises the main points.

In the Appendix, I give detailed information on the data I have used and its sources. I also provide the key variables I have used for the statistical analyses in this paper.

Thus, Section 2 is basically a summary of the recent literature on the curse of natural resources. Section 3 is a general introduction to the situation of the transition economies. Sections 4 and 5 constitute the core of this paper. They are also by far the longest sections. In these two sections, I use data that I have collected from different sources to perform an empirical analysis to verify whether the theory of the Curse is supported by the facts. I then interpret the results, some of which are surprising.

2 The Curse Of Natural Resources

2.1 Empirical Evidence

Since “natural resource abundance” is a somewhat vague concept, there is no unique measure for it. Some natural resources are not yet discovered; some are discovered but are not being extracted, maybe due to harsh climatic conditions or environmental concerns. The total stock of natural capital is not easily measured.

Therefore, in estimating the effects of natural resource abundance, one has to use proxies. The problems are similar to those in human capital theory: Which measures are available, and which ones do really reflect what is supposed to be measured? In measuring human capital, researchers have to rely on indicators such as average years of schooling, enrolment ratios, or expenditure on education per capita.

Gylfason (2001) uses the share of natural capital in total capital as a measure of natural resource abundance. If such data is available, this is probably the “best” measure of natural resource abundance. But unfortunately, especially in less developed countries, such data is not easily available.

Sachs and Warner (1995) use the share of natural resource exports in GDP as a measure of natural resource intensity. The reason is simple: Export statistics are available for almost all countries, and if the composition of exports is known, the share of primary goods in total exports can be calculated. Multiplying this share with the share of exports in GDP yields the share of primary exports in GDP.

This measure can be used because a large endowment of natural resources can be reasonably expected to result in a high share of primary goods in exports.

Using the share of primary exports in GDP, Sachs and Warner then examine a sample of 97 developing countries during the time from 1970 to 1989 and find a significant negative correlation between GDP growth and the ratio of natural resource exports to GDP. Gylfason (2001) finds a negative relationship between the share of natural capital in total capital and economic growth. These findings provide evidence for the notion that a large endowment of natural resources leads to slower economic growth in a country.

This relationship is stable: Even after controlling for a number of other variables, it persists. Sala-i-Martin (1997) tests 62 variables that are suspected to explain GDP growth and finds that the fraction of primary products in exports ranks among the top twenty of them in terms of robustness.

It does not seem to be very important which measure of natural resource abundance is used. All of them lead to the same result: Natural resource abundance is associated with slow economic growth. The fact that different indicators yield the same result makes the evidence even stronger.

In this paper, I use the share of primary goods in exports, simply because these data are available for most of the transition economies. I also use the share of primary exports in GDP to verify the main results.

2.2 Possible Estimation Bias

A possible explanation for the Curse could be that the results were simply biased: If, for example, some countries were equally endowed with natural resources in 1900, but differed in some other respect, they would have different growth rates. For example, some countries might enjoy a favourable geographic situation while others do not.

By 2000, those countries with a favourable geography would be rich, and the others would be poor. The share of natural resources in GDP would be higher in the poor countries, although the amount was equal, simply because the total economic size of these countries would be smaller. We would then find a negative correlation between economic development and natural resources, and conclude falsely that natural resources had slowed down growth. Hence, the share of natural resources in GDP may be a biased indicator.

Sachs and Warner (1997) have tested for this possibility. They argue that if there is an omitted variable like geography, the countries with favourable geography will always grow faster than others. In this case, the countries that grew fast in the time period considered (1970-1990 in Sachs and Warner) would have grown fast in the time before that period, too.

This possibility can be tested by including the average annual growth rate of previous periods as an additional variable in a regression. Sachs and Warner do so by including growth in the 1960s. The result is that even when previous growth is controlled for, the effect of natural resources on growth is still significant. Thus, the notion of bias in the indicator is rejected.

Sachs and Warner perform an additional test by controlling for geographic characteristics directly. They include variables such as the percent of a country's land area within 100 kilometres from the sea, the distance to the nearest major port, the fraction of the land area in the tropics, and a malaria index. Even with all these variables included, the effect of natural resources on growth is still significant.

The conclusion is that the curse of natural resources is not a statistical mirage. It is a fact that during the 20th century, and especially in the second half of it, natural resource-abundant economies tended to grow slower than economies with few natural resources.

Sachs and Warner (2001) also mention the argument of some commentators that one should distinguish natural resources that lead to lots of rent-seeking (minerals, oil etc) and others that do not (agriculture, fishing). Their conclusion is that the exact definition of natural resources does not result in any major quantitative changes.

2.3. The Diminishing Importance Of Natural Resources

The Curse used to be particularly puzzling because many economists, including Habakkuk (1962), believe that in the 19th century, it was natural resource abundance which helped the US to overtake Britain's position as economic leader. Other countries, such as Sweden and Australia, were also natural resource abundant in the 19th century, but they managed to achieve high and sustained growth to become highly developed and wealthy industrial economies, so obviously they did not fall prey to the curse of natural resources.

This is not a logical contradiction, because in some crucial respects the world in the 20th century was different. Easy access to coal may have been a great advantage in the 19th century, but this holds no longer true in today's global economy. Transport costs have decreased dramatically, economic borders have been broken down, and energy of all sorts is available to everyone. Domestic natural resources are no longer a great advantage when foreign ones can easily be imported.

The introduction of renewable energies may continue this development, because it decreases the dependence on fossil energy resources even more.

This argument is quite plausible, but it explains only part of the story: Even if domestic sources of natural resources today are no longer important, this means only that they do no longer drive growth. There is still no reason to assume that they actually slow down growth.

Furthermore, as Sachs and Warner (2001) point out, neither the US nor Australia or Sweden ever achieved the high ratios of primary exports to GDP as the Gulf States do today. They were natural resource abundant around 1900 by the standards of that time, but not by today's standards. Their natural resource sectors never became too dominant, and this may be the reason why they were spared by the curse of natural resources.

2.4 Crowding-Out Of Manufacturing Exports

Sachs and Warner (2001) argue that the curse of natural resources must lie in the fact that natural resources tend to crowd out some activity X, which is crucial to economic growth. In their view, activity X is likely to be manufacturing.

They explain how crowding-out of traded-manufacturing industries by a dominant natural resource sector can permanently depress economic growth: The benefits from the natural resource sector accrue to a part of the population that has no incentive to invest them productively. Instead, the export revenues are spent in such a way that the demand raises the prices of non-tradable goods and services, and especially wages. Since the manufacturing sector uses non-tradables and domestic labour as inputs for production, it cannot be competitive on the world market.

In countries with few natural resources, by contrast, the manufacturing sector receives a larger share of the total export revenue. Since manufacturing is usually a competitive industry, the money is spent efficiently: It is invested in new capital and new technologies. This raises the productivity of labour. Output grows, wages rise, and capital owners earn a fair return on their investment. There may also be technological progress due to learning-by-doing. If this mechanism does not work, there is no growth throughout the whole economy.

In other words, manufacturing exhibits a positive externality to the economy, as Sachs and Warner (1995) already point out. The problem is that the producers of manufactures do not capture the whole benefits from their activities. All they see is that due to high input prices, their competitiveness is low, and they close down their businesses. As a result, the positive externalities, which would accrue to the country as a whole, are lost.

If this hypothesis is to be tested with empirical observations, the test requires some measure for the relative price of tradable goods. Unfortunately, such a measure is not directly available. Sachs and Warner (2001) solve this problem by calculating the ratio of a country's purchasing power parity exchange rate to its nominal exchange rate.

This procedure should result in an unbiased estimator, because the price of tradables is more or less equal everywhere, so the general price level can be used as an indicator. It is a weighted average of the prices of tradables and non-tradables.

Sachs and Warner (2001) then perform a test on the difference in price levels. They control for the fact that in more developed countries, the price level is generally higher than in less-developed ones. As a result, they find that there is indeed a positive relationship between natural resource abundance and the general price level. So far, the explanation is credible.

The question then is whether the higher price level really impedes export growth. Unfortunately, Sachs and Warner do not provide a test whether high price levels are really negatively correlated with export growth. Although one should expect that competitiveness suffers under high price levels, which would lead to lower export growth, it would be interesting to know the significance and the size of this relationship.

However, they do show that the contribution of the growth of manufacturing exports to overall economic growth was smaller in natural resource abundant countries. They derive a proxy for this contribution by multiplying the growth in value added from manufacturing exports over the whole time period times the share of manufacturing exports in GDP in the starting year. This proxy, they say, is negatively correlated with natural resource abundance.

In addition to the rise in the general price level, natural resource abundance may also increase exchange rate volatility. Many countries are richly endowed with only one or two specific natural commodities. They are not sufficiently diversified, so that a shock in demand for their main export goods can have huge impacts on their exchange rate. Exchange rate volatility obviously provides another impediment to the growth of manufacturing exports.

Thus, the Dutch disease hypothesis appears to be credible: Export revenues from natural resources are spent on non-traded goods. Therefore, the prices of these goods are higher in a natural resource abundant country than in an otherwise similar country. Since the manufacturing sector uses non-tradable goods as inputs, it is not competitive on the world market. Exports of manufacturing grow more slowly than otherwise, and the manufacturing sector in general will grow more slowly because it also faces foreign competition in the domestic market. The crippling of the manufacturing sector slows down overall economic growth, partly because the positive externalities from manufacturing in the form of faster technological progress are lost.

2.5 Crowding-Out Of Investment In Human Capital

A similar reasoning of crowding out can be applied for investment in human capital. If high wages make manufacturing unprofitable, they also reduce the attractiveness of investing in education.

Gylfason (2001) argues that it is not the existence of natural resources per se that imposes a drag on growth, but rather the way governments deal with the issue. Using public expenditure on education as indicator, Gylfason finds a statistically significant relationship between natural resource abundance and low levels of educational effort. Counter-examples include Botswana and Norway. Other indicators also show a negative correlation between natural resource abundance and educational effort.

As a next step, Gylfason argues that education is important for economic growth. He finds clearly positive, but decreasing, returns to education. A positive relationship between secondary school enrolment and economic growth is found significant. Gylfason concludes that about half of the natural resource curse works through the education channel.

Against this, Temple (2001) argues that the effect of education on growth is not as strong as many believe.

From a theoretical point of view, it makes perfect sense to expect that education has an impact on growth. First of all, human capital is a production factor just like physical capital. Therefore, investment in human capital is the same as investment in physical capital. Even the simple Solow model predicts that as long as a country is below its steady state, a higher savings rate will lead to faster growth, and most countries are not in their steady state in reality. An extended Solow model with both human and physical capital can explain a large part of the variation in growth rates that we observe among countries: There is conditional convergence because each country is converging towards its unique steady state, and hardly any country can be said to be in a steady state.

Furthermore, in endogenous growth theory, the level of human capital can have a huge impact not only on short-run growth but also on growth in the long run. If the speed of technological progress depends on the level of the human capital stock, and this is a perfectly plausible assumption, then the long-run growth rate of the economy also depends on the level of the human capital stock. The size of the effect of investment in human capital depends on the specification of the model and on the size of the parameters: If the stock of knowledge helps in gaining additional knowledge, and knowledge is produced by human capital, there may be increasing returns to human capital. In this case, the benefits from investing in education can be enormous.

On the other hand, additional knowledge may become more and more difficult to acquire once a high stock of knowledge exists. Then there could be decreasing returns to human capital, so the benefits from education are rather small.

To sum up, there are good arguments, both theoretical and empirical, that neglect of investment in human capital may be one of the explanations for the curse of natural resources. It is unclear, however, how large this effect can be in reality.

2.6 Rent-Seeking And Corruption

The availability of natural resources tends to lead to massive rent-seeking in the government and the elite. Rent-seeking may take the form of tariff protection or outright corruption. This in turn leads to massive distortions of the economy and slows down growth.

Natural resource abundance may also create a false sense of security in the people, as pointed out by Auty (2001). Necessary (and possibly painful) reforms of the labour market and other sectors are delayed because the country can survive on natural resource exports alone.

Corruption always goes hand in hand with rents, because pressure groups may block political reforms in order to protect their rents. If there are no rents to be protected or captured, there is no need for corruption.

Why should rent-seeking behaviour be more common in countries where natural resources are abundant? Because the extraction of natural resources is usually controlled by huge corporations or state authorities. Natural resources are not produced in a competitive market environment. There are, so to say, huge barriers to entry. In contrast to manufacturing or services, it is simply not possible for private investors to start up a natural resource extraction company. The companies that exist often hold a monopoly position or are part of a cartel. Because of the need for acquiring mining concessions, there are close ties between the state authorities and the companies.

Natural resources are often found in areas which are not easily accessible and rather thinly populated. In contrast to manufacturing and service industries, which are typically situated in populated areas, natural resource production has to take place where the resources are, and these are often in unfriendly regions. The rule of law is not very strong in these areas.

In the case of Russia, the communist regime in some cases constructed whole cities just to provide housing for the workers in natural resource extraction. In such regions, the local natural resource producer has a monopsony position in the labour market, because there is no other employer in the region. This puts workers into a dependent position. Company managers then have considerable leeway to do whatever they want. This makes them extremely vulnerable to bribery and other forms of illegal behaviour.

The question is how corruption influences the growth rate of the economy. Some economists have seriously and plausibly argued that corruption may actually increase efficiency and welfare. In the presence of other distortions, corruption and black market activity may be a second-best solution to the original distortions. If the state bureaucracy is weakly developed, bribes and speed money may actually improve the efficiency of the bureaucracy because they are used to "buy" decisions that are beneficial and urgent for someone who might otherwise have to wait for years.

One has to keep in mind, however, that a second-best solution is worse than a first-best solution, and that the first-best solution would be to install the appropriate legislation, a powerful jurisdiction, and an efficient bureaucracy.

Corruption can create huge distortions in an economy. Since a bribe payment has to be kept secret, both bribers and bribees have to find ways to cover up the deal. Corrupt government officials and businessmen spend time and effort on hiding their activities. They could use the same time and effort to work productively.

Another point is that bribe payments are usually not used in efficient ways. A corrupt official cannot take his bribe receipts to the capital market and use them to finance profitable investments, because others may ask questions where he got the money from. Bribe payments are hidden in safes and foreign bank accounts, where they are of no use for the domestic economy.

Bardhan (1997) says that "corruption has its adverse effects not only on static efficiency, but also on investment and growth." If bribes have to be paid in order to receive a permission to start a new business, this clearly reduces the incentive to invest. Countries with efficient bureaucracies collect fees and taxes, but they are set up in such a way that they do not (at least in theory) depress economic growth. Investments leading to negative profits in the short run are tax-deductible, but bribes are not.

Thus, according to Bardhan, the negative effect of corruption on growth results mainly from a disincentive to invest. Corruption leads to low investment, and this in turn leads to slower growth.

Bardhan also argues that corruption does not only reduce the amount of investment, but also the composition of it. Even if the amount of investment is unchanged, it becomes less productive, because it is diverted into inefficient areas. If corrupt government officials divert the cement from road and bridge building to build their own palace, this cement still enters the national accounts as investment, but it will probably not contribute to economic growth.

A final point made by Bardhan is that entrepreneurship is discouraged by corruption. If it is frustrating to start a new business because there is a lot of red tape and bribe-paying involved, potential innovators may decide not to open their own business and work somewhere else.

Bardhan supports his theoretical considerations by citing evidence from Paolo Mauro (1995), who found a significant negative association between a corruption index and the investment rate in a sample of 70 countries.

Thus, there are good reasons to believe that natural resource abundance, by concentrating wealth and power in the hands of a small elite, fosters corruption and rent-seeking behaviour. This in turn depresses economic growth, because the incentive to invest is reduced, and the remaining investment is not used efficiently.

2.7 The Predatory State

Auty (2001) delivers an interesting framework for explaining the curse of natural resources in which he actually combines the effects mentioned above. He argues that the dominance of a natural resource sector leads to conditions which give rise to a predatory state structure, where a powerful elite controls the revenues from the natural resource exports.

To the conventional four necessary conditions for sustained growth

- relatively equitable access to land and primary education
- effective markets and public accountability
- open trade policy
- competitive economic diversification to give resilience to shocks he adds a fifth one: a developmental state

Auty defines the developmental state as "a state that is concerned about long-run social welfare and equity and aims to improve in this respects".

He contrasts two political models, the competitive industrialisation model and the staple trap model, against each other. Natural resource-rich countries are well described by the staple trap model, whereas successful economies like South Korea are a prime example for the competitive industrialisation model.

In the competitive industrialisation model, a virtuous economic circle and a virtuous social circle work together to create sustained growth. Key features are that the lack of natural resources forces the economy from the onset on to diversify into labour-intensive (light) industry. This creates a labour shortage, and this in turn leads to social equity (because everyone has a job), accelerated demographic development (urbanisation, slower population growth, more workers per dependent), increasing skills and education (I don't see why better education follows) and so on. The social development creates a homogenous working population, and this facilitates the development of social capital and democratic structures. There is little rent-seeking and corruption.

In the staple trap model, the root of all evil is natural resource abundance. The natural resource export sector provides jobs for unskilled workers. Therefore, there is little incentive for individuals to invest in education. At the same time, a powerful elite evolves around the natural resource sector. Among the elite, rent-seeking and corruption are widespread. The export revenues are not invested in useful projects, but wasted by the elite. A manufacturing sector will hardly develop because it cannot compete internationally. Even if infant-industry protection is applied, this does little good, because it creates further rents and distortions. It does not contribute to job creation because it is usually capital-intensive. And the protected industry will never become viable and continues to be supported by the state, which is another waste of money.

All these flaws lead to worsening income inequality and slow accumulation of human and social capital.

3 The Transition Economies

In this paper, I concentrate on the transition economies of the former Eastern Bloc under the dominance of the Soviet Union. Other countries, such as China, Mongolia, Vietnam, and Cuba, are also classified as transition economies by many commentators, and rightly so. After 1989, and in some cases even years before, virtually all communist States began the transition from a planned economy to a more or less free market economy.

However, I am mostly interested in the developments in the transition economies of Central and Eastern Europe and Central Asia. They have been economically closely intertwined through their membership in the Council of Mutual Economic Assistance (COMECON) and their geographical situation. They all began their transition at roughly the same time, although some Central European countries had experimented with market reforms years before the "transition period" began.

Therefore, my group of "transition economies" consists of the former member States of the Soviet Union and the former communist countries of Europe. Mongolia, China, Cuba, and Vietnam are not part of this group.

