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Natural Resources and Regional Growth

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Evidence from the Gross State Product data suggests that natural resource-dependent states out-performed less resource-dependent states over the 1964–86 period. Closer examination, however, suggests that the gains largely were due to an increase in wealth associated with positive resource-price shocks during the period. Interestingly, unlike the Dutch disease problem of the international literature, the non-resource industries of resource-dependent states were the principal beneficiaries of favorable natural resource price shocks.

What is the relationship between a state's dependence on natural resource production and its economic performance? Can differential growth rates of state economies be traced in part to differences in their dependence on agriculture, forestry, mining, and energy?

Past studies have provided mixed evidence on the relationship between natural resources and relative economic performance. The international literature has documented cases where dependence on natural resources has had detrimental side-effects on the economic structure of those countries. Moreover, the boom-bust cycle of mining towns offers evidence of the potentially ephemeral nature of natural resource industries. In contrast, however, other cases explicitly have linked spurts of economic growth to natural resource industry stimulus.

The purpose of this article is to address the linkages between a region's natural resource dependence and its economic performance using information from the Gross State Product (GSP) data prepared by the U.S. Bureau of Economic Analysis. These data, which offer relatively consistent information on the value added by each major industry in each state, allow some cross-state comparisons over the period from 1964 to 1986.

Using descriptive statistics from the data, the relative economic growth of resource-dependent states is compared to that of less dependent states. In general, the results show that resource-dependent states, particularly energy and mining states, had economies that grew more rapidly than average over the period, although they had greater variance around their trend growth rates as well. The evidence suggests, moreover, that the relative gains were more likely a result of strong price movements that generated significant wealth effects, rather than a result of intrinsic advantages associated with natural resource production.

The data also indicate that the "Dutch disease" problem cited in the international literature may not apply to regional economies. The "Dutch disease" refers to the effects of a sharp increase in world natural resource prices on a resource-dependent economy. The resource price increase can cause the resource-dependent economy's currency to appreciate, making its other commodities less competitive on world markets. As a result, a resource price increase can work to the detriment of non-resource industries.

At the regional level, the exchange rate effect is not present because of a common currency, but the increased demand for factors from the resource sector can bid up costs of those factors in the region and make its other outputs less competitive with those of other regions. Results from the state-level data, however, indicate that contrary to the Dutch disease problem, non-resource industries were the principal *beneficiaries* of resource price shocks. The price shocks apparently stimulated non-resource production even more than resource production.

Differences in resource endowments across states are described in the first section of this article, followed in the second section by an examination of the variety of channels through which natural resource dependence might affect the level, growth, and structure of a state's economy. The third and fourth sections present empirical findings. Conclusions are then presented in the fifth section.

I. Differences in Natural Resource Dependence

In this section the degree to which natural resource production varies across states is documented using GSP data. These data, released in 1988 for the first time, provide a measure of the value added annually by each major industrial grouping for the period from 1963 to 1986, and generally provide a better measure of activity than do the income or employment data.[1]

Each state's share of national output, both for the total economy and by resource industry, are shown in Table 1 for 1986. The first column presents each state's share of total national output (the latter being the sum of state GSP across states). The second column gives the share of national natural resource output, comprising agriculture, forestry and lumber, mining, and energy, that is contributed by each state.[2] By comparing these two columns, it is clear that the states' shares of *natural resource output* differ from their contributions to *total output*. Twenty states can be categorized as relatively dependent on natural resource production, in the sense that they contributed a larger proportion of total national natural resource production than would be predicted by their share of national output.

As shown in the table, the distribution of resource production is highly skewed across states and across resources. Rhode Island contributes only 0.05 percent of total natural resource production, while Texas provides 20.78 percent. The top 10 states in each natural resource subcategory, respectively, account for 50.4 percent of U.S. agricultural production, 54.8 percent of the nation's forestry and lumber, 56.9 percent of mineral mining, and 84.7 percent of national energy extraction.[3]