TABLE 3.1

The Three Groups of Transition Economies

Central and Eastern Europe (CEE)	Community of Independent States (CIS)	Baltic States
Albania	Armenia	Estonia
Bosnia and Herzegovina	Azerbaijan	Latvia
Bulgaria	Belarus	Lithuania
Croatia	Georgia	
Czech Republic	Kazakhstan	
Hungary	Kyrgyzstan	
Macedonia (FYR)[1]	Moldova	
Poland	Russia	
Romania	Tajikistan	
Slovakia	Turkmenistan	
Slovenia	Ukraine	
Yugoslavia	Uzbekistan	

[1] The official name of the country is: "The former Yugoslav Republic of Macedonia"

Table 3.1 shows a listing of the countries that I consider as "transition economies". In most analyses, there are three groups of transition economies:

The CEE States are those countries which belonged to the Soviet sphere of influence, but were never absorbed into the Soviet Union. Most of them have been independent States since the end of World War I or longer, but some gained their independence only in the last decade.

The Baltic States were absorbed by the Soviet Union during World War II. They declared themselves independent and were recognised as independent in 1991. They are not members of the CIS, and have oriented themselves in economic and political terms strongly towards the Western World. All of them are expected to join the European Union at some time in the near future. Lithuania may even belong to the first wave of EU ascendants together with countries like Poland and Hungary.

The Community of Independent States was formed after the break-up of the Soviet Union. Almost all of the Soviet Union's successor States, with the exception of the Baltic States, are now members of the CIS.

3.1 The Collapse of Communism

Although the collapse of the communist system had been predicted by economists, sociologists, and many others a long time ago, observers in the West were nevertheless surprised by the developments that took place between 1989 and 1991. In a period of roughly two years, the once-powerful Soviet Empire along with its satellites collapsed. Communist governments were overthrown all over Europe and the Soviet Union. The latter was formally dissolved in December 1991. The "Eastern Bloc" did no longer exist.

The ultimate reason for the fall of communist governments was the dissatisfaction of a huge majority of the people with their economic situation and the lack of civil liberties. The economic situation of the communist countries had deteriorated seriously since around 1970. The lag of the communist countries towards the Western capitalist countries had become all too obvious:

– Since 1970, the COMECON member states had experienced declining growth rates. During the 1980s, growth even turned negative in most of these countries.
– The productivity of both labour and capital was low compared to Western standards.
– There was slow technological progress. In the West, the rapid development of the IT industries created visible benefits for everyone, and the technology gap between West and East became increasingly apparent.
– What growth there was, was consumed by military expenditures. In order to compete with the US in terms of military power, especially the USSR spent an ever increasing share of its GDP on military expenditures.

- Especially in the USSR, the agricultural sector was still as inefficient as ever. COMECON as a whole was not self-sufficient and had to import food from the West.
- Standards of living were mediocre at best, compared with the West. Especially in the GDR, people knew this from watching West German TV programmes.

All this was of course not new. The economic superiority of the West and the political oppression in the East had existed for several decades. There had been uprisings and liberation movements before, in 1953 in East Germany, 1956 in Hungary, 1968 in Czechoslovakia, and in the early 1980s in Poland. The crucial difference in 1989 was that under Gorbachev the Soviet Union did not send its army to crush the opposition movements. Without the help of the Red Army, communist governments in Central and Eastern Europe saw no chance of staying in power, and many refrained from shooting their own people.

The reason why the Red Army did not intervene in 1989 was not purely Gorbachev's humanity, although this may be part of the reason. The economic situation in the USSR had deteriorated so badly that the party leadership decided to concentrate on domestic problems instead of over-stretching its capacities by meddling with the affairs of other states. Thus, the countries of Eastern and Central Europe had relatively few problems in gaining independence from the Soviet Union.

Along with the political changes, it was clear that there would also be a reorientation of the economic system from a planned economy to a market economy. In most of the former communist states, the new democratically elected governments immediately took measures to start the transition towards a market economy. Exceptions are Yugoslavia and the Soviet Union, which first had to be disbanded (in the case of Yugoslavia, this happened amidst a violent civil war) before their former member states could initiate the transition.

The disintegration of the Soviet Union occurred relatively peacefully. The Baltic states were the first to declare independence. Then, in December 1991, the Soviet Union was formally dissolved. Its former member states, excluding the Baltic states and Georgia, formed the Commonwealth of Independent States (CIS), which Georgia joined in 1993. The CIS, despite its name, was not a commonwealth but rather a loose economic co-operation agreement.

In Yugoslavia, people were not as lucky. Independence movements, first arising in Slovenia and Croatia, were fought by the Yugoslav (Serbian) army, and this led to a bloody civil war. Slovenia and Croatia were recognised as independent states by the international community in 1992. Later on, Macedonia and Bosnia and Herzegovina also gained independence.

The chaotic developments in former Yugoslavia disrupted the economies of its member states to differing degrees. In Bosnia and Serbia, the situation was so chaotic that economic data are not available for a large part of the 1990s. These two states are therefore not included in the statistical analyses in this paper.

Another federal state that was dissolved as a result of the transition was Czechoslovakia. The Czech and Slovak Republics, however, split peacefully and maintain friendly relations and close economic ties, even in the form of a monetary union.

3.2 Structural Reforms and Macroeconomic Stabilisation

Once the governments of Central and Eastern Europe had decided to transform their economies into market-based ones, Western experts and advisors rushed in to tell them how to achieve this. Heated debates about the most efficient way towards a market economy arose. In the beginning of transition, there was a big argument about the speed of transition: Should governments try the "big bang" approach by doing all the necessary steps at once, giving the economy a cold shower? Or should they be more careful and pursue a "go-slow" strategy of implementing one reform after the other so that the economy could adjust gradually?

The GDR took the most radical approach: Within less than one year after the fall of the wall, full economic and political integration with the Federal Republic of Germany was established. Thus, there was no real transition; it was more like a shock therapy. The remaining transition countries could not follow this example; they had to find ways to reform and stabilise their own economies.

Despite the confusion and the differing opinions about the "best" transition strategy, all countries followed astonishingly similar strategies: In all countries, the set of reforms to be implemented was more or less the same, although the speed and sequencing of the reform process differed.

The creation of a market economy required far-reaching structural reforms:

- the privatisation of enterprises, which were state-owned
- a reform of the banking and financial sector, which was practically non-existent in most countries
- the setting up of a tax system and tax authorities
- the setting up of a social safety net
- an industrial policy aimed at restructuring enterprises that were fit to survive and shutting down the others

In order to cushion the effects of these reforms, government also applied a set of macroeconomic stabilisation policies:

- price liberalisation, because price were distorted by massive subsidies
- balancing the government budget
- a restrictive monetary policy to prevent excessive inflation
- liberalisation of foreign trade and restoring the convertibility of the currencies

The debate of big bang versus gradualism was settled some years later when economists realised that it was not so much the speed of reform-making that mattered, but rather the sequencing of the reforms. In this respect, the transition economies differed considerably, especially in the privatisation and the reforms of the banking sector and the tax system.

Some countries, notably Czechoslovakia and Russia, put heavy emphasis on their mass privatisation programmes. In the case of Czechoslovakia, and later the Czech Republic, this had mainly political reasons: The democratic government wanted to make the reforms irreversible. It feared that due to political instability, it would have little time, so it wanted to push through as many reforms as possible within its term in office. Thus, a huge number of companies were privatised in two waves. The first wave was completed in 1992, and after the split-up of Czechoslovakia, the Czech Republic completed a second wave of mass privatisation in 1994, which Slovakia did not. In both waves, citizens were granted a certain number of points which they could bid for shares in the companies to be privatised. The creators of this programme believed strongly in the working of markets; the markets would ensure that prices would reflect market values of the shares, and so each citizen would earn a fair share.

The problem was that citizens had no clue which shares to bid for: Out of nowhere, hundreds of stocks had appeared on the Prague stock exchange where before there had been none. The average citizen, having little knowledge about how a market economy actually works, could not make reasonable buying decisions. As a logical consequence, most of them entrusted their points to the newly created investment funds, which were blossoming everywhere.

These investment funds turned out to be bad investments: Almost none of the fund managers possessed the necessary skills and knowledge to manage such a fund, and some were criminals who took the money and left for the Caribbean. They exploited the companies via so-called "tunnelling" techniques. Corruption became widespread, people lost their investments, and economic growth was disappointingly slow.

In 1997, the Czech economy got into serious trouble because of a banking crisis: Since a banking sector reform had not been undertaken, banks were still state-owned. As such, they had no incentive to maximise profits and made no sensible lending decisions: they just kept lending, even to non-viable companies. In 1997, they had accumulated a huge amount of bad debts, and severe bank failures threatened. The government had to bail out the indebted banks to prevent more damage to the economy, but this was expensive and drove up public debt. Since 1997, the Czech economy has recovered. Growth is now positive and rather stable, and living standards are rising.

In Russia, mass privatisation took a different shape: enterprises were encouraged to apply for being privatised. In order to make privatisation attractive, the workers of the enterprise were offered schemes that guaranteed them a majority stake in enterprise. The government, on average, retained another 20% of each company's shares. Thus, less than 30% of shares were on average auctioned.

This scheme led to a large degree of insider ownership in Russian companies. The idea was that insiders (workers and managers) would have the appropriate incentive to make a company profitable, so that principal-agent conflicts would not arise. In reality, unfortunately, the opposite happened: Workers and managers acted in the interests of themselves, and not in the interest of their companies. Companies that were absolutely incompetitive and should have been closed immediately were kept afloat by asset scrapping and lobbying for subsidies, because workers wanted to keep their jobs.

Especially in the outlying regions of Russia, where the rule of law was even weaker than in Moscow, crime and corruption bloomed. In many companies, managers put pressure on workers to sell them their shares at ridiculous prices, so that they could themselves gain a majority stake. These manager-owners were then free to do whatever they wanted. Since there was no central authority to register shareholders, companies themselves recorded share transactions and kept these information secret in safes. This provided another opportunity for owner-managers to cheat on owners of minority stakes.

As a result, the initial fall in output in Russia was longer and more pronounced than in other transition economies. Corruption and the lack of financial markets, which could have acted as a disciplining mechanism, led to an inefficient allocation of resources. Economic growth stayed negative until 1998, when reforms and a strengthening of the rule of law finally showed some beneficial effects.

The Czech Republic and Russia are often cited as prime examples of an unsuccessful mass privatisation programme. There were also more successful programmes: Hungary and Poland, in particular, were very successful in privatising their state-owned enterprises, although they followed fundamentally different approaches.

In Hungary, there was no mass privatisation. Enterprise ownership was not distributed for free; the enterprises were sold to investors who could pay for them. Foreign investors played a crucial role in the privatisation of banks and enterprises. Hungarians believed that investors from the capitalist countries, bringing in economic knowledge and management skills, could be a great help in the restructuring of these enterprises. As an additional benefit, foreign investors had to buy the enterprises from the government, so that much-needed cash came in. Hungary was one of the countries with the highest foreign debt, so a little government revenue was desirable.

The Hungarian programme had the intended effects: Foreign investors came rushing in. Between 1990 and 1992, foreign investment made up 75 percent of the total revenue from privatisation of state-owned enterprises.

Of course, foreign investment also has some drawbacks. By 1994, 31 percent of the nominal capital of companies was owned by foreigners. This can have adverse effects: Crises from abroad may quickly spill over, and parts of the population may openly oppose foreign ownership of domestic companies.

These drawbacks are the reason why Poland restricted foreign investment. Instead, Poland also implemented a mass privatisation programme, but with considerably more success than Russia and the Czech Republic. The crucial difference was that in Poland, the programme started relatively late, when institutions and laws were already installed that prevented the massive degree of corruption seen in other countries. Instead of allowing any dubious figure to manage an investment fund, the Polish government set up 15 National Investment Funds (NIFs) that were managed (but not owned) by foreign or domestic fund managers. The shares of state-owned enterprises were distributed among these NIFs, and ownership of the NIFs in turn was distributed among the population.

The ownership structure of the enterprises was arranged in such a way that in each enterprise, there was a "leading fund", an investment fund that owned 33 percent of shares and thus had an incentive to enforce shareholders' interests. As a result, there has been little corruption in Poland. Uncompetitive enterprises were shut down (as shareholders value was thus maximised), and viable enterprises were restructured.

The lesson to draw from these examples is that privatisation without a strong rule of law and proper supervisory institutions, as it happened in Russia and the Czech Republic, leads to chaos and corruption. Only when proper institutions are in place to guarantee that law is respected, privatisation is successful.

With respect to macroeconomic stabilisation, most countries have been rather successful. All countries experienced a period of very high inflation at the beginning of transition, and some were even struck by hyperinflation, but by the mid-1990s, inflation rates in all countries had stabilised at moderate to high levels except in Bulgaria, which ran into hyperinflation again in 1996-97. Inflation in the transition economies remains well above the Western European average, but within acceptable limits. The CEE-5 even managed to bring inflation down below 10 percent.

The initial surge in prices could have been expected: There was *monetary overhang*, and at the artificially low administered prices there was excess demand for most goods. Naturally, as prices became liberalised, this excess demand drove up prices to their equilibrium level. Once the equilibrium prices were reached, the shortages and queues so typical for communist countries had disappeared.

Furthermore, most transition countries had severely undervalued their currencies. This undervaluation had the beneficial effect of raising exports, especially to Western Europe, but it also fuelled inflation. Hordes of Western tourists came to Eastern Europe because even luxury goods were extremely cheap compared with Western standards, and with their spending they drove up prices.

Naturally, in those countries that had not immediately implemented a banking reform and set up an independent central bank, governments used the printing press to balance their budgets, and again drove up inflation. This was the cause of hyperinflation in Bulgaria in 1996 and 1997.

Balancing the government budget proved difficult in most countries: The drop in GDP, which was in general stronger than expected, reduced tax revenue and increased the need for social safety spending. Furthermore, tax evasion became widespread. The former communist bureaucracies had little experience in detecting tax evasion, and there were loopholes in the tax systems. This explains why huge companies like the Russian energy giant Gazprom did not pay taxes for years.

3.3 The Difference in Outcomes

To sum up, it is not easy to say why some countries were much more successful than others. All of them followed more or less the same set of policies, but the results are as different as they can be: In the most successful countries, like Poland or Slovenia, output fell by about 20 percent and then grew at rates of around 3 percent. Today, real GDP per capita in the CEE-5 countries is higher than it was in 1989.

In contrast, the more unsuccessful countries went into economic depression for more than half of the 1990s. In Russia, real GDP fell to a little more than half of its level in 1989. Other countries, like Georgia, performed even worse: By 1994, Georgia's GDP had fallen to less than one quarter of its pre-transition level.

There is no unique explanation for these differences in growth performance. Even the outcome of the Czech mass privatisation programme, which can only be called disastrous, did not prevent the Czech Republic from being among the top performers among the group of transition economies, although behind Poland, Hungary, and Slovenia.

Some authors argue that openness to trade, especially with Western Europe, eased the transition process considerably. This may be true, but it explains only part of the story: Romania and Bulgaria have been very open to international trade. Romania, for example, has been member of the IMF and GATT since the early 1970s, but it performed considerably worse than Slovenia, which is not a GATT member and joined the IMF as late as 1993.

One respect in which the transition countries differed considerably is the abundance of natural resources. Some countries, especially the Central European ones, have few natural resources within their borders. In this respect, they are similar to their neighbour countries Germany, Austria, and Italy, which are also poorly endowed with natural resources. As a consequence, these countries export mostly industrial manufactured goods.

Other countries are relatively richly endowed with natural resources. Russia is one of world's greatest oil exporters, and it has coal, gold, and other mines. Kazakhstan has also oil and coal. Naturally, in these countries primary goods make up a large share of total exports.

This difference in natural resource abundance may be one of the factors explaining the difference in outcomes. It is a stylised fact that the Central European countries, which have few natural resources, performed relatively well after 1990. The Asian transition economies, which are on average richly endowed with natural resources, performed relatively poorly.

These observations may indicate that the curse of natural resources could be one powerful factor influencing growth in the transition economies. In the next section, I will examine whether there is evidence for the curse of natural resources in the transition economies, and how large the impact of the Curse is likely to be.

4 Evidence For The Curse

In this section, I examine the relationship between natural resource abundance and growth and find that they are negatively correlated. As a proxy for natural resource abundance, I decide to use the share of primary goods in total exports (ShaPrimEx). I perform a test for possible bias in this proxy and find no evidence for bias.

In order to test for the robustness of the negative association between natural resource abundance and growth, I perform a stepwise regression: I include a wide range of plausible explanatory variables and eliminate one by one the least significant ones. It turns out that natural resource abundance is one of the most significant factors influencing growth in the transition economies.

4.1 The relationship between natural resource abundance and growth

In order to estimate the extent of the natural resource abundance of a country, I have two different (but related) indicators:

An obvious indicator is the share of primary goods in exports (ShaPrimEx). Primary goods are defined as agriculture, fuels, and ores and metal. These data are easily available for most countries. I prefer ShaPrimEx for reasons that I will explain later.

Sachs and Warner (1995) prefer the share of primary exports in GDP (ShaPrimGDP). They argue that the effect of natural resources should depend on the amount of natural resources in the economy, and not so much on their share in export revenue. It is possible, for example, that in a rather closed economy with little exports these few exports happen to be primary goods. The importance of the natural resource endowment to the economy could still be small, but its share in exports relatively high. This would result in a high value of ShaPrimEx, although the economy is actually not very dependent on natural resources. However, there is no reason to suspect a systematic bias in ShaPrimEx.

Of course, it would be ideal to have an objective measure like “total value of natural resources within the country’s borders”, but such a measure is not available for the transition countries.

Figures 4.1 and 4.2, respectively, plot one indicator of natural resource abundance against average growth of real GDP per capita. In both figures, the negative relation is obvious. Natural resource abundance does seem to be associated with slow (or prolonged negative) growth.

FIGURE 4.1

The Share of Primary Exports in GDP and Growth

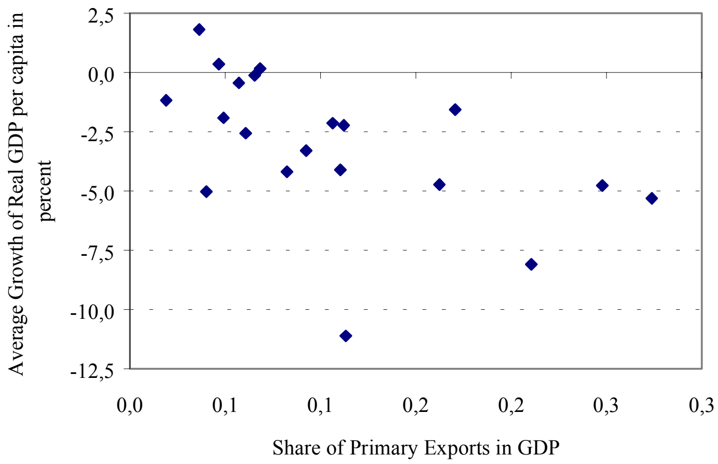
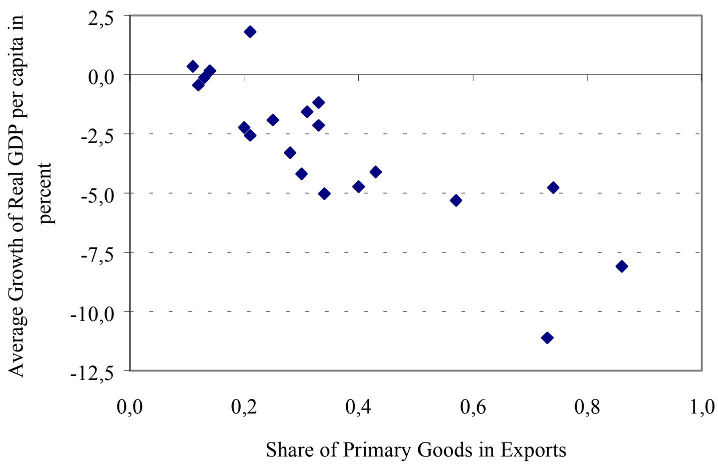


FIGURE 4.2

The Share of Primary Goods in Exports and Growth



I run four regressions to test this relationship: One with ShaPrimEx, one with ShaPrimGDP, and then with their respective natural logarithms. Table 4.1 summarises the results:

TABLE 4.1

The Curse of Natural Resources

Dependent variable: AvGroRGDPpC

Regression	1	1a	2	2a
Independent Variable	ShaPrimGDP	LOG(ShaPrimGDP)	ShaPrimEx	LOG(ShaPrimEx)
Coefficient	-22,3713012	-5,5723879	-11,9203259	-9,7376976
p-value	0,0169323	0,0123014	0,0000023	0,0000041
R^2-adjusted	0,2377313	0,2618382	0,7047214	0,6845697

Table 4.1 shows that for both indicators of natural resource abundance, and for different specifications, the results are essentially the same: Among the transition countries, natural resource abundance is strongly correlated with slow (and prolonged negative) economic growth.

I find that the result is much stronger for ShaPrimEx than for ShaPrimGDP. This finding is in line with Sachs and Warner (1995), who also found stronger results for this indicator.

I choose to use ShaPrimEx from now on as indicator for three reasons:

- Especially in transition economies, it may be a more reliable measure. It is widely believed that natural resource abundant countries tend to have more corrupt governments, so they will have a larger share of shadow economy in GDP. If this is true, GDP may be underestimated, and ShaPrimGDP may be biased. Export statistics are probably more reliable.
- I think that it provides a more intuitive interpretation.
- It yields stronger results.

In general, the main conclusions from this section are the same whatever indicator is used. In Section 4.4, I mention the differences that arise when using ShaPrimGDP instead of ShaPrimEx.

Table 4.2 shows that natural resource abundant countries did not only grow slower, they also reached the trough of growth later than other countries. The trough is defined as the year with the lowest GDP since the beginning of the period. All transition economies contracted in the early stages of transition, but most of them recovered sooner or later and returned to positive growth figures.

TABLE 4.2

Natural Resource Abundance and the Trough

Country	Trough	ShaPrimEx
Albania	1992	0,33
Armenia	1993	0,34
Azerbaijan	1995	0,86
Belarus	1996	0,20
Bosnia-Herzegovina	N/A.	N/A.
Bulgaria	1993	0,33
Croatia	1993	0,25
Czech Republic	1992	0,12
Estonia	1994	0,31
Georgia	1995	N/A.
Hungary	1993	0,14
Kazakhstan	1995	0,74
Kyrgyzstan	1995	0,40
Latvia	1995	0,43
Lithuania	1994	0,30
Macedonia	1995	0,28
Moldova	1999	0,73
Poland	1991	0,21
Romania	1992	0,21
Russia	1998	0,57
Slovakia	1993	0,13
Slovenia	1992	0,11
Tajikistan	1996	N/A.
Turkmenistan	1997	N/A.
Ukraine	1999	N/A.
Uzbekistan	1995	N/A.

Countries like Poland, Romania, and Slovenia, reached their trough very early. Romania and Slovenia did so in 1992, Poland as early as 1991. These three countries are not natural resource abundant.

Russia, with a primary export share of 57%, reached its trough only in 1998, and Moldova, with a primary export share of 73%, had not even reached the trough in 1999.

These data also indicate that natural resource abundant transition economies performed on overall much worse than those with little natural resources.

4.2 Testing for possible bias

As already mentioned in Section 2.2, it is in principle possible that the seemingly obvious association of natural resource abundance with low growth may be the result of a possible bias in the indicator. As Sachs and Warner (2001) point out, ShaPrimGDP may be a biased indicator because of an omitted variable error. If, for example, economic growth would depend on some other variable like geography, those countries with a favourable geography would grow faster than others. After some time, they would have a higher GDP. If all countries had the same amount of natural resource endowments, the poorer countries would appear to be more resource abundant simply because their GDP was lower, so that the share of primary goods in GDP would be higher. Under these circumstances, an observer would find an association of natural resource abundance with low growth, although there is no causal relationship.

The same reasoning goes for my preferred estimator ShaPrimEx: Countries with a favourable geography would tend to grow faster, and along with GDP growth would come export growth. With rising total exports, the share of primary exports would decline, and I would also find a negative correlation.

In order to test for the likelihood of bias, Sachs and Warner (2001) propose a simple test: If there is an important factor like geography, then countries with a favourable geography will always grow faster, not only in the time period being considered. Since their dataset concerns the years 1970-1990, they include growth during the 1960s as an additional variable in a regression. If there is an important variable like geography explaining growth, then the effect of this variable will be captured by the variable that measures past growth. The effect that remains for natural resource abundance is then the true effect of natural resource abundance on growth (although this in turn may be correlated with other variables).

I perform a similar test with a measure of average annual GDP growth from 1980 to 1989. Note that this is not GDP per capita. I use this measure because it is readily available, and it should serve well enough as a proxy.

Table 4.3 summarises the result of the test for omitted geography bias. The first result is that the coefficient for ShaPrimEx is still negative and very significant. Thus, the evidence for the Curse survives this test easily.

If there was an omitted geography bias, this would be indicated by a positive coefficient. It is therefore rather puzzling to see a negative (and pretty significant) coefficient for growth in the 1980s. There is some evidence that fast growth in the 1980s was actually associated with slow growth in the 1990s.

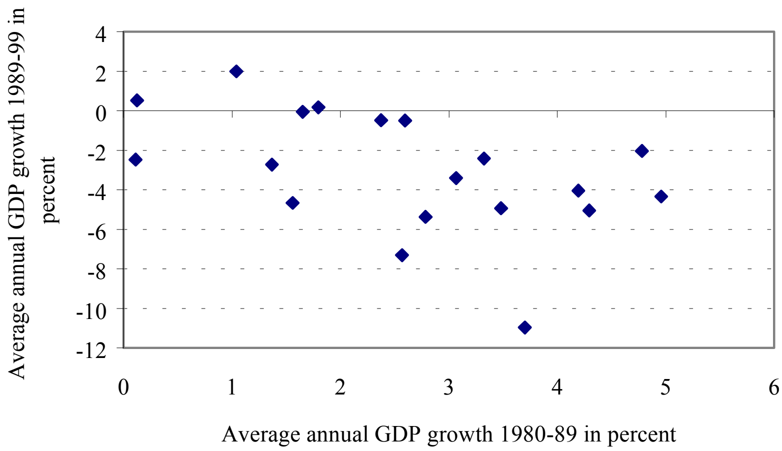
TABLE 4.3

Test for omitted geography bias

Dependent variable	AvGroRGDP			
Multiple correlation coefficient	0,8809112			
R^2	0,77600455			
Adjusted R^2	0,74965214			
Standard Error	1,52825473			
Observations	20			
	Coefficient	Standard Error	t-statistic	p-value
Intercept	2,12297159	0,81360618	2,60933561	0,01832268
ShaPrimEx	-11,0407386	1,66802137	-6,61906305	4,3445E-06
Growth8089	-0,51002617	0,24796792	-2,05682323	0,05538458

FIGURE 4.3

Growth in the 80s and 90s



The negative relationship between growth in the 80s and growth in the 90s can be seen in Figure 4.3. There are two possible explanations:

The observed pattern may be the result of convergence. Countries that grew slowly during the 80s could grow relatively faster in the 90s because of knowledge spillovers or other effects. If there is indeed convergence among the transition countries, one could test this by including the initial income per capita in a regression. I do so in the next section and find that there is no conditional convergence. In fact, there is even evidence for divergence. Therefore, this explanation is not credible.

It is probably more likely that the pattern arises due to the statistical peculiarities that prevailed in the transition economies prior to 1989. Company managers as well as government officials had incentives to cheat and exaggerate figures in order to increase their perceived performance. It is possible, and indeed likely, that for some of these countries growth figures for the 1980s are somewhat over-estimated.

During the 1990s, statistical offices were only being set up in most transition economies. Until 1989, statistical figures from communist countries were widely believed to be manipulated, overstating a country's economic performance significantly.

Unless figures in all countries were overstated by exactly the same proportion (which would be very unlikely), some countries' growth figures were more overstated than others. As statistical practices were improved and past errors corrected, and the new practices revealed the true figures, growth in the early 1990s may have been understated in these countries.

4.3 Robustness Analysis: Stepwise Regression

In a stepwise regression, I start by estimating a model with the average annual growth of real GDP per capita as dependent variable and a wide range of variables that can plausibly be expected to explain growth as independent variables. I then eliminate the least significant one and run a regression on this reduced model. This procedure should result in a model that contains only significant variables and still explains a large part of the variation in growth.

In the first regression, I have eight explanatory variables:

- The share of primary goods in exports (ShaPrimEx) as a proxy for natural resource abundance
- Real GDP per capita in 1989 (RGDPpC89) in US dollars as a measure of initial income, controlling for conditional convergence
- An index of trade liberalisation (TradLib) as a proxy for trade openness
- Gross capital formation (CapForm); this is approximately the same as gross domestic investment
- An index measuring the extent of corruption in the state apparatus (SCI)
- The gross secondary enrolment rate in 1990 (SecEnrol90) as a proxy for the initial stock of human capital
- The average annual growth of exports between 1994 and 1999 (ExGro9499)
- The average annual growth of the population between 1989 and 1999 (PopGro8999)

A detailed description of the data, its sources and the reasons why I have used these specific data is provided in the appendix.

TABLE 4.4

Regression 1

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,93478710			
R^2	0,87382692			
Adjusted R^2	0,77288845			
Standard error	1,49514695			
Observations	19			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-0,34994036	21,4480685	-0,01631571	0,98730346
ShaPrimEx	-9,00565611	2,44982414	-3,67604187	0,00427423
LOG(RGDPpC89)	3,40778512	1,71367960	1,98857775	0,07479748
TradLib	0,40729916	0,40256091	1,01177028	0,33550217
LOG(CapForm)	-7,77819003	4,26033497	-1,82572265	0,09785768
SCI	2,97926160	5,38629211	0,55311920	0,59233128
LOG(SecEnrol90)	-2,13034308	10,7264525	-0,19860649	0,84655026
ExGro9499	0,18349003	0,06919611	2,65173917	0,02424058
PopGro8999	1,11799161	0,82056184	1,36247088	0,20294476

Table 4.4 shows the results of Regression 1, with eight explanatory variables. Adjusted R^2 is 77 percent, which indicates that the variables explain a large part of the variation in average growth rates.

In Regression 1, four variables are significant at a 10 percent error level: ShaPrimEx, LOG(RGDPpC89), LOG(CapForm), and ExGro9499.

The negative coefficient on ShaPrimEx and the low p-value (less than 1 percent) provide some rather impressive evidence for the curse of natural resources. A large share of primary goods in total exports is obviously strongly associated with low economic growth. The size of the coefficient on ShaPrimEx means that an increase of ten percentage points in the share of primary goods in total exports would decrease expected growth by 0.9 percent.

The positive coefficient on RGDPpC89 provides an interesting mystery: According to most growth models, there should be conditional convergence among countries. This would be reflected in a negative coefficient on initial income in a cross-country regression, and indeed, most empirical studies come to this result.

One might speculate that in the context of the transition economies, those countries which had relatively high income levels in 1989 were given a head start. Maybe for them it was easier to adopt Western practices and institutions in the way of organising their markets, or to attract foreign capital inflows.

The negative coefficient on gross capital formation is also difficult to explain: Why is high investment associated with slow growth? I have to admit that the indicator is somewhat weak, because extensive data were only available from 1996 on. But if the data were just inaccurate, the variable would probably be insignificant.

The positive coefficient on export growth may have two explanations: Either, exports grew along with GDP simply because all else being equal, a larger economy will always export more than a small one. But it also possible and quite likely that export growth directly raises GDP growth. Trade liberalisation and export promotion policies are said to be welfare-enhancing exactly because exports raise overall growth.

SCI, with a p-value of 59.2 percent, is very insignificant. Furthermore, as I show in Section 5.1, it is closely correlated with ShaPrimEx, so that its presence reduces the significance of ShaPrimEx. Therefore, I exclude SCI and run the reduced regression again. Table 4.5 shows the results:

TABLE 4.5

Regression 2

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,93069627			
R^2	0,86619554			
Adjusted R^2	0,78814294			
Standard error	1,40587039			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-5,2043092	13,0697141	-0,3981961	0,69747918
ShaPrimEx	-8,1869620	1,93863570	-4,22305337	0,00118248
LOG(RGDPpC89)	3,04151025	1,51996937	2,00103391	0,06853058
TradLib	0,45978730	0,36547420	1,25805680	0,23230016
LOG(CapForm)	-6,69862595	3,53888140	-1,89286534	0,08273886
LOG(SecEnrol90)	0,35392814	6,33850760	0,05583777	0,95638998
ExGro9499	0,16483059	0,05714503	2,88442581	0,01371740
PopGro8999	0,85986312	0,70617341	1,21763735	0,24676397

The number of observations has increased to 20 because Macedonia is now included, too (No SCI value for Macedonia was available).

In comparison with Regression 1, one may note first that adjusted R^2 has gone up to 78.8%. This indicates that SCI was indeed insignificant and it was good to drop it.

Concerning the sizes of the coefficients, few substantial changes have occurred. The coefficient on ShaPrimEx has decreased in size, but is still of the same magnitude. The largest change has occurred in the coefficient on SecEnrol90, which has gone up from –2.13 to 0.35. The coefficient has changed its sign, and the p-value of 95.6 percent indicates that this variable is now completely insignificant.

Dropping SCI has improved most p-values. Except for SecEnrol90 and PopGro, all variables are now more significant than in Regression 1. This provides further evidence that SCI should have been dropped.

Most interestingly, the p-value of ShaPrimEx has fallen as a result of dropping SCI, from 0.4 percent to 0.1 percent. This indicates that there was multicollearity between SCI and ShaPrimEx.

The next logical step is to exclude SecEnrol90, because it is completely insignificant. Table 4.6 shows the results of Regression 3:

TABLE 4.6

Regression 3

Dependent variable	AvGroRGDPpC
Multiple correlation coefficient	0,93067759
R^2	0,86616077
Adjusted R^2	0,80438882
Standard error	1,35089204
Observations	20

	Coefficient	Standard error	t-statistic	p-value
Intercept	-4,53762682	5,10836282	-0,88827419	0,39053288
ShaPrimEx	-8,17260301	1,84636159	-4,42632855	0,00068372
LOG(RGDPpC89)	3,03151776	1,45037088	2,09016728	0,05681696
TradLib	0,45577109	0,34431380	1,32370844	0,20840627
LOG(CapForm)	-6,65841351	3,32933291	-1,99992422	0,06684943
ExGro9499	0,16583659	0,05210986	3,18244158	0,00720714
PopGro8999	0,85122159	0,66206193	1,28571295	0,22097416

Excluding SecEnrol90 has improved the fit of the regression. R^2-adjusted has gone up to 80.4%, which is quite satisfactory. The coefficients of the remaining variables are almost unchanged from regression 2, and all p-values have improved. It was definitely right to exclude SecEnrol90.

Four of the six remaining variables are significant at a 10 percent error level. Two of them are even more significant.

ShaPrimEx is now very significant, with a p-value of 0.0007 percent. There is no doubt that natural resource abundance, measured as the share of primary goods in total exports, has a significant negative impact on growth. The size of the coefficient is almost unchanged from Regression 2, from –8.19 to –8.17.

The positive coefficient on RGDPpC89 persists. It is now significant with a p-value of only 5.7 percent, and its size is almost unchanged from regression 2.

TradLib is not sufficiently significant, but it is not completely insignificant either, with a p-value of 20.8 percent.

The negative sign on CapForm still provides something of a mystery. It is now significant with a p-value of 6.7 percent, so it cannot be easily rejected.

Export growth is by now significant at an error level of only one percent. The relation between export growth and economic growth is thus proven.

The coefficient on PopGro8999 is still positive, but not very significant.

Since neither TradLib nor PopGro8999 are sufficiently significant, I try to exclude each one to see what happens. Table 4.7 shows the results of regression 4, where I have dropped PopGro:

TABLE 4.7

Regression 4

Dependent variable	AvGroRGDPpC
Multiple correlation coefficient	0,92148902
R^2	0,84914201
Adjusted R^2	0,79526415
Standard error	1,38204045
Observations	20

	Coefficient	Standard error	t-statistic	p-value
Intercept	-3,55012865	5,16674125	-0,68711175	0,50323630
ShaPrimEx	-8,48773559	1,87221662	-4,53352220	0,00046820
LOG(RGDPpC89)	2,14752321	1,30649226	1,64373205	0,12249193
TradLib	0,36941950	0,34548644	1,06927351	0,30303662
LOG(CapForm)	-4,78629716	3,06307183	-1,56258077	0,14046752
ExGro9499	0,15742467	0,05288953	2,97648090	0,01000717

Unfortunately, R^2-adjusted decreases slightly.

The p-values of most of the other variables have increased. RGDPpC89 and CapForm are no longer significant at a 10 percent error level.

Table 4.8 shows the results of Regression 5, where I have dropped TradLib:

TABLE 4.8

Regression 5

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,92093499			
R^2	0,84812126			
Adjusted R^2	0,79387886			
Standard error	1,38670819			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-3,48259620	5,17958132	-0,67237021	0,51229298
ShaPrimEx	-9,10100222	1,75324748	-5,19093984	0,00013683
LOG(RGDPpC89)	3,16915540	1,48499358	2,13412061	0,05100184
LOG(CapForm)	-6,09225783	3,38928508	-1,79750528	0,09385145
ExGro9499	0,14538935	0,05108725	2,84590283	0,01295418
PopGro8999	0,68027407	0,66656041	1,02057377	0,32476944

Regression 5 is inferior to Regression 3 in the sense that R^2-adjusted is slightly smaller. In Regression 5, PopGro8999 is rather insignificant. I therefore decide to exclude it, too.