Chart 1
Resource Share of Total Gross State Product

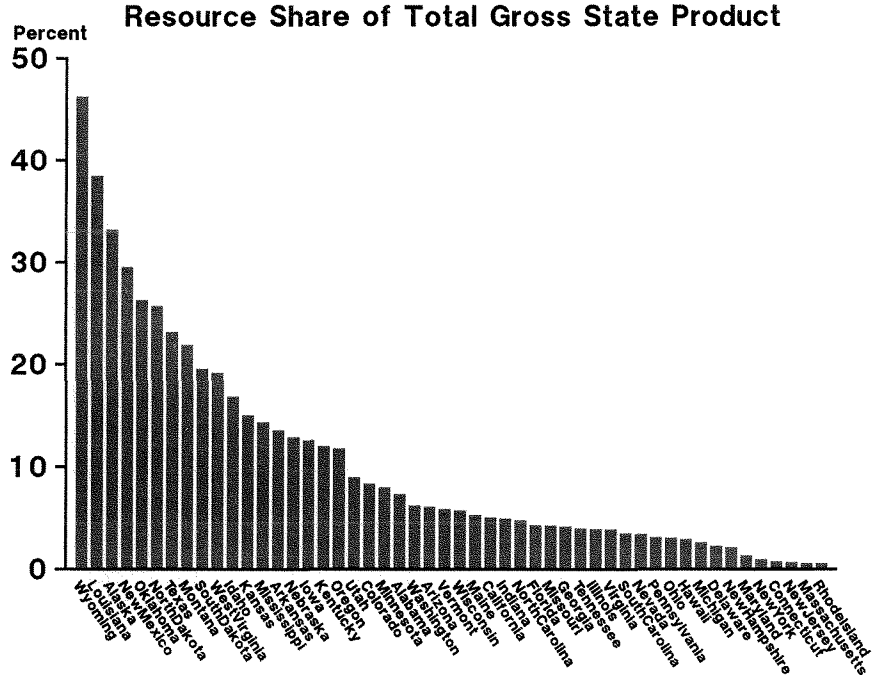


Table 1

Shares of National Natural Resource Production, By State

(Percentage of national total in 1986)

State	All* Industries	All** Resources	Agriculture	Forestry	Mining	Energy
ALABAMA	1.32	1.64	1.49	3.59	0.86	1.44
ALASKA	0.53	3.82	0.03	0.49	0.41	7.62
ARIZONA	1.26	0.81	1.06	1.07	6.17	0.18
ARKANSAS	0.77	1.40	2.30	2.53	0.35	0.56
CALIFORNIA	12.70	8.16	10.42	9.60	8.08	6.14
COLORADO	1.42	1.61	1.66	0.56	3.34	1.65
CONNECTICUT	1.69	0.22	0.37	0.47	0.37	0.05
DELAWARE	0.28	0.12	0.29	0.16	0.03	0.00
FLORIDA	4.16	2.67	4.20	3.21	7.48	1.05
GEORGIA	2.43	1.59	2.35	4.90	6.39	0.03
HAWAII	0.44	0.20	0.51	0.05	0.03	0.00
IDAHO	0.32	0.77	1.41	1.75	1.95	0.01
ILLINOIS	5.03	2.64	4.43	1.48	2.26	1.51
INDIANA	2.08	1.58	2.70	3.03	1.41	0.46
IOWA	1.11	2.39	5.99	1.00	0.90	0.01
KANSAS	1.03	1.94	3.70	0.48	0.53	0.97
KENTUCKY	1.30	2.48	2.23	1.04	1.29	3.04
LOUISIANA	1.87	7.69	0.88	1.79	2.15	14.47
MAINE	0.41	0.27	0.25	1.76	0.04	0.00
MARYLAND	1.79	0.41	0.82	0.50	0.70	0.06
MASSACHUSETTS	2.80	0.28	0.47	0.82	0.93	0.00
MICHIGAN	3.73	1.52	2.14	1.69	2.55	0.93
MINNESOTA	1.86	2.10	4.35	3.02	4.61	0.02
MISSISSIPPI	0.77	1.24	1.24	3.11	0.30	0.94
MISSOURI	1.99	1.19	2.54	1.01	2.32	0.10
MONTANA	0.29	1.03	1.24	0.98	1.63	0.83
NEBRASKA	0.65	1.63	4.18	0.21	0.28	0.05
NEVADA	0.44	0.30	0.14	0.13	6.31	0.02
NEW HAMPSHIRE	0.47	0.13	0.11	0.84	0.26	0.00
NEW JERSEY	3.65	0.40	0.65	1.19	0.85	0.03
NEW MEXICO	0.58	2.03	0.59	0.35	2.53	3.44
NEW YORK	8.46	1.18	1.96	1.95	2.50	0.33
NORTH CAROLINA	2.39	1.58	2.70	4.65	3.17	0.01
NORTH DAKOTA	0.27	1.15	2.02	0.03	0.14	0.77
OHIO	4.28	1.96	2.50	2.59	1.44	1.46
OKLAHOMA	1.26	3.85	2.21	0.36	0.53	6.02
OREGON	0.98	1.61	1.64	10.06	0.52	0.02
PENNSYLVANIA	4.40	2.26	2.48	3.81	2.37	1.78
RHODE ISLAND	0.36	0.05	0.08	0.19	0.06	0.00
SOUTH CAROLINA	1.07	0.44	0.57	1.94	1.15	0.01
SOUTH DAKOTA	0.24	0.81	1.97	0.23	1.21	0.02
TENNESSEE	1.75	0.94	1.55	1.94	1.92	0.20
TEXAS	7.55	20.78	6.35	5.36	5.44	35.96
UTAH	0.58	0.52	0.46	0.33	1.95	0.51
VERMONT	0.21	0.17	0.31	0.44	0.25	0.00
VIRGINIA	2.41	1.32	1.26	2.92	1.55	1.03
WASHINGTON	1.84	1.69	2.66	6.30	1.33	0.07
WEST VIRGINIA	0.59	1.80	0.24	0.62	0.31	3.34
WISCONSIN	1.92	1.89	4.05	3.34	0.89	0.01
WYOMING	0.30	1.72	0.25	0.13	5.96	2.87

* Percentage of total national output (summed over states) contributed by each state.
** Weighted average of agriculture, forestry, mining, and energy shares.

The information in Table 1 does not account for differences in the sizes of states' economies. Such a comparison is presented in Chart 1. Resource industry shares of total state GSP are calculated using averages from the 1964–86 period. As can be seen by comparing the chart, which has shares of *state* output, with Table 1, which reports shares of *national* output, differences in national natural resource production shares have been translated into differences in concentration in resource production. The uneven dispersion of resources across states has resulted in differences in reliance on natural resource industries. Resource dependence, as measured by the share of real GSP accounted for by the resource industries, varies widely across states and across resources. As shown in Chart 1, the average share of real GSP contributed by resource industries (agriculture, forestry and fisheries, mining, and fuel mining) over the period 1964–86 ranged from virtually zero in Rhode Island to nearly 50 percent in Wyoming.

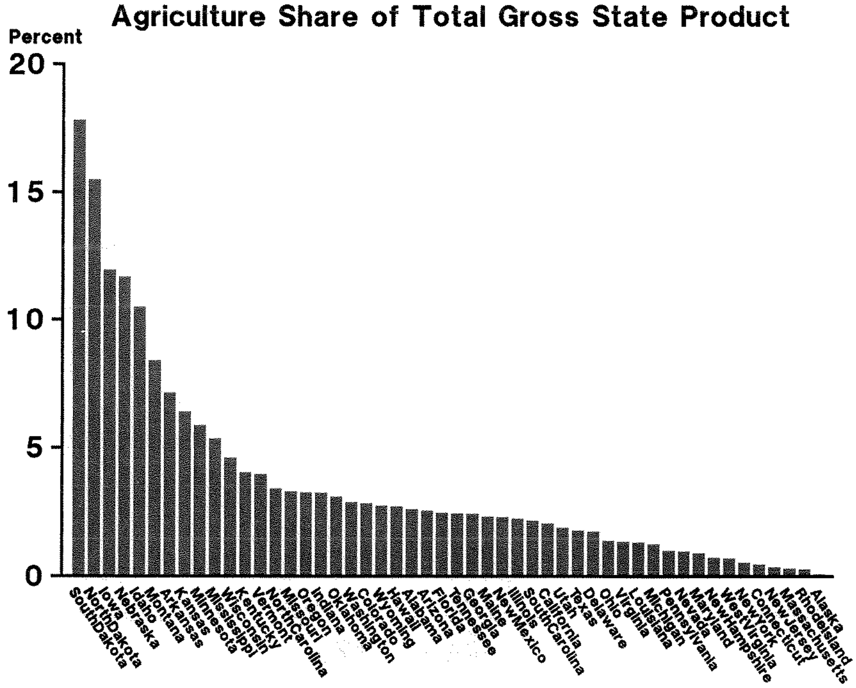
The composition of resource endowments varies significantly across states as well. As shown in charts 2 through 5, the states with the largest shares of GSP in each resource are different across resources, with little overlap between agricultural states and mining states.