TABLE 4.9

Regression 6

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,91477965			
R^2	0,83682180			
Adjusted R^2	0,79330762			
Standard error	1,38862841			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-2,82826264	5,14686412	-0,54951181	0,59074235
ShaPrimEx	-9,21667701	1,75200269	-5,26065232	9,5972E-05
LOG(RGDPpC89)	2,41308195	1,28878420	1,87237084	0,08078143
LOG(CapForm)	-4,62604706	3,07398697	-1,50490132	0,15311364
ExGro9499	0,14161930	0,05102408	2,77553881	0,01414018

In Regression 6, I have excluded both PopGro8999 and TradLib:

In Regression 6, there are only four explanatory variables left. All of them are significant to a certain extent:

ShaPrimEx is by far the most significant variable. With a p-value close to zero, the evidence for the Curse cannot be denied. The coefficient is now –9.2, which is not far from the previous estimates.

Export Growth is also highly significant. With a p-value of 1.4 percent, the relationship between export growth and GDP growth can hardly be rejected.

The significance of RGDPpC89 and CapForm is not as strong. With p-values of 8.1 percent and 15.3 percent, respectively, both variables are on the edge of being significant.

Since none of the coefficients in Regression 6 is completely insignificant, it would be hard to choose which one to exclude, so I decide to try something else:

I have just shown that export growth is one of the most important factors in explaining growth in the transition economies. However, it is possible that export growth is more crucial in natural resource abundant countries than in others. The reason is that these countries are typically dependent on their export revenues to finance investment into new capital goods. As Szirmai (1997) explains, theories of dependent development argue that in countries that are very dependent on primary exports, the internal market is "disrupted" in the sense that there are few linkages between the primary sector and the rest of the economy. There is no continuous production chain from primary goods production to manufacturing. Instead, these countries export primary goods and import capital goods. External shocks, such as a world-wide economic downturn and a fall in demand for this country's exports, have a much stronger effect on these countries because the lack of export revenue causes a fall in investment. The domestic economy cannot make the capital goods itself. Without export revenues, the country cannot pay for capital imports, and investment falls. Since investment is crucial for future growth, a fall in export revenue has a lasting effect on these countries' growth rates.

In countries with little primary exports, the effect of a fall in export revenue is not that strong. These economies are typically more diversified. Capital goods are at least partially produced within the country. Export revenues are not spent primarily on capital goods, but also on consumption. Thus, a fall in export revenues does not only hit investment, but reduces consumption and investment proportionately. The effect of export growth on economic growth is less pronounced.

In order to test for this possibility, I have calculated an interaction variable to measure the effect of a combination of natural resource abundance and export growth, which I have simply called "InterAction". It is defined as ShaPrimEx times ExGro9499.

The idea is that if I multiply ShaPrimEx with ExGro9499, this interaction term will take on high values for natural resource abundant countries which enjoyed high export growth. Countries that are poorly endowed with natural resources and experienced low export growth will have low values. Countries which have high natural resources but low export growth, or vice versa, will have average values.

TABLE 4.10

Regression 7

Dependent variable	AvGroRGDPpC
Multiple correlation coefficient	0,93384342
R^2	0,87206354
Adjusted R^2	0,82637195
Standard error	1,27272259
Observations	20

	Coefficient	Standard error	t-statistic	p-value
Intercept	-2,47744544	4,72064786	-0,52481047	0,60792592
ShaPrimEx	-12,343464	2,26133764	-5,45847898	8,427E-05
LOG(RGDPpC89)	2,00221671	1,19959798	1,66907309	0,11730256
LOG(CapForm)	-2,83711121	2,96101928	-0,95815357	0,35424066
ExGro9499	-0,02449239	0,09665392	-0,25340302	0,80364011
InterAction	0,43265706	0,22031713	1,96379219	0,06972951

Table 4.10 shows the results, which offer more than one surprise:

First of all, R^2-adjusted has gone up to 82.6 percent. This is the highest value for R^2-adjusted that I have seen so far. The increase in R^2-adjusted together with the observation that the interaction variable itself is pretty significant, with a p-value of 7 percent, allows me to conclude that the introduction of InterAction has improved the fit of the regression.

Secondly, ExGro9499 is now completely insignificant, with a p-value of more than 80 percent. This comes as a surprise because in previous regressions, export growth has always been very significant.

ShaPrimEx is still highly significant. The coefficient is larger in absolute terms. This is not a surprise, because ShaPrimEx now measures solely the negative impact of natural resource abundance itself. If a country is natural resource abundant and enjoys strong export growth, this positive effect may offset the negative impact of natural resource abundance. The interpretation goes as follows: If a country enjoys no growth in exports (InterAction then equals zero), then the curse of natural resources will reduce economic growth. An increase of 10 percentage points in the share of primary goods in total exports will then reduce average growth by 1.2 percent per year. Export growth may offset the negative impact.

I should also note that the other explanatory variables, initial income and gross capital formation, have become less significant.

My next step is to drop export growth from the regression, because it is now completely insignificant. Table 4.11 shows the results:

TABLE 4.11

Regression 8

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,93352919			
R^2	0,87147674			
Adjusted R^2	0,83720387			
Standard error	1,23238341			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-2,48923518	4,57080402	-0,5445946	0,59403686
ShaPrimEx	-11,9356474	1,53823667	-7,75930494	1,2518E-06
LOG(RGDPpC89)	2,05697922	1,14257198	1,80030603	0,09195189
LOG(CapForm)	-3,12621953	2,6457899	-1,18158268	0,25576609
InterAction	0,38379799	0,10321997	3,7182531	0,00206061

TABLE 4.12

Regression 9

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,92709996			
R^2	0,85951433			
Adjusted R^2	0,83317327			
Standard error	1,24754617			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-5,1525964	4,02528521	-1,28005747	0,21877353
ShaPrimEx	-12,0397385	1,55460682	-7,74455528	8,4267E-07
LOG(RGDPpC89)	1,60229169	1,0890572	1,47126495	0,1606136
InterAction	0,37572511	0,1042608	3,60370443	0,00238051

Unfortunately, R^2-adjusted decreases slightly, from 83.7 percent to 83.3 percent. The exclusion of CapForm has little effect on ShaPrimEx and InterAction. Their coefficients change by marginal amounts. The p-value of ShaPrimEx falls slightly, while that of InterAction increases from 0.21 percent to 0.24 percent.

RGDPpC89 is now considerably less significant than in Regression 8, and its coefficient has fallen from 2.06 to 1.60.

Although RGDPpC89 is not completely insignificant in Regression 9, I drop it in Regression 10 just to see what happens:

TABLE 4.13

Regression 10

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,91679234			
R^2	0,8405082			
Adjusted R^2	0,82174445			
Standard error	1,28957122			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Schnittpunkt	0,71407479	0,56876492	1,25548317	0,22628674
ShaPrimEx	-13,1539117	1,40342276	-9,37273648	3,967E-08
InterAction	0,38511075	0,10757102	3,58006034	0,00230659

In Regression 10, R^2-adjusted has fallen from 83.3 percent to 82.2 percent.

Furthermore, the coefficient on ShaPrimEx is now larger in absolute terms, and even more significant than before. This leads me to the suspicion that ShaPrimEx might be negatively correlated with RGDPpC89. If this is the case, ShaPrimEx now captures part of the effect of RGDPpC89 on growth, since RGDPpC89 is excluded.

The coefficient and p-value of InterAction are virtually unchanged by the exclusion of RGDPpC89.

I conclude that Regression 9 is superior to Regression 10 because obviously, RGDPpC89 has some explanatory power, although it is not as significant as I might wish.

I thus have a model which powerfully explains a great part of the variation in growth rates among transition countries with only three variables: ShaPrimEx, RGDPpC89, and the interaction term.

The significance of ShaPrimEx provides sufficient evidence to support the hypothesis that in the transition economies, there is also a curse of natural resources. Moreover, the curse is one of the prime reasons why transition economies differ so sharply in their growth rates.

The model shows also that in principle it is possible to offset the negative impact of natural resources on growth by having great export growth. However, it is not likely that a country may achieve this in reality. Using the coefficients of Regression 9, one can estimate that a country would need an average export growth of more than 30 percent per year to overcome the negative impact of the curse of natural resources. Among the transition economies, the highest average growth rate of exports is 18.7 percent in Belarus, well below thirty percent.

4.4 The Same Procedure with ShaPrimGDP

In the above analysis I have used ShaPrimEx, the share of primary goods in exports, as an indicator for natural resource abundance. There are arguments for using ShaPrimGDP, the share of primary exports in GDP, as an indicator. In order to verify the robustness of the results from Section 4.3, I have followed the same procedure with ShaPrimGDP instead of ShaPrimEx.

I have replicated all the regressions from Section 4.3 with ShaPrimGDP. An "a" indicates that the indicator for natural resource abundance is now ShaPrimGDP. Thus, Regression 1a is the same as Regression 1, but with ShaPrimGDP instead of ShaPrimEx. I do not report all results from Regressions 1a to 10a because that would add little value while blowing up the size of this paper unnecessarily. Instead, I focus on the main points.

The results, in short, are that:

– There is also ample evidence for the curse of natural resources, though not as ample as when I used ShaPrimEx. For ShaPrimGDP, I find p-values around 1 percent.
– The effect of initial income is more significant and larger in size. It is significant at a five percent error level.
– The interaction term of ShaPrimGDP and ExGro9499 is less significant than export growth itself. This is in contrast to the above analysis, where I found that the impact of export growth was stronger the higher the natural resource dependence of the economy. When using ShaPrimGDP, the effect of export growth seems to be more symmetric.
– Adjusted R^2 is lower in regressions with ShaPrimGDP. With ShaPrimEx, it reached values of more than 80 percent. In the regressions with ShaPrimGDP, the highest value of adjusted R^2 is 63.6 percent. Thus, ShaPrimEx seems to have more explanatory power than ShaPrimGDP.

Table 4.14 shows the results of Regression 9a, the "best" one in terms of explanatory power. Adjusted R^2 is only 52.6 percent. In Regression 9, by contrast, it was 83.3 percent.

TABLE 4.14

Regression 9a

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,77502623			
R^2	0,60066565			
Adjusted R^2	0,52579046			
Standard error	2,10333743			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-14,7091019	5,96666127	-2,46521484	0,02538718
ShaPrimGDP	-28,2692288	8,29754412	-3,40693925	0,00360696
LOG(RGDPpC89)	3,95852193	1,67019832	2,37009096	0,03068977
InterAction	1,37213015	0,60146869	2,28129937	0,03656379

ShaPrimGDP has a negative coefficient and a p-value of 0.4 percent. Thus, there is strong evidence for the Curse, also when using ShaPrimGDP.

LOG(RGDPpC89) is now remarkably more significant than in Regression 9. Its p-value is 3.1 percent, compared to 16.1 percent in Regression 9.

InterAction is still significant, but considerably less so than in Regression 9. Its p-value is now 3.7 percent, whereas in Regression 9 it was 0.2 percent.

TABLE 4.15

Regression 9b

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,81212204			
R^2	0,6595422			
Adjusted R^2	0,59570636			
Standard error	1,94210301			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-15,4694092	5,46019823	-2,83312226	0,01199239
ShaPrimGDP	-18,5386008	6,3814952	-2,90505598	0,010332
LOG(RGDPpC89)	3,76018838	1,54620338	2,43188473	0,02713807
ExGro9499	0,19914128	0,06686033	2,97846681	0,00886887

Table 4.15 shows that a modified version of Regression 9a, with ExGro9499 replacing InterAction, yields a higher adjusted R^2.

When ShaPrimGDP is used, export growth itself provides a better regression fit than the interaction term. In Regression 9b, the p-value on ExGro9499 is only 0.9 percent, which is lower than the 3.7 percent that InterAction achieved in Regression 9a.

In general, ShaPrimGDP does not reach the astonishingly low p-values that ShaPrimEx does. This seemed like a problem in the first stages of the stepwise regression.

In Regression 1a, which is analogous to Regression 1, the p-value for ShaPrimGDP is 24.6 percent. Thus, there is little evidence for the Curse. However, ShaPrimGDP is still one of the more significant variables. Due to the strong correlation between natural resource abundance and corruption, there is multicollinearity between ShaPrimGDP and SCI.

Some other results from Regression 1 also change in Regression 1a. Aside from the reduced significance of ShaPrimGDP, most of the other p-values also change, sometimes substantially. Adjusted R^2 is only 53.6 percent compared to the 77.3 percent in table 4.4.

In both cases, SCI is highly insignificant. Furthermore, its presence obscures the effect of natural resource abundance on growth: SCI and ShaPrimEx (or ShaPrimGDP) are closely correlated, as I show in Section 5.1, so that multicollinearity arises if both are included.

Thus, when I drop SCI from the regression in Regression 2a, the p-value of ShaPrimGDP immediately falls to 10.2 percent.

Excluding further insignificant variables improves the significance of ShaPrimGDP. In Regression 4a, it becomes for the first time significant at a five percent error level. In Regression 6a, which has the highest value for adjusted R^2, ShaPrimGDP is highly significant with a p-value of 0.8 percent. Thus, there is once again strong evidence for the curse of natural resources.

A particularly eye-catching effect is that LOG(RGDPpC89) is more significant when ShaPrimGDP is used instead of ShaPrimEx. In every single regression, its p-value is lower in the "a"-version than in the original one. Depending on which other variables are in the model, the p-value of LOG(RGDPpC89) moves between one and three percent and is usually close to two percent.

This is one of the reasons why I believe in the importance of initial income per capita. It is definitely significant if ShaPrimGDP is used and almost significant if ShaPrimEx is used.

It is not only more significant when ShaPrimGDP is used; the size of the coefficient on LOG(RGDPpC89) is also larger. In Regression 1a-9a, the coefficient of LOG(RGDPpC89) hovers between 4 and 5 and slightly above. In the original regressions, in contrast, it takes on values between 1.6 and 3.5.

Another important observation is that when ShaPrimGDP is used, the interaction term is not as powerful as with ShaPrimEx. In Regression 7a, ExGro9499 is still pretty significant with a p-value of 8.5 percent, while InterAction is completely insignificant with a p-value of 76.7 percent. This is in contrast to Regression 7, where InterAction was significant and ExGro9499 was not.

This raises some doubt about the notion that export growth is more important for natural resource abundant countries than for others. However, InterAction is still significant when ExGro9499 is not included. In Regression 9a, its p-value is 3.7 percent, so the effect is not completely rejected. However, in Regression 9 the p-value for InterAction is less than one percent, so the evidence there is much stronger.

One must keep in mind that if ShaPrimGDP is used, the interaction term takes different values because ShaPrimGDP now also replaces ShaPrimEx in the definition of InterAction.

LOG(CapForm) is more significant in most of the regressions with ShaPrimGDP, but not in all of them. It reaches its lowest p-value, 11.7 percent, in Regression 6a. In Regression 6, its p-value was 15.3 percent.

The coefficient on LOG(CapForm) remains negative and of comparable size. However, it is still strange that high savings rates seem to be negatively correlated with economic growth.

Finally, the other variables are still not significant. SCI reaches a p-value of 98.8 percent in Regression 1a, which is one of the most spectacular p-values I have ever seen, and is therefore excluded. Once again, I stress that the perceived insignificance of SCI is caused by the multicollinearity between SCI and ShaPrimGDP.

LOG(SenEnrol90) is excluded because its p-value is 86.7 percent in Regression 2a.

In Regression 3a, TradLib and PopGro8999 reach p-values of 42.7 percent and 40.3 percent, respectively, and are therefore excluded. They are considerably less significant than in Regression 3, where their p-value were 20.8 percent and 22.1 percent, respectively. TradLib has (as expected) a positive coefficient, and PopGro8999 has (unlike expected) a positive coefficient, too.

I conclude from this section that the effect of the curse of natural resources is robust. When ShaPrimGDP is used instead of ShaPrimEx, there is still sufficient evidence for the Curse, though weaker than with ShaPrimEx.

Furthermore, ShaPrimEx seems to have more explanatory power than ShaPrimGDP, because it leads to higher values of adjusted R^2. This might indicate that the impact of natural resources depends more on their share in exports than in GDP, but this idea is only speculative.

4.5 Evidence for the Curse: A Short Summary

In this section I have shown that there is ample evidence for the curse of natural resources in the transition economies of Europe and Central Asia.

As a measure for natural resource abundance, I have used the share of primary goods in total exports. This measure is only a proxy for the natural resource endowment of an economy, but it is not biased and readily available for most countries.

Verification with ShaPrimGDP as indicator instead of ShaPrimEx provides further evidence for the existence of the curse of natural resources in the transition economies. In the regression results, ShaPrimGDP is not as significant as ShaPrimEx, but it reaches p-values of around one percent, which is definitely low enough to be called significant. Thus, the evidence for the Curse is not a result of data mining. Using different indicators for natural resource abundance still leads to the same result.

I have shown that there is a negative association of natural resource abundance and economic growth. This negative association is statistically significant and of remarkable size. Precisely, if the share of primary goods in total exports is by ten percentage points higher in one country than in an otherwise similar country, the first country is estimated to grow slower by roughly one percent per year.

The relationship between natural resource abundance and growth is not independent of export growth: A natural resource abundant country may offset the negative impact of natural resources on growth by having strong export growth.

The curse of natural resources is one of the most important factors in explaining growth in the transition economies: Other common variables, like secondary enrolment ratios as a proxy for human capital or population growth, appear to have little impact on growth.

There is no evidence for conditional convergence among the transition economies: Countries that were relatively rich in 1989 tended to grow faster than poorer countries during the 1990s. This effect is visible in all regressions, even when a wide range of other explanatory factors is controlled for. The positive coefficient on LOG(RGDPpC89) could mean that economies that were relatively well developed in 1989 were in a better position to deal with the difficulties of transition than others and recovered earlier, and that therefore there was no convergence.

I believe that the most enlightening regression is Regression 9, with ShaPrimEx, RGDPpcC89, and the interaction term as explanatory factors. These three variable explain more than 80 percent of the variation in growth among transition economies.

Natural resource abundance clearly imposes a drag on growth. This negative effect can be partially offset by high export growth, which has a great effect on growth in natural resource abundant countries. However, to offset the curse completely, a country's exports would have to grow by more then 30 percent annually, a value which is almost never reached in practice.

Initial income in this regression can be interpreted as a general term capturing the initial condition of the economy in 1989. In Regression 9 it is only mildly significant, but in Regression 9a, with ShaPrimGDP instead of ShaPrimEx, it is statistically significant at a five percent error level, indicating that countries that were in good economic shape in 1989 achieved relatively high growth rates in the 1990s.