The magnitude of dependence on resources varies across resources as well as across states. Among the resource-dependent states, energy stands out as the most dominant single source of resource output. The top six energy-dependent states have between 20 and 40 percent of their gross state product originating in the energy sector. Agriculture also plays a major role in the agriculture-dependent states, with five states reporting an average of 10 to 20 percent of their GSP from agricultural production.

In contrast, mining and forestry play less dominant roles even in the states with the highest concentrations of those activities. Lumber and wood products account for less than five percent of output in all states except Oregon, while mining accounts for less than four percent of total output even in the states with the highest concentrations of mining output. (Mining in this article refers to non-energy mining; coal, oil, and natural gas outputs are combined to form the energy category.)

These figures, however, may understate the importance of the natural resource industries to state economies, particularly in the short run. For example, according to the 1977 California input-output model, agriculture has a multiplier of 3.2 in the economy, suggesting that a 10 percent increase in agricultural output generates a 32 percent increase in aggregate output through the associated increase in demand for inputs, processing, marketing, transporting, and retailing (State of California, 1980.) Because such measures tend to assume that these factors could not be shifted to other uses, however, the multiplier effects tend to overstate the importance of resource industries.[4]

Chart 2
Agriculture Share of Total Gross State Product



II. Natural Resources and Production

These differences in resource endowments can be expected to result in different economic orientations, and thereby to affect the level of activity and the rate of growth of regional economies. In this section, several strands of the literature are summarized to shed some light on the effects that a natural resource orientation can have on different regional economies.

Comparative Advantage

The most obvious effect of differential endowments of natural resources is that states with large shares of a particular resource specialize in the production of that resource. This result displays the basic concept of comparative advantage laid out in the Heckser-Ohlin theorem in the international trade literature. Regions (or countries) with different factor proportions can generate higher total output and consumption by specializing in the production of commodities in which they have a relative abundance of the needed inputs. Total output is maximized when regions specialize in the production of commodities that best reflect the area's relative resource mix (its comparative advantage) and then trade with areas that have a comparative advantage in producing other goods. Consequently, regions with abundant natural resources would be expected to specialize in natural resource-intensive production, using resource outputs to trade for non-resource commodities from other regions.

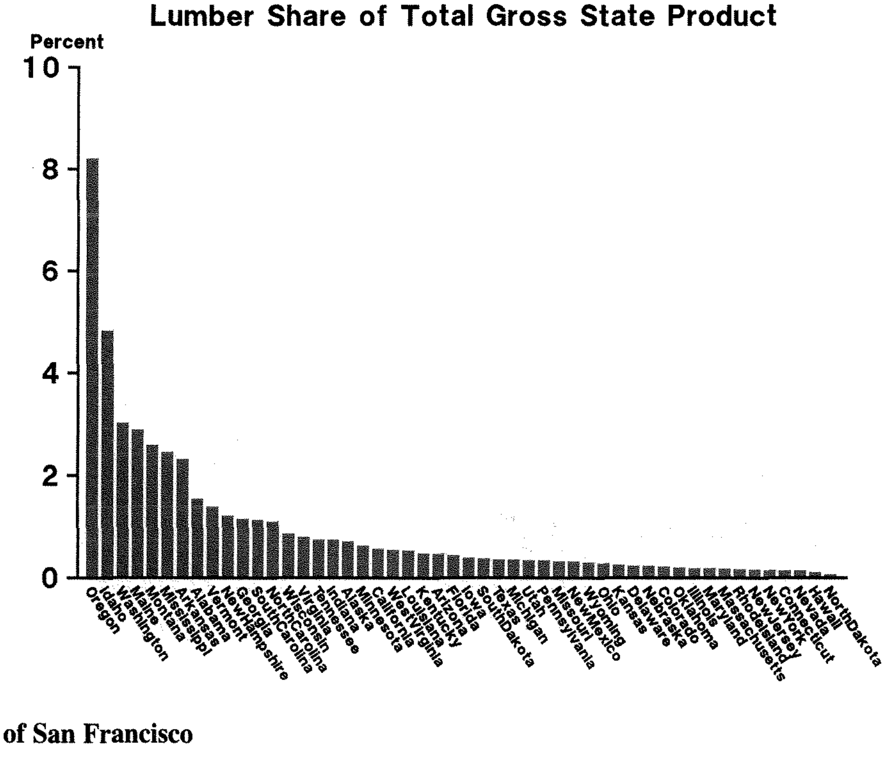
In the regional economics literature, differences in natural resource endowments are important in explaining different regional production processes. If all regions had identical resource endowments, there would be little reason to expect specialization across regions. In fact, differences in resource production and therefore, in industry mix across states, have led to different responses to technology or price shocks. A recent study by Cox and Hill (1988), for example, predicts the differential incidence of exchange-rate shocks at the state level by taking into account industry-mix characteristics and the relative trade-sensitivity of those sectors. Similar research has examined the differential regional effect of oil price shocks. These studies explicitly assume that differences in factor endowments promote different productive processes and outputs, and hence, expose regional economies to different external forces.

Levels vs. Growth Rates

While the principle of comparative advantage predicts that differences in resource endowments would affect the composition of output across regions, natural resources also may be key factors determining both the level and rate of growth of regional economies.

In the case of natural resources, the answer to the question "is more better?" seems obvious at first glance. From the standpoint of an economy, being resource-rich

Chart 3
Lumber Share of Total Gross State Product



increases productivity. Abundant natural resources lower the cost of certain inputs, enhancing the competitiveness of resource-intensive production.

Simple production-function models of an economy suggest that the level of output is a direct function of the resource base. As long as some factor substitution is possible, an abundance of a given resource boosts total output.

The effect of the resource stock on the *rate* of growth is less clear. Natural resources could increase the rate of growth of an economy if the resource stock grew over time, or if the "effective stock" (that is, the actual stock adjusted for changes in that stock's productivity) were to rise over time because of technological efficiency gains. Conversely, natural resources could cause the rate of growth to slow, if increasing scarcity of the natural resources constrained the growth of related sectors.

Consequently, theory suggests that a higher stock of a natural resource should raise the level of activity, but the effect on the rate of growth depends in part on the degree to which natural resource production expands and spurs other industries to develop. As shown in the remainder of this section, theoretical evidence on the extent to which resources spur growth is not conclusive.

Agglomeration Effects vs. Boom Towns

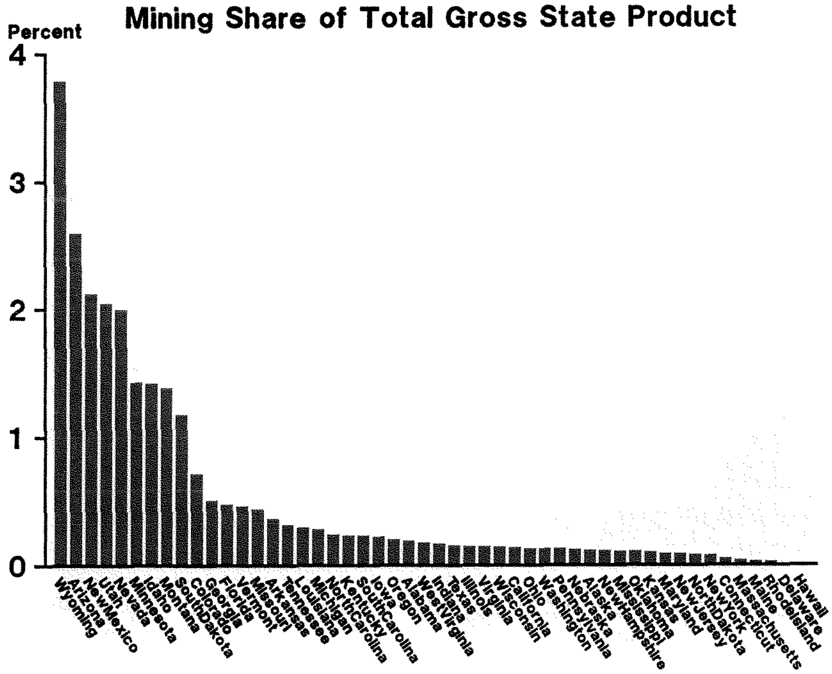
The classic model highlighting the role of natural resources as a stimulus for regional economic growth was developed by North (1955). In North's export-base model, natural resources are viewed as a driving force for economic growth, modeled along the lines of economic development in the United States. Early settlers to a region often are attracted by the economic potential of that area, which typically includes its natural resources. Trappers were attracted to the western areas by available wildlife populations. Farmers were attracted to the Midwest and West by available low-cost land. Miners were attracted to the western states by discoveries of gold and silver. Loggers were attracted to the Pacific Northwest and upper Midwest by available supplies of timber. Discoveries of massive oil reserves brought an influx of people to Texas.