5 Reasons for the Curse

Now that I have shown that the Curse exists in the transition economies, it is time to think about the reasons for the curse. In section 2 I have mentioned several common and plausible explanations for the Curse. I will now analyse the most common explanations to see whether they apply to the transition economies or not. I proceed as follows:

I consider a variable X that may be a plausible explanation for the Curse, for example corruption. In theory, natural resource abundance leads to serious corruption, and serious corruption leads to low growth. Thus, natural resource abundance must have an impact on X, and X in turn must have an impact on growth. Only then the explanation is credible.

For each X, I proceed in three steps:

In the first step, I examine the relationship between natural resource abundance and X. If there is no statistically significant relationship, the variable X is "out": It is not correlated with natural resource abundance, so it cannot explain differences between natural resource abundant countries and other countries. Only if X is somehow correlated with natural resource abundance, the analysis proceeds.

In the second step, I examine the relationship between X and growth of real GDP per capita. If there is significant relationship, I can conclude that X is a variable which explains a part of the curse of natural resources.

In the third step, I try to estimate the size of the effect. It is possible that a variable passes both the first and the second step of my analysis, but that the size of the effect is too small to explain a significant fraction of the total effect of natural resource on growth. Then I have made little progress in explaining the Curse.

5.1 Rent-seeking (Corruption)

One plausible explanation for the Curse is that natural resource abundance leads to rent-seeking in the government, the state apparatus, and the business class. A common form of rent-seeking in government circles is corruption, but there are also other possibilities: Tariff barriers are often the result of rent-seeking by domestic producers, who lobby the government to erect tariffs to protect domestic industries.

If rent-seeking is a plausible explanation, I would have to find a positive correlation between natural resource abundance and the extent of rent-seeking. This is the first step in my analysis.

The problem with corruption is that it is impossible to measure directly. By definition, corruption takes place where it cannot be observed, so there are no numerical data on corruption available. Even if they were, one could hardly know which data to use.

The amount of total bribes paid in the economy? The ratio of corrupt government officials to honest ones?

Furthermore, as I pointed out in section 2, it is not entirely clear what corruption actually is. There is corruption in the government, but also in the private sector. Some forms of corruption are illegal, others are not.

However, since corruption is often considered an important determinant of economic performance, econometricians have been quite innovative in this respect. Several studies have constructed indexes which indicate the extent of corruption in a country.

In this paper, I use the State Capture Index (SCI) as a measure for the extent of corruption, which was constructed by Hellman, Jones, and Kaufmann with data from the Business Environment and Enterprise Performance Survey conducted by the World Bank in 1999. This index measures the extent to which decisions by the government, the central bank, and the courts can be, or have to be, "bought" by firms. The larger the index, the greater the extent of corruption. In contrast to other corruption indexes, the State Capture Index is available for almost all of the transition economies, because the study was explicitly aimed at these countries.

FIGURE 5.1

Natural Resource

Abundance and Corruption

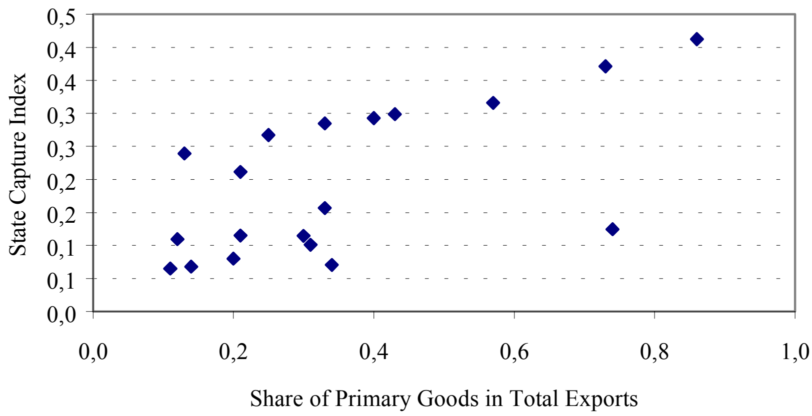


Figure 5.1 plots the relation between SCI and the share of primary goods in total exports. At a first glance, the relation appears to be strongly positive. To quantify this relation, I run a regression on SCI with ShaPrimEx as explanatory variable.

Table 5.1 shows the results:

TABLE 5.1

Natural Resource Abundance and Corruption

Dependent variable	SCI
Multiple correlation coefficient	0,63407624
R^2	0,40205268
Adjusted R^2	0,36687930
Standard error	0,08913191
Observations	19

	Coefficient	Standard error	t-statistic	p-value
Intercept	0,08214085	0,03907924	2,10190517	0,05077224
ShaPrimEx	0,31881751	0,09429913	3,38091674	0,00355144

There is indeed a very strong correlation between natural resource abundance and corruption. The coefficient is not easily interpreted, because the index is an abstract measure, but the p-value of 0.0036 means that the relationship is statistically very significant.

The size of R^2 gives further confidence: It indicates that about 40 percent of the variation in corruption can be explained by natural resource abundance. Obviously, natural resources are an important determinant of corruption.

The second step is to examine the relationship between corruption and growth.

FIGURE 5.2

Corruption and Growth

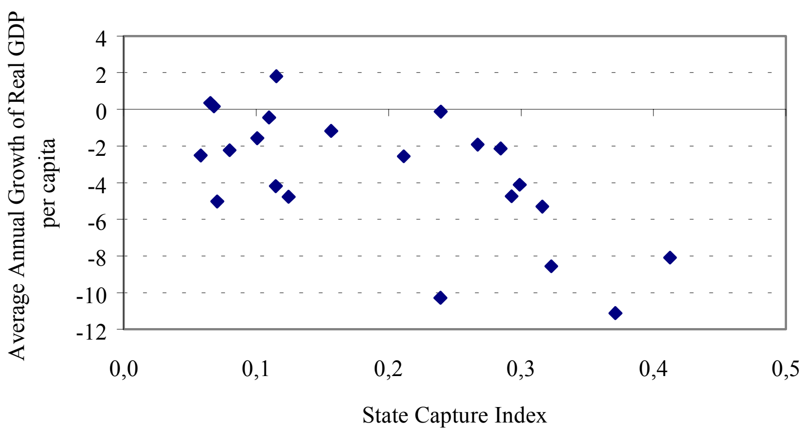


Figure 5.2 plots SCI against the average annual growth of real GDP per capita in percent. The relationship appears to be negative, which would imply that the explanation is

credible. To make sure, I run a regression on AvGroRGDPpC with SCI as independent variable:

TABLE 5.2

Corruption and Growth

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,63023134			
R^2	0,39719154			
Adjusted R^2	0,36705111			
Standard error	2,76795297			
Observations	22			
	Coefficient	Standard error	t-statistic	p-value
Intercept	0,27828993	1,21333458	0,22935960	0,82091870
SCI	-19,5980626	5,39868293	-3,63015626	0,00166731

Table 5.2 shows that corruption is strongly associated with low economic growth. The number of observations has increased to 22 in comparison with Table 5.1 because SCI and AvGroRGDPpC are available for almost all countries.

The p-value on SCI is less than one percent. This provides ample evidence for a negative impact of corruption on economic growth.

The size of the coefficient is also interesting: An increase of 0.1 in the state capture index is expected to decrease annual growth by 1.9 percent. Given that the value of SCI varies from 0.058 in Uzbekistan to 0.412 in Azerbaijan, a difference of 0.1 in SCI is not very much. Thus, the effect of corruption on growth appears to be not only significant, but also surprisingly large.

The third step in my analysis is to estimate the size of the total effect of natural resource abundance via the corruption channel. I run a regression on AvGroRGDPpC with both ShaPrimEx and SCI as explanatory variables:

TABLE 5.3

Direct Effects of Corruption and Natural Resources on Growth

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,86314364			
R^2	0,74501695			
Adjusted R^2	0,71314406			
Standard error	1,68033623			
Observations	19			
	Coefficient	Standard error	t-statistic	p-value
Intercept	1,62612437	0,82694019	1,96643527	0,06684308
SCI	-4,79976184	4,57233996	-1,04973862	0,3094364
ShaPrimEx	-10,4807276	2,29900119	-4,5588178	0,00032196

SCI is now rather insignificant, because it is so closely correlated with ShaPrimEx.

The direct effect of ShaPrimEx on growth is estimated to be –10.5. The indirect effect is found by multiplying its effect on SCI with the direct effect of SCI on growth:

$$-4.8 * 0.319 = -1.531$$

The total effect of ShaPrimEx on growth is now:

$$-10.481 + (-1.531) = -12.012$$

The part of the Curse that is explained by rent-seeking behaviour is:

$$1.531 : 12.012 = 0.127$$

In words: Roughly one tenth of the curse of natural resources is explained by the rent-seeking effect. If a country could manage to eliminate rent-seeking completely, the curse of natural resources would be reduced by about 13 percent.

This estimate is of course not very exact. The high standard error on SCI in table 5.3 means that the estimate of the effect of SCI on growth is pretty inaccurate. This is an example of multicollinearity: The correlation between SCI and ShaPrimEx is so strong that it is almost impossible to disentangle their individual effects on AvGroRGPpC.

One way to deal with the problem of multicollinearity is to use an instrumental variable for SCI instead of the true values. The idea is to find a model which explains the variation in SCI among countries. Then, the values of the explanatory variables are used to compute the estimated value of SCI in each country, the value that SCI "should" have if the model was perfect.

I perform a stepwise regression on SCI to find out which factors determine the extent of corruption in a country. The result is a model with only two remaining explanatory variables, ShaPrimEx and ExGro9499, as shown in table 5.4:

TABLE 5.4

Regression on SCI

Dependent variable	SCI			
Multiple correlation coefficient	0,72757724			
R^2	0,52936864			
Adjusted R^2	0,47053972			
Standard error	0,08150920			
Observations	19			
	Coefficient	Standard error	t-statistic	p-value
Intercept	0,15346394	0,04952185	3,098913945	0,00689555
ShaPrimEx	0,25659606	0,09127347	2,811288677	0,01254568
ExGro9499	-0,00623037	0,00299469	-2,080467814	0,05391159

Table 5.4 shows that ShaPrimEx and ExGro9499 together explain roughly a half of the variation in SCI among countries. Other variables, such as GDP per capita or secondary enrolment rates, were insignificant.

Once again, the strong positive correlation between natural resource abundance and corruption becomes obvious: The coefficient on ShaPrimEx is positive and highly significant, with a p-value of 1.2 percent.

There is a negative association between corruption and export growth. With a p-value of 5.4 percent, and a t-statistic greater than 2, this relationship is statistically significant. The direction of causality is not entirely clear: It may be the case that corruption poses an impediment to international trade, and so countries with high corruption would have low growth in exports. But it is also possible that under high export growth, businessmen and government officials learn the practices and rules of conduct from efficiently governed foreign economies.

I use the coefficient estimates from Table 5.4 to calculate the instrumental variable for SCI, which I call SCI*. It is defined as:

$$SCI^* = 0.15346 + 0.25660\ ShaPrimEx - 0.00623\ ExGro9499$$

Next, I run a regression on AvGroRGDPpC with ShaPrimEx and SCI* as explanatory variables in order to find out the effect of each variable. Table 5.5 shows the result:

TABLE 5.5

The Effects of ShaPrimEx and SCI* on Growth

Dependent variable	AvGroRGPpC			
Multiple correlation coefficient	0,88854495			
R^2	0,78951213			
Adjusted R^2	0,76474885			
Standard error	1,48145918			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	2,85360913	0,96548602	2,95561933	0,008853
ShaPrimEx	-5,61941383	3,08887728	-1,81924153	0,08653291
SCI*	-19,9851717	8,45060352	-2,36494017	0,03018879

In Table 5.4 there were only 19 observations, because I have no SCI value for Macedonia, but since SCI* can be calculated for Macedonia just as for any other country, I have a value for SCI* in Macedonia. Thus, Macedonia does not drop out in Table 5.5.

Since ShaPrimEx and SCI* are not as closely correlated as ShaPrimEx and SCI are, both variables are now (more or less) significant. Thus, the coefficient estimates from this regression should be more credible.

The indirect effect of ShaPrimEx on AvGroRGDPpC via SCI* is:

$$- 19.9852 * 0.2566 = - 5.1282$$

The direct effect of ShaPrimEx on AvGroRGDPpC is now estimated to be –5.6194. Thus, the total effect of ShaPrimEx on AvGroRGDPpC is:

$$- 5.1282 – 5.6194 = 10.7476$$

This is not exactly the estimate of –12.04 from Regression 9, but it is close to it.

According to this estimation, the indirect effect via SCI* is almost as large as the direct effect of ShaPrimEx on growth. This means that possibly almost half of the curse of natural resources could be attributed to corruption.

This result should not be taken too serious. It is not robust: If I include LOG(RGDPpC89) and the interaction term in the last regression, SCI* becomes insignificant again, and its coefficient becomes positive.

However, the regression with SCI* shows that it is possible that corruption accounts for almost half of the Curse. Unfortunately, my corruption index SCI and natural resource measure ShaPrimEx are so closely correlated that it is almost impossible to disentangle their effects on growth. Further research in this area could be extremely valuable.

5.2 The Dutch Disease

The Dutch disease has its name from the difficulties that the Dutch economy faced after natural gas was discovered and extraction had begun on a large scale. In an economy that suffers from the Dutch disease, the revenues from primary exports raise the purchasing power of the economy. The additional wealth is at least partially spent on non-tradable goods and services. Since purchasing power parity does not hold for non-tradables, the price of these goods is free to rise even under free trade.

The rise in prices for non-tradables creates problems for the manufacturing sector: Among non-tradables are crucial inputs for manufacturing production, such as wages and rents for buildings. Due to the high input prices the manufacturing sector is internationally not competitive. Exports of manufactures thus grow slower. Depending on transport costs and tariffs, foreign producers may enter the market and drive prices down, so that domestic producers cannot compete. This would reduce the growth of the manufacturing sector as a whole.

Sachs and Warner (2001) argue that manufacturing may exhibit positive externalities for the economy as a whole. They say that in manufacturing, technological progress is achieved simply through learning-by-doing. In other sectors, there is less learning-by-doing. If this is true, the crippling of the manufacturing sector due to high price levels will have a lasting negative effect on growth.

As suggested by Sachs and Warner, I have constructed a proxy for the relative price level of a country by dividing GNP valued at market exchange rates by GNP valued at the purchasing power parity rate, with both figures for 1999. This way , I compare domestic prices with an international average of prices.

I first examine the relationship between natural resource abundance and relative price levels:

FIGURE 5.3

Natural Resource Abundance and Relative Price Levels

Figure 5.3 shows that there is no obvious relationship between natural resource abundance and relative price levels. Furthermore, virtually all transition economies (with the exception of Latvia and Lithuania) have relatively low price levels.

Nevertheless, I run a regression to see whether this is really true:

TABLE 5.6

The effect of ShaPrimEx on RelPrice

Dependent variable		RelPrice		
Multiple correlation coefficient		0,25089276		
R^2		0,06294718		
Adjusted R^2		0,00782642		
Standard error		0,24832005		
Observations		19		
	Coefficient	Standard error	t-statistic	p-value
Intercept	0,50839711	0,10295211	4,9381905	0,00012473
ShaPrimEx	-0,27248144	0,25498015	-1,06863785	0,30017307

In table 5.6, there is no evidence for a positive relation between natural resource abundance and relative price levels. If anything, there could even be a negative relationship.

However, this picture may be slightly blurred by the fact that in relatively rich countries, price levels tend to be higher. Sachs and Warner (2001) therefore include per capita income to control for this effect. Then they find a significant positive effect of natural resource abundance on price levels.

I follow their example and run a regression on RelPrice with GDP per capita and ShaPrimEx as explanatory variables. Table 5.7 shows the results:

TABLE 5.7

The effect of ShaPrimEx and GDPpC on RelPrice

Dependent variable	RelPrice			
Multiple correlation coefficient	0,44039851			
R^2	0,19395084			
Adjusted R^2	0,08647762			
Standard error	0,24066815			
Observations	18			
	Coefficient	Standard error	t-statistic	p-value
Intercept	0,34335369	0,18435950	1,86241385	0,08224903
ShaPrimEx	-0,08334389	0,31874747	-0,26147311	0,79728386
GDPpC	4,0523E-05	3,0131E-05	1,34489789	0,19864158

While GDPpC seems to have the expected effect of raising the relative price level of a country, ShaPrimEx is still insignificant. I therefore try several different specifications:

TABLE 5.8

Evidence for the Dutch disease

Dependent variable	RelPrice			
Multiple correlation coefficient	0,66328678			
R^2	0,43994936			
Adjusted R^2	0,31993851			
Standard error	0,20765056			
Observations	18			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-0,34002636	0,31819167	-1,06862118	0,30332048
ShaPrimEx	3,1341004	1,32628839	2,36306103	0,03312783
GDPpC	7,9745E-05	3,043E-05	2,62057338	0,02015343
$ShaPrimEx^2$	-3,20235247	1,29137544	-2,47979973	0,02647932

Table 5.8 shows that with the correct specification, I can find relatively strong evidence for Dutch disease effects: Including the square of ShaPrimEx leads to the expected finding: ShaPrimEx, $ShaPrimEx^2$, and GDPpC are now all significant at a five percent error level.

GDP per capita has the expected effect of raising the relative price level.

Natural resource abundance also appears to increase the relative price level of an economy. The effect is more pronounced at low levels of ShaPrimEx and diminishes as ShaPrimEx increases. It is estimated to be positive until ShaPrimEx reaches a value of 97.9 percent. Since no country in my sample is even close to such a value, the effect is positive in the relevant range.

I have thus shown that natural resource abundance indeed tends to increase a country's price level. This is likely to impose a drag on the manufacturing sector's international competitiveness.

The second step in the test for Dutch disease effects is to examine whether the increase in relative price levels in turn affects the growth rate of an economy.

FIGURE 5.4

Relative Price Levels and Growth

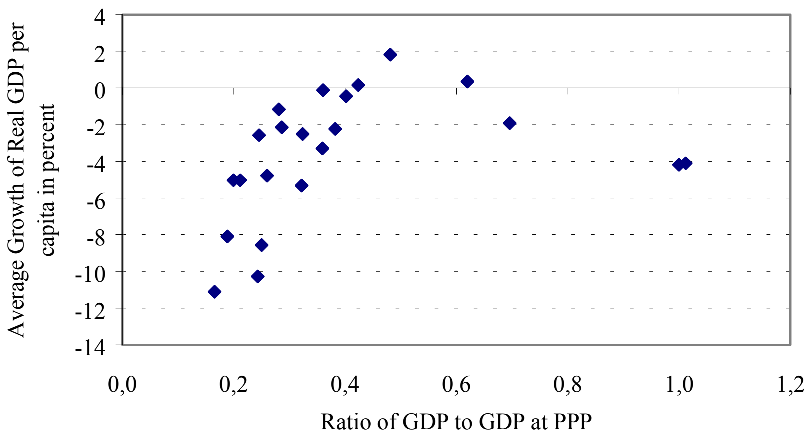


Figure 5.4 makes it clear at a glance that this is very unlikely. On the x-axis I have plotted the relative price level of a country, calculated by dividing GDP in US dollars at market exchange rates by GDP in US dollars at purchasing power parity. The y-axis plots the average growth of income per capita against this.

From the figure, there seems to be a rather strong positive correlation between relative price levels and growth of income per capita. Nevertheless, I run a regression to verify this suspicion:

TABLE 5.9

Growth and Relative Price Levels

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,33126263			
R^2	0,10973493			
Adjusted R^2	0,06522168			
Standard error	3,34163500			
Observations	22			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-5,57287162	1,40959988	-3,95351311	0,00078429
RelPrice	4,82104071	3,07052770	1,57010168	0,13207803

Table 5.9 shows the result of this test. There is indeed evidence for a positive correlation between growth and relative price levels, though not very strong. With a p-value of 13.2 percent, RelPrice is not extremely significant, and R^2-adjusted is very low. I therefore try to find further verification of the result.

Figure 5.4 suggests that the positive effect of relative prices on growth might be diminishing. The regression line would then be hill-shaped. This would mean that $RelPrice^2$ would be significant in a regression on growth. I therefore run a regression with RelPrice and $RelPrice^2$. The results are reported in table 5.10.

TABLE 5.10

Growth and Relative Price Levels II

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,78805447			
R^2	0,62102984			
Adjusted R^2	0,58113825			
Standard error	2,23686642			
Observations	22			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-16,3910391	2,33577078	-7,01740052	1,1081E-06
RelPrice	55,104516	10,1419674	5,43331621	3,0485E-05
$RelPrice^2$	-43,1806326	8,52862407	-5,06302449	6,9076E-05

Table 5.10 shows that my suspicion was probably right: Including RelPrice² improves the fit of the regression tremendously. R^2-adjusted shoots up from 6.5 percent to 58.1 percent, and both regressors are highly significant.

Both coefficients also have the expected sign. As relative prices rise, the positive correlation with growth diminishes and finally levels off or becomes even negative. However, in the range where the transition economies lie, the relation between RelPrice and growth is still positive.

Of course, the result seems to contradict all economic intuition: Why should countries that have a relatively high price level grow faster than others? If there is a causal relationship, it can only be the other way around: Countries that have grown fast may have higher relative price levels.

Since R^2-adjusted is still comparatively low, the inclusion of other explanatory variables might change the picture. In order to check for the robustness of the results of table 5.10, I run a regression with the variables that I found most significant in Section 4, adding RelPrice and RelPrice². Table 5.11 shows the results:

TABLE 5.11

Growth, Relative Price Levels, and Other Variables

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,95931527			
R^2	0,92028579			
Adjusted R^2	0,88707154			
Standard error	1,06956379			
Observations	18			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-7,03296979	5,08759128	-1,38237712	0,19204358
RelPrice	19,0132356	11,7752651	1,61467580	0,13235142
RelPrice²	-16,6328870	8,70599722	-1,91050911	0,08025055
ShaPrimEx	-9,93489730	1,80886294	-5,49234387	0,00013794
InterAction	0,38339942	0,10126327	3,78616479	0,00259430
LOG(RGDPpC89)	0,75564092	2,02479218	0,37319431	0,71551285

When ShaPrimEx, InterAction, and RGDpC89 enter the regression, RelPrice and RelPrice² are no longer as significant as they were alone. ShaPrimEx and InterAction are significant, as expected. RGDPpC89 is not significant. This may be due to the correlation between price levels and income per capita. If both are included in one regression, their significance is lower than if only one were included.

Thus, I have at least managed to explain the evidence that high relative price levels are associated with high growth. This observed correlation can be explained by the fact that high income per capita leads to high price levels, and since the high income countries were also those with high growth, I observe a correlation between price levels and growth.

However, I have not been able to find any evidence on a negative impact of high price levels on growth. This provides some evidence against the Dutch disease hypothesis. Natural resource abundance can be shown to increase relative prices, but as long as relative prices do not reduce growth (which, surprisingly, they do not), the Dutch disease hypothesis is not credible.

One might argue in this context that the indicator I have used, relative price levels, is not the optimal one. Prices are influenced by a lot of other factors. Especially in the transition economies, prices were heavily distorted in the beginning of the transition as a heritage of the central planning system. Some countries, like Estonia and Lithuania, have established and maintained a peg to Western currencies, but many other countries experienced hyperinflation and serious exchange rate fluctuations or devaluations. Thus, prices may be a rather poor indicator.

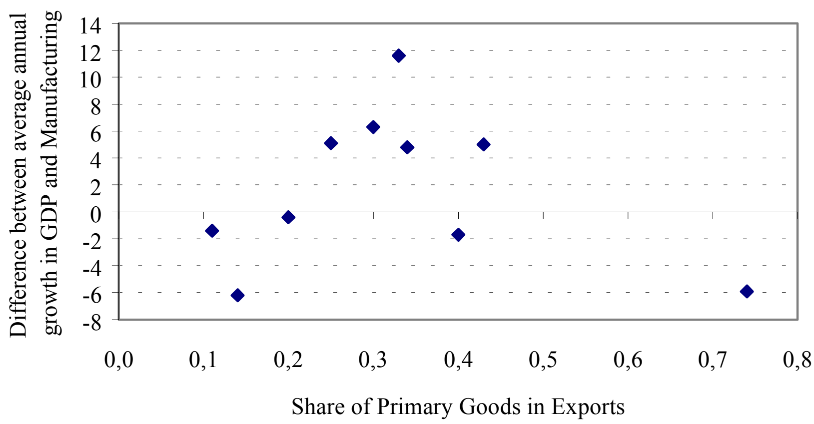
It would be preferable to measure the growth of manufacturing directly. Unfortunately, these data are not available for all countries. Data on the average annual growth of manufacturing are available for only 11 countries. Running a regression with only 11 observations does not appear very promising, but I will do so anyway.

If the Dutch disease hypothesis hold, one would expect that in natural resource abundant countries, the manufacturing sector grows slower than the other sectors. There should be a lag between the growth of GDP as a whole and the growth of the manufacturing sector.

In order to test for this possibility, I have calculated a variable ManLag (Manufacturing Lag), which is defined as the difference between the average annual growth of GDP in percent and the growth of the manufacturing sector.

FIGURE 5.5

Natural Resource Abundance and The Manufacturing Lag



There are only ten countries for which both ShaPrimEx and ManLag are available. These ten countries are plotted in Figure 5.5:

If there is a relationship between ShaPrimEx and ManLag, it appears to be non-linear. I run a regression of ManLag on ShaPrimEx and ShaPrimEx². The results are shown in table 5.12:

TABLE 5.12

Natural Resource Abundance and the Manufacturing Lag

Dependent variable	ManLag
Multiple correlation coefficient	0,74714459
R^2	0,55822504
Adjusted R^2	0,43200363
Standard error	4,32924539
Observations	10

	Coefficient	Standard error	t-statistic	p-value
Intercept	-11,6992949	5,72241625	-2,04446765	0,08018245
ShaPrimEx	85,0533211	31,0224852	2,74166691	0,02884870
ShaPrimEx²	-105,412922	35,7765816	-2,94642242	0,02151595

Although I have only ten observations, I find a significant relationship between natural resource abundance and the manufacturing gap. The relationship is non-linear: At low levels of ShaPrimEx, it is highly positive; it levels off as ShaPrimEx rises.

The effect of ShaPrimEx on ManLag is positive until ShaPrimEx reaches a value of 0.806. Only one country, Azerbaijan, exceeds this value slightly, and all other countries are far below it. Thus, the overall effect of ShaPrimEx on ManLag in the relevant range of ShaPrimEx is clearly positive.

This finding provides evidence for the claim that natural resource abundance indeed impedes the growth of the manufacturing sector, probably via Dutch disease effects.

While it seems natural that in countries that are richly endowed with natural resources the *share* of the manufacturing sector in GDP should be small, it does not automatically follow that the *growth* of the manufacturing sector should be lower than that of GDP. The fact that in natural resource abundant countries the manufacturing sector grows slower compared to the rest of the economy strongly indicates that the Dutch disease is at work.

The effect of the Dutch disease symptoms on growth is difficult to quantify. There is obviously the direct effect of slowing down the growth of the manufacturing sector, which is part of the economy.

Sachs and Warner (2001) calculate the contribution of manufacturing exports to overall growth, by multiplying the growth in value added from manufacturing exports with the share of manufacturing exports in GDP. For this contribution to GDP growth, they find a negative association with natural resource abundance, so they can conclude that in developing countries, there was an effect of natural resources on growth via reduced competitiveness.

However, the lower growth of the manufacturing sector does not explain lower overall growth by itself. If the only effect were the reduced competitiveness in manufacturing, good old Ricardian logic would imply that a country would specialise in the goods where it has a comparative advantage: natural resources. The shift from manufacturing to the primary sector would be economically efficient and it would in fact raise welfare.

The reason why a specialisation in natural resources, mirrored by a decline of the manufacturing sector, may be undesirable is that manufacturing may exhibit positive externalities.

Sachs and Warner (2001) argue that the manufacturing sector may be characterised by learning-by-doing effects. In contrast, natural resource extraction is usually performed by more or less unskilled workers. In many cases, the capital equipment that is used in the extraction process is imported from foreign producers. In such cases, there are no learning effects from natural resource extraction.

If learning-by-doing occurs in manufacturing more than in other sectors, then manufacturing exhibits a positive externality on the other sectors of the economy, by speeding up technological progress. However, since technological progress is not easily observed, I cannot verify this hypothesis empirically.

I conclude this sub-section with the observation that Dutch disease effects can be observed in the transition economies, but the size of these effects is not yet known.

I have shown that natural resources tend to increase the relative price level of a country. There is no negative relationship between relative price levels and growth, but this does not disqualify the Dutch disease hypothesis because causality can run both ways here, and prices could be distorted by other factors.

In natural resource abundant countries, the manufacturing sector tends to grow relatively slowly, compared to the rest of the economy. If it is true that manufacturing exhibits positive externalities in the form of technological progress through learning-by-doing, the indirect effects on growth may be considerably larger than the direct effect of slow growth in manufacturing.

It would be interesting to perform a growth accounting analysis here. Specifically, if there is learning-doing in manufacturing, one should find that total factor productivity (TFP) grows slowly in countries where the manufacturing sector grows slowly. Natural resource abundance would then be associated with low TFP growth, and this might explain a large part of the variation in growth. For this growth accounting analysis, one would need data on the growth of the labour force and the (physical and human) capital stock.

5.3 Neglect of Investment in Human Capital

Gylfason (2001) finds that among developing countries, neglect of investment in human capital is one of the prime reasons that explain the curse of natural resources. In fact, the impact of neglecting education is so strong that “of the total effect of natural capital on growth, almost half can [...] be attributed to education...”.

In traditional growth models, neither the rate of investment in capital nor the stock of capital influences long-run economic growth. This holds for human capital just as it does for physical capital. There are three reasons why I suspect that investment in human capital could have had an impact on growth in the transition economies:

Firstly, one decade is probably not what most growth theories mean when they are concerned with the “long run”. And in the short run, a rise in the savings rate does speed up growth because the economy moves toward a new (higher) steady state.

Second, the notion that the savings rate does not influence growth only holds if the economy is in a steady state. The transition economies were definitely not in a steady state after 1989. They may have come from a steady state, but during the 1990s they were in *transition* towards a new steady state.

Third, endogenous growth theory has shown that if technological progress is determined endogenously, investment in human capital may very well have an impact on long-run growth. Different models and different assumptions lead to different results, but in many cases the stock, or the growth of the stock, of human capital determines growth.

One might argue that, since the transition economies are not at the technological frontier, technological progress is exogenous to them. But even in that case, they may need human capital in order to understand and apply the knowledge that spills over from abroad.

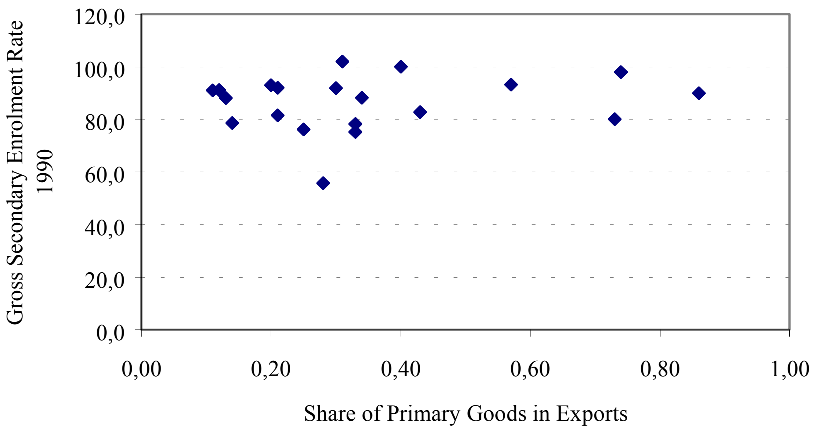
In the first step, I examine the relationship between natural resource abundance and gross secondary school enrolment in 1990.

It is common practice in studies on economic growth to use a measure of school enrolment (primary, secondary, or tertiary) at the start of the time period considered. The reason is that initial enrolment rates indicate the initial level of human capital. Following this tradition, I examine the relationship between gross secondary enrolment in 1990 and average annual growth of GDP per capita. Ideally, I would have used data from 1989, but they were not available for all countries.

A quick glance at Figure 5.5 does not reveal any obvious relationship between the share of primary goods in exports and secondary enrolment rates. I use enrolment data from 1990 because it is widely available and should give an approximation of the level of human capital in an economy at the beginning of the transition. Data from 1989 would be preferable, but is not available for several countries. Over the whole range of the country sample, with ShaPrimEx varying between twelve percent and eighty-seven percent, there is no trend in gross secondary enrolment.

FIGURE 5.6

Natural Resource Abundance and Secondary Enrolment Rates in 1990



However, it is still worth verifying such a hypothesis. Therefore, I first run a regression on secondary enrolment rates in 1990 to see whether natural resource abundant countries really neglected education. Table 5.13 shows the results:

TABLE 5.13

Natural Resource Abundance and Secondary Enrolment 1990

Dependent variable	SecEnrol90			
Multiple correlation coefficient	0,14468910			
R^2	0,02093493			
Adjusted R^2	-0,03345757			
Standard error	10,8296155			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	83,8727567	4,66993613	17,9601507	6,1163E-13
ShaPrimEx	7,08796376	11,4249736	0,62039213	0,54277538

There may be a rather weak relationship between natural resource abundance and secondary enrolment rates in 1990.

I have also tried different specifications, but the result does not change. R^2-adjusted is always negative, and there is no evidence for a relationship between ShaPrimEx and SecEnrol90.

Why is there no relationship between gross secondary enrolment and natural resource abundance in the transition economies?

In developing countries, the relationship is significant and quite strong. Gylfason (2001) finds that "an increase in the natural capital share by five percentage points goes along with a decrease by 10 percentage points in the secondary school enrolment rate..." If this relationship would hold in the transition economies, with their enormous differences in natural resource abundance, I should find huge variations in secondary enrolment rates.

One reason may be that prior to 1989, investment in education was not based on market incentives, but on ideological ones. The neglect of human capital investment in natural resource abundant countries is usually explained by a crowding-out effect of the primary goods industries: If unskilled workers can earn a reasonable wage in the primary goods sector, they have little incentive to invest in education. High wages in the primary sector crowd out investment in human capital. This influences the decisions of individuals as well as the government: Individuals consider the alternative between working at a reasonable wage and going through long years of unpaid and unpleasant education. Limited access to schooling especially in the countryside might also require moving to another city.

The government in turn has little incentive to invest heavily in education as long as the economy can live off the primary goods sector fairly enough. There may even be lobbying from the natural resource industry against education programmes because they may prefer cheap unskilled workers to expensive skilled ones.

In the centrally planned economies, things were different: There was no crowding out of investment in human capital because of the distorted prices. Schooling was essentially free and widely available. Therefore, individuals went to school happily.

Governments were massively subsidising education due to ideological reasons. In an idealistic view, one may argue that there was still the socialist ideal of a classless society. Necessary for the classless society was obviously an equally educated workforce. Differences in the access to education would again increase social differences and lead to class-building.

In a more pragmatic view, Soviet leaders stressed the need for education in their quest for technological supremacy over the West. Even in the 1980s, when the communist countries had fallen far behind in terms of living standards and economic development, they were still renowned for considerable scientific achievements, like building the first permanently manned space station *Mir*. The basis for the communist countries' strength in science was their heavy investment in education.

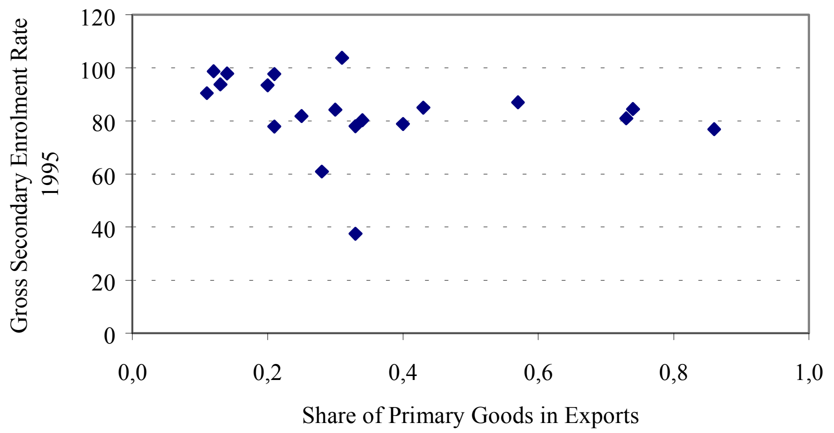
Therefore, secondary enrolment rates in most communist countries were close to the maximum of one hundred, and the data for 1990 still reflect this.

If the above reasoning is true, it follows that the transition to a market economy should lead to the same problems encountered in many developing countries. In natural resource abundant countries, both governments and individuals would neglect investment in human capital, and enrolment rates would fall.

Figure 5.6 plots the share of primary goods in exports against gross secondary enrolment rates. There seems to be a slightly negative relation between these two variables.

FIGURE 5.7

Natural Resource Abundance and Secondary Enrolment rates 1995



In order to test whether this perceived relationship is significant, I run a regression on secondary enrolment rates in 1995 (SenEnrol95) with ShaPrimEx as explanatory variable.