In many parts of the country, therefore, economic growth was either initiated or boosted by the influx of people seeking to use natural resources. Accordingly, exports of natural resource products to other regions and countries became important in the early development of regional economies.

In the export-base literature, the creation of exportable commodities shapes a region's economy and spurs further growth. As production of the resource increases, rising wages and returns to capital encourage the migration of productive factors from other regions (Borts [1960], Borts and Stein [1964], and Schmidt [1985]). Population rises because of immigration, and export earnings and investment allow the capital stock to grow.

In the early stages, this investment is closely tied to the resource sector. Processing and transportation facilities develop, along with services to support the resource industry's employees and production.

Chart 4
Mining Share of Total Gross State Product



Over time, however, other industries not directly tied to resource production develop to take advantage of the growing economic and social infrastructures. Moreover, firms that initially support resource industries diversify into other products. For example, Texas Instruments began as a company manufacturing seismic equipment for oil drilling. As the company grew, it expanded into other electronic instruments. Today, equipment for the oil industry is only a small part of the company's sales.

Natural resources, therefore, can be a primary source of early development, followed by diversification of the economy into other fields not tied to an area's natural resources. But as evidenced by boom towns, natural resources are not always a source of lasting growth. In the case of extractive or nonrenewable natural resources, the extent to which a region diversifies into non-resource production may determine the sustainability of its economic growth. In many cases, natural resource booms have led to temporary growth, followed by decline. This idiosyncratic relationship between growth and natural resources has been described by economic historian Jonathan Hughes in the following way:

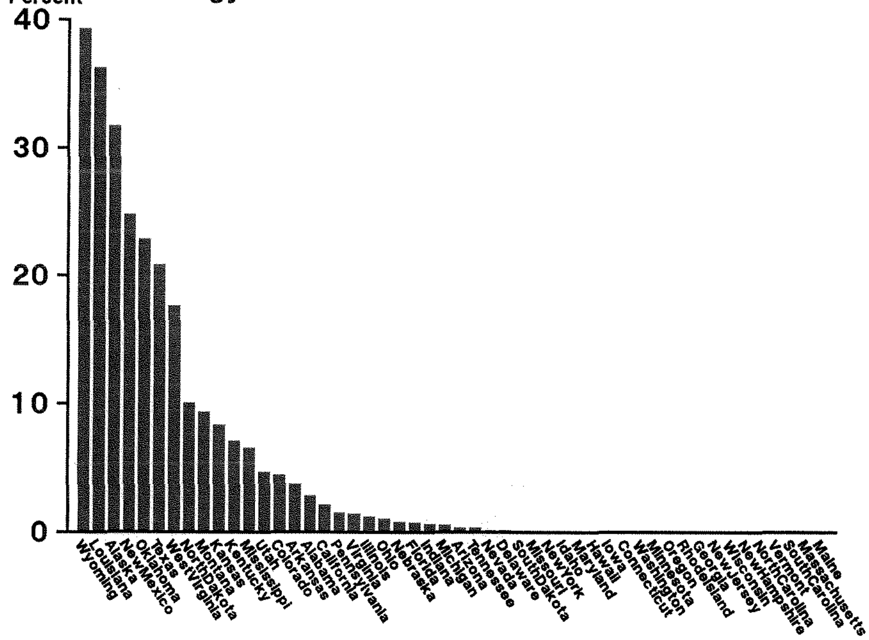
> Apart from agriculture, no doubt the best known cause of increased economic growth in the past came from the discovery and exploitation of natural resources. The ghost towns of the Rockies and the capped oil and gas wells of [the oil states] are witness to the fragile tenure of economic growth from such sources. Exploitation growth via nonreproducible natural resources usually involves only the relatively short-lived creation of fungible wealth that is carried off, leaving a hole in the ground, a stumped-over woodland, or an ocean stripped of one of its main species. In the past, there have been many examples of this purely ephemeral kind of growth. It was caricatured by historian Christopher Lasch once with these lines: 'American capitalism's idea of economic development was to leave the continent a smoking ruin.' Sometimes one must agree with Lasch on this point. Fortunately, the smoking ruin is the exception and not the rule. [Hughes 1985, p.5]

Natural resources, therefore, can be the impetus for sustained growth, but that is not always the case.

Information Effects

Dependence on natural resources also may affect regional economic growth because of the way natural resource price movements and/or discoveries of new deposits tend to change perceptions of the economic opportunities in the affected region. As shown in Plaut and Pluta (1983), Miernyck (1985), Gruben, Martens, and Schmidt (1988), and Gruben and Schmidt (1989), energy price shocks were instrumental in explaining shifts of labor and capital among regions. Those regions that were energy exporters benefited markedly from rising oil prices relative to non-energy producing states. The factor flows were not directed solely to energy industries, but rather to the broader economy. Although part of the expansion and contraction in the energy states can be directly linked to energy-supporting industries, the factor movements appeared to reflect investors' and migrants' expectations of rapid growth in other sectors as well.

Chart 5
Energy Share of Total Gross State Product



As hypothesized by Schmidt and Gruben (1988), this larger effect reflects the imperfect information available to migrants and investors regarding spatial opportunities. Because information is costly and known only with a lag, shocks that have easily recognized impacts convey an unusually large amount of information. The oil price rises in 1973–74 and 1979–80 highlighted investment opportunities in the oil patch states, while the price collapse may have encouraged potential investors to spend their limited resources acquiring information on other regions not likely to be hurt by the collapse.

Because resource price movements often are dramatic and typically are expected to have differential geographic incidence, a state's characterization as natural resource-dependent may give strong signals—whether false or true—regarding the potential opportunities to outside factors. Dramatic price movements tend to focus attention on a resource-rich region, thereby giving investment opportunities a better chance of attracting the needed factors than areas that are less well known.

"Dutch Disease"

The previous aspects of the relationship between natural resources and economic growth have stressed the ways in which natural resource production can attract factors of production from other regions. In this way, natural resources can be a source of non-resource industry growth.

The assumption in those cases is that the income or wealth effects from expanding natural resource production will spill over into non-resource production, thus diversifying the economy. In contrast, the literature in international economics points to the potential for an expanding natural resource sector to crowd out non-resource industries, known in the literature as the "Dutch disease" (Laney [1982]).

This phenomenon has been applied to cases of oil exporting countries, in particular, although the same process affects other markets as well. In this framework, a sudden price shock to a key export industry (such as the oil price increases of 1973–74 and 1979–80) boosts the nominal value of the country's exports, causing an increase in the country's trade surplus. As a result, the country's exchange rate appreciates.

The higher exchange rate then makes imports less expensive and non-petroleum exports more expensive. Consequently, domestic industries that export or compete with imports in the domestic market become less competitive. At the same time, productive factors may flow into the petroleum sector away from other sectors, thus raising factor costs in other sectors as firms bid for potentially scarce labor and capital.

If the price shock persists, the negative effects on the other sectors of the economy are transitional as the economy shifts to a new production mix that reflects the heightened comparative advantage of the natural resource industry. However, if the shock is expected to persist and, instead, proves to be temporary, the cost in terms of misallocated factors, particularly irreversible investment in plant and equipment, can offset the potential gains to the economy of the positive price shock. Moreover, such temporary losses of competitiveness can result in the loss of market share in non-resource industries that may be difficult to recapture. Finally, Dutch disease also can expose a country to greater risk by making its export portfolio less diversified.

Similar forces are at work in a regional context, although there are important differences as well. Resource price shocks can lead to increased production of those resources, which can cause factors to be reallocated from other industries. Moreover, factor prices can be bid upward, increasing the cost of other sectors' output relative to other areas of the country. Thus, even though there is a common currency, a process akin to exchange rate appreciation can occur through a rising relative cost of living.

The most important difference between regions and nations, however, is the greater mobility of factors across regional boundaries. Constraints are not placed on interstate movements of labor or capital, nor are constraints placed on shipments of products. Therefore, whereas the Dutch disease can lead to sharply higher factor prices in the resource-dependent country, factor prices need not rise as sharply in a region where factors can be drawn from other regions relatively easily.