TABLE 5.14

Natural Resource Abundance and Secondary Enrolment Rates 1995

Dependent variable	SecEnrol95			
Multiple correlation coefficient	0,239760517			
R^2	0,057485105			
Adjusted R^2	0,005123167			
Standard error	14,62535581			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	89,0902231	6,306731516	14,12621147	3,50359E-11
ShaPrimEx	-16,16658969	15,42938472	-1,047779284	0,308606506

Table 5.14 shows the result of this test. In contrast to table 5.13, there is now a negative association between natural resource abundance and gross secondary enrolment. R^2-adjusted is now positive, but still very small. Unfortunately, the relationship between

ShaPrimEx and SecEnrol95 is statistically very weak. With a p-value of 30.9 percent, the negative relationship could still result from sheer coincidence.

In order to improve the regression , I try out a non-linear specification. Table 5.15 shows that the inclusion of ShaPrimEx² improves the fit of the regression.

TABLE 5.15

Natural Resource Abundance and Secondary Enrolment Rates 1995 II

Dependent variable	SecEnrol95			
Multiple correlation coefficient	0,401656515			
R^2	0,161327956			
Adjusted R^2	0,062660657			
Standard error	14,19613774			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	105,1931191	12,67534199	8,299035972	2,20668E-07
ShaPrimEx	-111,505998	67,39870274	-1,65442351	0,116385388
ShaPrimEx²	103,0568745	71,03302149	1,450830506	0,165029281

ShaPrimEx, with a p-value of 11.7 percent, is now almost significant at a ten percent error level. ShaPrimEx² is less significant, with a p-value of 16.5 percent.

To test whether this development has continued it would be ideal to run a further regression with enrolment data from more recent years. Unfortunately, the most recent data I could find for a sufficient number of countries is from 1997, and it is not available for Russia, the largest of the transition economies.

Table 5.16 shows that in 1997, the relationship between natural resource abundance and secondary enrolment rates had become even stronger than in 1995. R^2-adjusted is higher than in the regression for 1995, and both explanatory variables have increased in size and significance.

TABLE 5.16

Natural Resource Abundance and Secondary Enrolment Rates 1997

Dependent variable	SecEnrol97			
Multiple correlation coefficient	0,42446144			
R^2	0,18016752			
Adjusted R^2	0,07768845			
Standard error	14,3862627			
Observations	19			
	Coefficient	Standard error	t-statistic	p-value
Intercept	107,742145	13,2851787	8,10995072	4,6433E-07
ShaPrimEx	-121,859156	71,3415237	-1,70810981	0,10694078
$ShaPrimEx^2$	111,130092	74,2285735	1,49713361	0,15382496

This might indicate that the negative relationship between natural resource abundance and secondary enrolment, which emerged during the first half of the 1990s, strengthened further from 1995 to 1997. If this trend continues, it is quite plausible that natural resource abundance, via lowering enrolment rates, will reduce growth in the future.

I now try something different: Instead of relating secondary enrolment rates to natural resource abundance, I look at the change in percentage terms in secondary enrolments from 1990 to 1995. I have calculated the arithmetic mean of the total change, so that I compare the average annual change in percentage terms.

FIGURE 5.8

Natural Resource Abundance and the Change in Secondary Enrolment

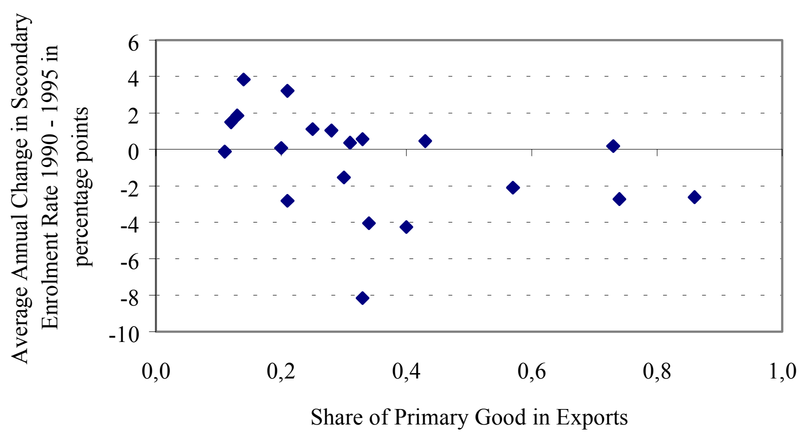


Figure 5.7 plots the share of primary goods in exports against the change in secondary enrolment rates. I have calculated this indicator by dividing the change in percentage points from 1990 to 1995 by the number of years (usually five; in some cases two or three because data were not available for 1990 and 1995).

There appears to be a negative correlation between natural resource abundance and the change in secondary enrolment rates.

TABLE 5.17

Natural Resource Abundance and the Change in Secondary Enrolment Rates

Dependent variable	SecEnrolChng			
Multiple correlation coefficient	0,506801288			
R^2	0,256847545			
Adjusted R^2	0,169417844			
Standard error	2,594583958			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	4,264613895	2,316632847	1,840867404	0,083162510
ShaPrimEx	-24,08099180	12,31825135	-1,954903430	0,067241389
ShaPrimEx²	20,61066025	12,98248449	1,587574417	0,130806711

Table 5.17 shows the result of the accompanying regression: The coefficient of ShaPrimEx is negative and relatively significant, with a p-value of 6.7 percent. ShaPrimEx² is less significant, but excluding it would reduce the significance of ShaPrimEx, so I decided to retain it.

I conclude from these observations that natural resource abundance has the expected effect of decreasing investment in human capital, measured as enrolment in secondary education.

The reason for the non-correlation between natural resource abundance and secondary enrolment in 1990 is the absence of market forces under the communist regimes. Since then, markets forces have emerged, and the abundance of natural resources makes investment in human capital less attractive, for governments as well as individuals. The relation between natural resource abundance and secondary enrolment rates was not yet very pronounced in 1995 because all countries started off at similar levels of enrolment. However, there is some evidence that since 1990, secondary enrolment rates in natural resource abundant countries have dropped, while in natural resource poor countries they have risen. If this development continues, one can expect to find a significant correlation between natural resource abundance and secondary enrolment rates in the near future.

The second step in the test for the education channel is to examine whether low investment in human capital can be shown to have a negative impact on growth.

FIGURE 5.9

Secondary Enrolment 1990 and Growth during the 1990s

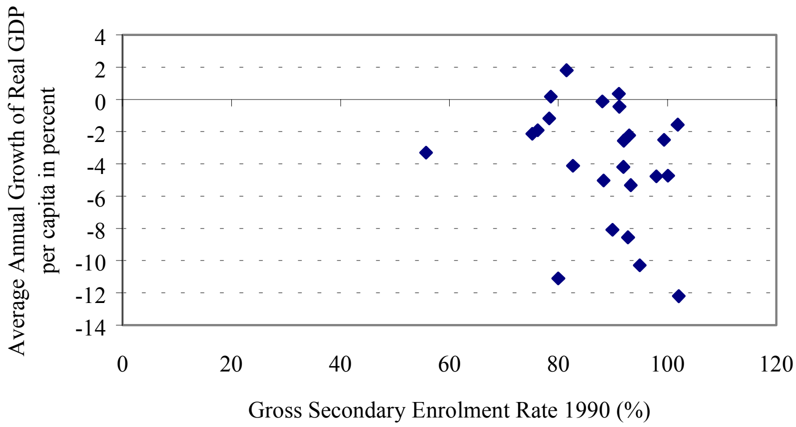


Figure 5.8 shows that graphically, there appears to be no significant relationship between these two variables.

In order to verify this, I first run a simple regression of average annual growth of real GDP per capita on gross secondary enrolment rates in 1990. Table 5.18 shows the result:

TABLE 5.18

Secondary Enrolment Rates 1990 and Growth

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,26094756			
R^2	0,06809363			
Adjusted R^2	0,02573425			
Standard error	3,71590500			
Observations	24			
	Coefficient	Coefficient	t-statistic	p-value
Intercept	4,21345966	6,45894366	0,65234501	0,52093705
SecEnrol90	-0,09223143	0,07274456	-1,26788086	0,21809536

Thus, there is no significant relation between SecEnrol90 and average growth of real GDP per capita. There is even some hint of a negative relation between these two variables. I have checked for the robustness of the result by trying different specifications with the natural logarithm and the square of SenEnrol90, and the results were similar: No evidence for a positive impact of initial enrolment rates on growth.

TABLE 5.19

Secondary Enrolment Rates 1990, other explanatory variables, and Growth

Dependent variable			AvGroRGDPpC	
Multiple correlation coefficient			0,93112527	
R^2			0,86699427	
Adjusted R^2/			0,83152607	
Standard error			1,25369000	
Observations			20	
	Coefficient	Standard error	t-statistic	p-value
Intercept	-2,78786582	4,79498197	-0,58141320	0,56959666
ShaPrimEx	-12,0012450	1,56282490	-7,67920002	1,4202E-06
LOG(RGDPpC89)	1,56833555	1,09504479	1,43221133	0,17259248
InterAction	0,41684142	0,11393726	3,65851712	0,00232884
SecEnrol90	-0,02725349	0,02967309	-0,91845811	0,37291235

Table 5.19 shows that the result persists when I introduce some powerful explanatory variables. ShaPrimEx, LOG(RGDPpC89), and InterAction are similarly significant as in Section 4, and SenEnrol90 is insignificant.

This result is of course no surprise because SecEnrol90 was one of the first variables I excluded in Section 4 precisely because of its weak significance.

However, by now I can explain why SecEnrol90 is rather insignificant in explaining growth during the 1990s: There are two possibilities:

Differences in the initial stock of human capital cannot explain the variation in growth simply because there were (almost) no differences in initial human capital. Most countries started at secondary enrolment rates between 80 and 100 percent in 1990, and no country except Macedonia (which was not a country at that time) was far from this range. In statistical terms, the *leverage* of the variable SenEnrol90 is small. If this is the case, it becomes difficult to reveal the true relationship with OLS methods. If the sample contained some countries with remarkably lower values of SecEnrol90, I might find the positive relationship between SecEnrol90 and AvGroRGDPpC that I expected to find.

Another possibility is that since all countries are close to the highest possible enrolment rate, they are in the range where investment in education runs into decreasing returns, and that therefore no positive relationship can be found.

I have shown above that in 1990, natural resource abundance and secondary enrolment rates were not correlated, but during the 1990s a (somewhat weak) negative correlation arises. Natural resource abundance is negatively correlated with the change in secondary enrolment rates.

Therefore, I find it worthwhile to examine whether I can find a correlation between the change in secondary enrolment and growth during the 1990s.

TABLE 5.20

The Change in Secondary Enrolment and Growth

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,45778965			
R^2	0,20957136			
Adjusted R^2	0,17193191			
Standard error	3,49169537			
Observations	23			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-3,36113894	0,77388163	-4,34322099	0,00028596
SecEnrolChng	0,62284577	0,26395885	2,35963205	0,02805117

Table 5.20 shows the results of a regression of AvGroRGDPpC on SecEnrolChng, the average annual change in the gross secondary enrolment rate. Apparently, there is a positive correlation here. Adjusted R^2 is rather low, but SecEnrolChng is significant at a five percent error level. The coefficient on SecEnrolChng means that if a country decreased its gross secondary enrolment rate by one percent each year, it slowed down growth by 0.6 percent.

The result from table 5.20 should be judged with caution. First of all, the causality is not clear. It may have been the case that those countries that were in economic turmoil anyway had to decrease their efforts on schooling. This would mean that slow growth led to low enrolment, and not the other way around. If people are credit-constrained (which certainly was the case in the transition countries with their weak banking sector), it makes sense that if output drops dramatically, parents can no longer afford to finance their children’s education.

Furthermore, the effect of investment in human capital on growth usually comes with a large time lag. If secondary enrolment increases in year zero, the effect on growth will materialise only in a few years from now, when today’s students finish school and enter the labour market. It takes even more time until those who entered secondary education after year zero make up a large share of the labour force.

Keeping all these problems in mind, I nevertheless try to estimate the size of the effect of natural resource abundance through the education channel. I first run a regression of AvGroRGDPpC on ShaPrimEx and SecEnrolChng to find the direct effects of the two variables on growth. Table 5.21 shows the results:

TABLE 5.21

The Effects of Natural Resource Abundance andthe Change in Secondary Enrolment Rates on Growth

Dependent variable	AvGroRGDPpC
Multiple correlation coefficient	0,84980995
R^2	0,72217695
Adjusted R^2	0,68949188
Standard error	1,70200286
Observations	20

	Coefficient	Standard error	t-statistic	p-value
Intercept	1,08852693	0,75013044	1,45111686	0,16495056
ShaPrimEx	-11,6655291	1,94376467	-6,00151312	1,4297E-05
SecEnrolChng	0,05081938	0,14847327	0,34227967	0,73633568

Once again, a problem of serious multicollinearity arises: The presence of ShaPrimEx obscures the effects of SecEnrolChng on growth, so SecEnrolChng becomes completely insignificant. This means that the coefficient on SecEnrolChng cannot be estimated with sufficient precision.

As I did in Section 5.1 in the case of SCI, I therefore try to find an estimate for an instrumental variable of SecEnrolChng.

Table 5.22 shows the result of a stepwise regression on SecEnrolChng. ShaPrimEx is not very significant, but excluding it reduces adjusted R^2 considerably, so I decided to retain it.

TABLE 5.22

Regression on SecEnrolChng

Dependent variable	SecEnrolChng			
Multiple correlation coefficient	0,69742846			
R^2	0,48640645			
Adjusted R^2	0,39010766			
Standard error	2,22332534			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	-4,75062618	2,26605003	-2,09643482	0,05229534
CapForm	0,21930814	0,08171721	2,68374469	0,01630559
PopGro8999	-2,23764270	0,92444031	-2,42053779	0,02775975
ShaPrimEx	-3,60628379	2,39932508	-1,50304093	0,15230867

All the coefficient have a plausible sign. The positive coefficient on CapForm means that countries that invest a lot in capital goods tend to invest in secondary education at the same time. The negative coefficient on PopGro8999 means that countries with high population in general did not invest sufficiently in new schools to maintain their enrolment ratios. Finally, the negative coefficient on ShaPrimEx means that in natural resource abundant countries enrolment rates declined in general.

TABLE 5.23

The Effects of SecEnrolChng* and ShaPrimEx on Growth

Dependent variable	AvGroRGDPpC			
Multiple correlation coefficient	0,84897129			
R^2	0,72075224			
Adjusted R^2	0,68789957			
Standard error	1,70636131			
Observations	20			
	Coefficient	Standard error	t-statistic	p-value
Intercept	1,09905622	0,77593977	1,41641950	0,17471607
ShaPrimEx	-11,7160537	2,15399419	-5,43922252	4,4186E-05
SecEnrolChng*	0,04074235	0,23591674	0,17269800	0,86492823

Using the estimates from the regression on SecEnrolChng I compute the instrumental variable SenEnrolChng*:

SecEnrolChng* = - 4.7506 + 0.2193 CapForm – 2.2376 PopGro – 3.6063 ShaPrimEx

Then, I run the appropriate regression on AvGroRGPpC, with ShaPrimEx and SecEnrolChng* as explanatory variables. Table 5.23 shows the results:

Unfortunately, this does not solve the problem: SecEnrolChng is still very insignificant. Thus, I cannot use the coefficient estimate as a reliable estimate of the true effect.

To sum up, the effect of educational effort on growth in the transition economies remains rather vague. The data show that all countries started their transition with similar levels of secondary enrolment. I have shown that there was a tendency for natural resource abundant countries to neglect education: In those countries, secondary enrolment rates generally declined. In other countries, they increased.

There is little evidence for an effect of this difference in educational effort on growth. The reason could be that in the mid-nineties, for which I have data, the differences in enrolment rates were not yet sufficiently large to have an impact on growth. However, one can reasonably assume that in the future this might change. If enrolment rates keep falling in the natural resource abundant countries, this will probably have a negative effect on their growth rates in the future.

6 Conclusion

6.1 The Curse Exists

There can be little doubt that among the group of transition economies in this paper, natural resource abundance is associated with slow economic growth. The evidence is surprisingly strong: Those countries that are relatively abundant in natural resources performed very poorly in terms of economic growth. The countries that are less abundant in natural resources recovered from the shock of transition much more quickly and returned to "normal" (positive) growth rates after three or less years of transition.

Among the CEE-5 countries, which outperformed all other transition economies, Poland has the highest share of primary goods in total exports: 21 percent in 1999. None of the CEE-5 is natural resource abundant.

The countries that rank highest in terms of natural resource abundance are "growth disasters": Russia, with a primary export share of 57 percent, suffered negative GDP growth rates from 1990 to 1998. Moldova, with a primary export share of 73 percent, had negative growth rates throughout the last decade of the 20^{th} century.

These observations, eye-catching as they are, are no exceptions: Multiple regressions including a wide range of other explanatory variables show that natural resource abundance is statistically negatively correlated with economic growth. According to my findings, natural resource abundance is one of the most powerful variables in explaining economic growth in the transition economies.

The effect of the curse of natural resources is quite sizeable: A country with a primary export share that is 10 percentage points higher than in an otherwise similar country is estimated to grow by one percent slower than the latter country.

Aside from natural resource abundance, there are two other important explanatory variables: Real GDP per capita in 1989 and the growth of exports.

Real GDP per capita in 1989 is positively correlated with growth in the 1990s. This may seem surprising, because usually, initial income is negatively correlated with subsequent growth, indicating conditional convergence. Among the transition economies there appears to be no conditional convergence.

The level of GDP per capita in 1989 can be interpreted as a proxy for the general development level of an economy. Economies that were relatively well developed may have been in a better position to deal with the problems of transition than less developed economies. This may explain why relatively advanced economies, such as the CEE-5, managed to recover quickly. The less advanced economies, especially the outlying regions of the former Soviet Union, were less adaptive. This theory explains why initial GDP per capita is positively correlated with subsequent growth.

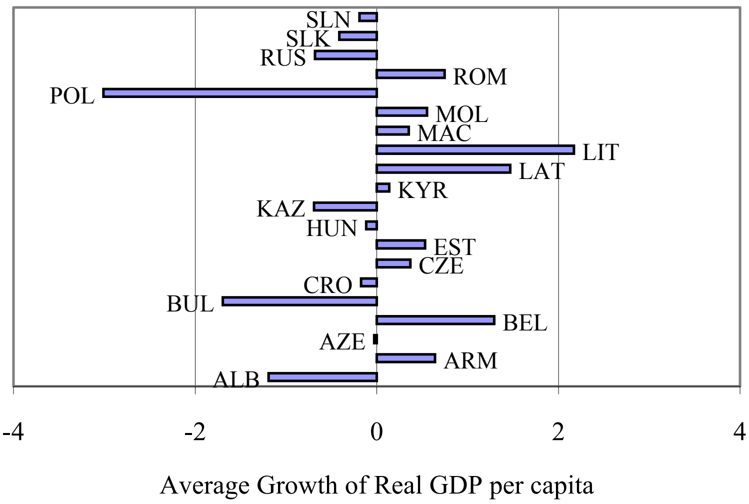
The effect of export growth on GDP growth is more complicated. Export growth itself is positively correlated with economic growth, but the effect may not be symmetric in all countries. The interaction term I have used indicates that the effect of export growth on output growth may be stronger in natural resource abundant countries than in other countries.

These three variables, natural resource abundance, initial GDP per capita, and export growth, together explain more than 80 percent of the variation in growth rates among the transition economies. This is an impressive result.

Figure 6.1 shows how powerful a model with these three variables is in explaining the variation in growth rates. The model from Table 4.12 predicts economic growth with astounding accuracy:

FIGURE 6.1

Model Prediction Error



The model prediction error is the difference between the growth rate that the model predicts when one enters the variables for each country and the actual growth rate.

For 13 out of the 20 countries for which the necessary data are available, the model prediction error is less than one percent. Only for two countries, Poland and Lithuania, the model prediction differs more than two percent from the actual value.

For Poland, the model would predict an average growth rate of –1.2 percent. In reality, Poland achieved an average growth rate of 1.8 percent. Thus, the model prediction error is three percent. Poland performed extremely well, considering its natural resource endowment, which is the highest among the CEE-5, and its initial GDP per capita, which was lowest among the CEE-5. There must be some factor that raised Poland's growth rate above what could be expected; maybe the extremely successful mass privatisation programme helped a lot.

To sum up, natural resource abundance had a very significant negative impact on economic growth in the transition economies. In fact, it appears to be the most important factor. Other important factors are the initial level of GDP per capita and export growth.

However, the example of Poland shows that the natural resource endowment of a country does not determine the fate of an economy. It appears that through sound economic policy, Poland managed to overcome the curse of natural resources. This provides some optimism, because other countries may learn from the Polish example.

6.2 Corruption Is The Main Reason For The Curse

The reasons for the curse of natural resources have been summarised in Section 2. In the world of the transition economies, corruption seems to be the main driving force behind the curse: A state capture index, which measures the extent of corruption in the state bureaucracy, is closely correlated with natural resource abundance. This observation supports the theoretical argument that natural resource abundance tends to foster corruption.

In Section 5.1 I have shown that there is a strong negative correlation between economic growth and the extent of corruption in a country. This finding completes the chain of causality: Natural resources abundance leads to corruption, and corruption leads to slow economic growth.

Of course, the relationship is not perfect. Corruption is not caused solely by natural resources. The heritage of the former communist regimes certainly also plays a role. The various approaches to privatisation also influenced the extent of corruption: The Czech mass privatisation programme gave rise to massive corruption, and this may explain why the Czech Republic performed worse than the other CEE-5 countries.

The size of the effect is difficult to estimate because in order to do so, one needs to run a regression on growth with natural resource abundance and corruption as explanatory variables to discern the direct and indirect effects of natural resource abundance. Doing so leads to problems of multicollinearity, precisely because of the close correlation of natural resource abundance and corruption. The coefficient estimate of the corruption index then becomes very inaccurate.

Using an instrumental variable instead of the corruption index itself partly solves this problem. In Section 5.1, I find that almost half of the total curse of natural resources can be explained by corruption.

Dutch disease effects may also play a role in the transition economies, but the evidence is mixed. Controlling for GDP per capita, I find a non-linear, but positive, effect of natural resource abundance on the relative price level of a country. The reason is that revenues from primary exports are spent domestically on non-tradable goods; this raises the price level in general.

According to theory, this relatively high price level should impose a drag on growth because it makes producers of manufactured goods incompetitive on the world market. I do not find a significant relationship between relative price levels and economic growth, but I do find that in natural resource abundant countries the manufacturing sector as a whole has grown relatively slowly.

The relationship between growth in manufacturing and GDP growth is not entirely clear. In order to find out whether there are positive externalities to manufacturing (for example in the form of learning-by-doing technological progress), one would have to analyse total factor productivity growth. One might expect to find a positive relationship between manufacturing and TFP growth. Further research into this direction may prove fruitful.

Neglect of investment in human capital, which accounts for a large part of the total curse of natural resources in developing countries, seems to have had little impact on the transition economies.

The reason is probably the time lag associated with education. There is some evidence for the claim that natural resource abundant countries have tended to neglect education: Secondary enrolment rates in these countries are falling (see Figure 5.8). However, most transition countries started in 1990 at similar rates of secondary enrolment as a heritage of the communist system, which emphasised the role of education. The neglect of education may lead to differences in secondary enrolment rates, but by 1997, the effect was not yet very pronounced.

Nevertheless, in Table 5.20 I find a positive relationship between the change in secondary enrolment rates and economic growth. However, the direction of causality is not clear: It may be that educational effort increased growth, but it may be as well that slow economic growth forced governments to cut back on educational spending.

There is almost no evidence for an impact of educational effort on economic growth. This is not surprising: If countries do not (yet) differ significantly in terms of enrolment rates, different enrolment rates cannot be an explanation for different growth rates. However, there is reason to assume that over time, the neglect of education will have an impact on growth.

If more recent data on education effort become available, further research may lead to stronger results: If the trend of neglecting education in natural resource abundant countries continues, this will finally result in different enrolment rates. And these differences in turn may have an impact on growth. If more data become available, one might find better results using panel data. Finally, one might also consider using alternative measures of educational effort, such as the number of teachers per student, or the percentage of the government budget spent on education. A more extensive study could treat these issues.

6.3 Advice For Policy-Makers

The ultimate goal of economic research is to provide policy-makers with advice how to improve the economic performance, and thus raise living standards of the population.

What can policy-makers in the transition countries learn from this paper? That natural resources are bad for growth? Should they set oilfields on fire and demolish the gold mines?

The answer is of course: No. As Gylfason (2001) puts it: "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 unambiguous blessing."

So what can be done to overcome the curse of natural resources? The most obvious solution is easier said than done: Fight corruption.

The data show that countries where corruption is widespread and common perform poorly in terms of economic growth. In Section 2.6 I point out why corruption is bad for growth. According to my estimates, corruption may explain up to one half of the total curse of natural resources. Thus, the benefits from reducing corruption would be tremendous.

Of course, corruption is not easily rooted out by sheer willpower. Something needs to be done against corruption, and policy-makers should definitely put more emphasis on the fight against corruption. If corruption cannot be rooted out completely, a more centralised state structure may be a good idea. Centralisation by itself does not reduce corruption, but in a centralised bureaucracy, corruption may have less distortionary effects than in a decentralised system (Bardhan, 1997).

The positive effect of export growth on GDP growth also provides a useful hint: Policies that aim at increasing exports may have additional benefits. Most countries already pursue export-oriented economic policies. Membership in the EU may provide additional export growth. One might consider an industrial policy that targets especially the export-oriented manufacturing sector.

Another point is that education should not be neglected. The gains from education will accrue to the population with a time lag of more than a decade, which is why they are so often neglected by today's policy-makers, but they are huge.

I believe that Norway provides a shining example of how to deal with extraordinary natural resource endowments: In Norway, almost 90 percent of oil revenues are collected by the state. These revenues are then invested in infrastructure, education, and to a large share in foreign pension funds. This way, the Dutch disease effects are mitigated because only part of the oil revenues are spent in Norway itself. Furthermore, the benefits from oil extraction are spread evenly among the whole population and even over time.

Of course, in order to follow the Norwegian example, one needs a strong, efficient bureaucracy. Otherwise, the oil revenues may again vanish in black holes somewhere in the state bureaucracy. This again strengthens the point to fight corruption.

There is no need to become desperate. Governments of natural resource abundant countries, if they want to raise national welfare, should announce credible actions against corruption and take swift action. They should set up proper tax systems and institutions that enforce the payment of taxes. If corruption is credibly fought, the revenues from natural resource exports may be used as in the Norwegian model. Thus, the main priority of these governments should be to find ways to reduce the extent of corruption within their state bureaucracy.

Appendix A: Data Sources

Average annual growth of exports, 1994 – 1999 (ExGro9499)

Source: Calculated from export data from the *Economic Survey of Europe*. Ideally, I would have used export growth over the whole period 1989-1999, but export figures are not available for most countries before 1994. Especially for the former Soviet union member states, which became independent just in 1991, export figures before 1994 are not available.

Average annual growth of the manufacturing sector

Source World Bank (www.worldbank.org). I have used this variable to calculate the manufacturing lag, the difference between the growth of the economy as a whole and the manufacturing sector.

Average annual growth of real GDP per capita (AvGroRGDPpC):

Source: own calculations using the growth of real GDP and the population.

Average annual growth of real GDP 1980 – 1989 (Growth8089):

Source: calculated from real GDP estimates taken from the *Economic Survey of Europe* published by the United Nations.

Average annual growth of the population 1989 – 1999 (PopGro8999):

Source: calculated from population figures taken from the International Data Base of the U.S. Census Bureau (http://www.census.gov/ipc/www/idbnew.html)

Gross capital formation as percentage of GDP(CapForm):

Source: World Bank (www.worldbank.org). Gross capital formation is roughly the same as gross domestic investment. Annual data are available for most countries from 1995 on. My variable CapForm is actually the average between 1995 and 1999, so it does not reflect any upward or downward trends within a country. It merely reflects differences among countries.

Exports in US dollars:

Source: *Economic Survey of Europe*. I have used these data to calculate the share of exports in GDP.

GDP in billions of US dollars (1998):

Source: World Economic Outlook database.

Manufacturing Lag (ManLag)

Source: Calculated by taking the difference between the growth of the manufacturing sector and GDP growth.

Real GDP 1989 – 1999 (index):

Source: Economic Survey of Europe

Real GDP per capita in 1989 in billions of US dollars (RGDPpC89):

Source: calculated using GDP per capita 1998 in billions of US dollars at PPP, growth of real GDP, and population. I have used 1998 as base year because for this year data were available for all countries. I preferred using PPP rates for conversion because market exchange rates behaved very erratically during the 1990s in the transition economies. For example, Bulgaria's GDP fell from 47 billion dollars in 1989 to 8 billion dollars in 1991, valued at market exchange rates.

RGDPpC89 is thus valued at 1998 prices and purchasing power parity. This should result in a measure which roughly reflects the actual development level of the economy.

Relative price level (RelPrice):

Source: calculated by dividing GNP in US dollars at market exchange rates by GNP in US dollars at purchasing power parity rates. Both GNP figures were taken from *Globale Trends 2002*.

Secondary enrolment rate (Gross, 1990, 1995, 1997)

Source: UNESCO online database (www.uis.unesco.org). Gross secondary enrolment is one of the most common measures of educational effort. However, as I point out in the text, other measures could also be used.

Share of exports in GDP:

Source: calculated by dividing exports in US dollars by GDP in US dollars. All data are from 1999 except for Croatia, Czech Republic, Macedonia, Slovak Republic, and Slovenia (1998). I have used this variable to calculate the share of primary exports in GDP.

Share of primary goods in exports (ShaPrimEx):

Source: *World Bank* (www.worldbank.org). The share of primary goods (food, agricultural raw materials, fuels, ores and metals) in exports.

Share of primary exports in GDP (ShaPrimGDP):

Source: Calculated by multiplying ShaPrimEx with the share of exports in GDP

State capture index (SCI)
Source: *Business Environment and Performance Survey*. This survey was sponsored by the World Bank and aimed specifically at the transition economies. The index reflects to what extent the decisions of the different bodies of the government have to be "purchased" by the companies; in other words, how many bribes they have to pay.

Although there are various corruption indexes, I have decided to use this specific one because it is available for all transition economies, and the accompanying study aimed precisely at these countries. The close correlation between this index and economic growth supports the credibility of the index.

Trade liberalisation index (TradLib):
Source: *Transition Report 1999*, EBRD. This is an index incorporating various measures of trade liberalisation, such as import barriers and currency convertibility. The index ranges from "1" (high barriers to trade) to "4+" (almost complete liberalisation). For the regression analyses, I have transformed the "4+" into a "5". Otherwise, the computer could not process it.

Appendix B: Dataset

Indicator	Average annual growth of real GDP per capita	Average annual growth of real GDP	Share of Primary Goods in exports	Share of Primary Exports in GDP	Real GDP per capita 1989 (USD)	Trade and foreign exchange system liberalisation
Short name	AvGroRGDPpC	AvGroRGDP	ShaPrimEx	ShaPrimGDP	RGDPpC89	TradLib
Albania	-1,18	-0,49	0,33	0,019	1.390,44	4
Armenia	-5,03	-4,93	0,34	0,040	971,81	4
Azerbaijan	-8,09	-7,31	0,86	0,210	1.322,52	3
Belarus	-2,23	-2,04	0,20	0,112	1.781,61	1
Bulgaria	-2,14	-3,41	0,33	0,106	1.978,42	5
Croatia	-1,91	-2,47	0,25	0,049	6.187,27	4
Czech Rep.	-0,45	-0,48	0,12	0,057	5.728,24	5
Estonia	-1,56	-2,42	0,31	0,171	4.070,00	4
Georgia	-10,28	-10,91	N/A	N/A	3.263,72	4
Hungary	0,16	-0,06	0,14	0,068	4.816,73	5
Kazakhstan	-4,77	-4,67	0,74	0,248	2.170,80	3
Kyrgyzistan	-4,73	-4,04	0,40	0,162	620,45	4
Latvia	-4,11	-5,04	0,43	0,110	3.995,05	5
Lithuania	-4,18	-4,33	0,30	0,082	4.377,94	4
Macedonia	-3,30	-2,61	0,28	0,092	2.481,81	4
Moldova	-11,11	-10,97	0,73	0,113	1.518,55	4
Poland	1,81	1,99	0,21	0,036	3.686,91	5
Romania	-2,56	-2,73	0,21	0,061	2.131,28	4
Russia	-5,31	-5,37	0,57	0,274	3.380,00	2
Slovakia	-0,12	0,17	0,13	0,065	3.890,13	5
Slovenia	0,35	0,52	0,11	0,047	10.604,61	5
Tajikistan	-12,21	-10,47	N/A	N/A	632,6	3
Turkmenistan	-5,04	-2,97	N/A	N/A	682,19	1
Ukraine	-8,56	-8,92	N/A	N/A	2.098,08	3
Uzbekistan	-2,51	-0,63	N/A	N/A	1.602,35	1

Indicator	Gross Capital Formation (% of GDP)	State Capture Index	Gross secondary enrolment 1990	Gross secondary enrolment 1995	Avg Annual Change in SecEnrol 90-95	Average annual export growth 94-99 in %
Short name	CapForm	SCI	SecEnrol90	SecEnrol95	SecEnrolChng	ExGro9499
Albania	16,1	0,157	78,3	37,5	-8,2	13,774835
Armenia	19,4	0,071	88,3	N/A	-4,1	0,549483
Azerbaijan	40,0	0,412	89,9	76,8	-2,6	7,305135
Belarus	25,1	0,080	93,0	93,4	0,1	18,729581
Bulgaria	13,4	0,285	75,2	78,0	0,6	0,121685
Croatia	24,2	0,267	76,2	81,8	1,1	0,051589
Czech Rep.	31,4	0,110	91,2	98,7	1,5	11,068688
Estonia	28,2	0,101	101,9	103,7	0,4	17,621917
Georgia	14,5	0,239	94,9	75,6	-3,9	6,326679
Hungary	28,3	0,068	78,6	97,8	3,8	18,507220
Kazakhstan	16,4	0,125	98,0	84,4	-2,7	11,595335
Kyrgyzistan	20,1	0,293	100,1	78,8	-4,3	5,953519
Latvia	23,5	0,299	82,7	85,0	0,5	11,76496
Lithuania	24,6	0,115	91,9	84,2	-1,5	8,085236
Macedonia	21,7	N/A	55,7	60,9	1,0	1,309628
Moldova	23,9	0,371	80,0	80,9	0,2	-6,166336
Poland	24,7	0,115	81,5	97,6	3,2	9,678655
Romania	21,6	0,211	92,0	77,9	-2,8	6,695405
Russia	19,4	0,316	93,3	N/A	-2,1	1,744751
Slovakia	35,4	0,239	88,1	N/A	1,9	8,821474
Slovenia	25,3	0,065	91,1	90,5	-0,1	4,590894
Tajikistan	N/A	N/A	102,1	80,6	-4,3	6,434110
Turkmenistan	36,9	N/A	N/A	N/A	N/A	-11,629741
Ukraine	21,2	0,323	92,8	N/A	N/A	2,429655
Uzbekistan	21,6	0,058	99,4	N/A	N/A	3,504017

Indicator	Average annual population growth 89 - 99 in %	Interaction of ShaPrimEx with ExGro9499	GNP per capita (USD) over GNP per capita (USD) at PPP	GDP per capita in USD (1998)	Manufacturing Lag
Short name	PopGro8999	InterAction	RelPrice	GDPpC98	ManLag
Albania	0,74683003	4,545695583	0,281	1075,394	11,600
Armenia	0,10624727	0,186824437	0,212	494,225	4,800
Azerbaijan	0,85016673	6,28241637	0,189	535,302	N/A
Belarus	0,1930167	3,745916263	0,382	1402,517	-0,400
Bulgaria	-1,29799821	0,040156282	0,286	1378,209	N/A
Croatia	-0,56284226	0,012897484	0,696	4826,308	5,100
Czech Rep.	-0,03236228	1,328242607	0,402	5477,555	N/A
Estonia	-0,86527095	5,462794497	N/A	3334,279	N/A
Georgia	-0,70170992	N/A	0,243	1003,758	N/A
Hungary	-0,21720587	2,591010832	0,424	4719,018	-6,200
Kazakhstan	0,10836276	8,580548033	0,260	1306,980	-5,900
Kyrgyzistan	0,72420467	2,381407775	N/A	357,432	-1,700
Latvia	-0,97113599	5,05893275	1,012	2513,732	5,000
Lithuania	-0,15805072	2,425570947	1,000	2845,337	6,300
Macedonia	0,72184678	0,366695936	0,359	1600,630	N/A
Moldova	0,16517146	-4,501425295	0,166	499,875	N/A
Poland	0,17964752	2,032517518	0,481	4226,136	N/A
Romania	-0,17329106	1,406035149	0,246	1690,259	N/A
Russia	-0,06146703	0,994508427	0,322	1882,304	N/A
Slovakia	0,29369895	1,146791579	0,360	3777,142	N/A
Slovenia	0,16954655	0,504998341	0,620	10123,642	-1,400
Tajikistan	1,98393175	N/A	N/A	168,912	N/A
Turkmenistan	2,18025365	N/A	0,200	N/A	N/A
Ukraine	-0,38746275	N/A	0,250	842,539	2,700
Uzbekistan	1,93602023	N/A	0,323	1216,030	N/A

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