Special Characteristics of Natural Resources

The preceding discussion, while couched in terms of resource industries, is not unique to natural resources. Many of the same relationships between resource industries and regional economies can be found in states that are highly dependent on non-resource-based industries, such as autos and steel.

There are, however, several areas in which natural resource industries differ from other industries. Natural resources lend at least three primary advantages to a developing economy over and above simple comparative advantage: a developed market, low initial technological requirements, and access to capital. First, natural resources often enjoy developed markets, both domestic and international. To an area that is sparsely developed, a natural resource can provide a readily exportable commodity. Unlike many finished commodities, a resource does not require strong local demand during start-up phases of the operation. As long as the region has access to transportation, trade is possible.

A second, related advantage that accrues to natural resource production concerns the relatively low level of skill and capital that is required at initial stages of production. Typically, the existence of abundant resources and access to transportation make the cost of extracting the first units relatively low.[5] Mineral mining can be profitable with a shovel and pan, logs can be obtained with a saw and a river, and oil can be extracted with little more than the technology to drill a water well. Thus, in initial phases, successful development requires risk-taking by the available labor supply and only modest support operations. Production initially does not require a large collection of highly-trained technical and professional workers.

The third advantage of a natural resource is that it initially can produce economic rents that allow the region to import needed capital for other ventures. Because natural resources tend to be scarce worldwide, the price of the resource generally will be sustained above the marginal cost of producing it in areas where it is abundant. Trading with more developed countries allows the region to import capital goods that cannot be developed locally with existing capital. A natural resource, therefore, can serve as a channel through which raw materials are converted into reproducible capital.[6]

At the same time, however, dependence on natural resource production has several disadvantages that can threaten sustained economic growth of more developed economies. To begin with, access to world markets makes the region highly susceptible to fluctuations in those markets. Changes in terms of trade, embargoes, or trade barriers can have a large impact on a resource-dependent economy. Moreover, changes in world supplies, such as the discovery of new reserves elsewhere, or in demand, such as shifts in taste or technology, have immediate impacts on the local economy. Markets are less predictable and controllable than when supply and demand are more insulated geographically.

The downside of resource price volatility clearly has been evident in the oil-dependent states in the 1980s. While the rest of the nation has enjoyed a record peacetime expansion, the oil states have experienced the worst recession in the post-depression era because of the sharp drop in oil prices.

The problem is exacerbated by the close linkage between natural resource production and government policy. In most countries, natural resources are heavily controlled or owned by governments. Oil prices are determined in large part by OPEC's decisions about production. Agricultural production is highly subsidized in most countries. Forestry sales are heavily dependent on decisions concerning access to public stands of timber—decisions that often are influenced by environmental policy considerations. These government controls, therefore, further expose a resource-dependent economy to political uncertainty, as well as to the uncertainty that would normally arise in the market.

The low skill requirements needed in many of the extraction industries also can work to the detriment of long-term regional growth. In many cases, boom periods lead to rapid increases in the wages of low-skilled workers, encouraging a migration of such workers from other areas of the country. These low-skilled workers receive high wages because of temporary output surges and concomitant shortages of labor, rather than as a result of a steady-state measure of their opportunity cost. In periods with slowing demand and production, these workers often become unemployed and typically are less able than skilled workers to find other work at similar pay.

Moreover, the temporarily high returns to low-skilled labor—which may not be perceived to be temporary by the workers—can inhibit investment in human capital. The value of boosting human capital through training and education is obscured by the temporary returns to relatively low levels of such human capital. Over the long run, a drop in the skilled labor pool can slow innovation and productivity growth.

Finally, the theory of exhaustible resource production typically points to declining production after some stage. Optimal production behavior calls for spreading production over time, but even in cases where production capability first must expand, production is expected to decline eventually, both as a share of output and in absolute levels (Pindyck [1978]). Production tends to rise in early stages as discoveries are made and new reserves are developed, but finding large new deposits to replace the reserves that were used in previous periods becomes harder over time. The case of declining U.S. oil production in the face of rising prices during the 1970s offers dramatic evidence of this potential problem.

Summary

Natural resources potentially can play an important role in a region's economy. First, a region heavily endowed with natural resources can be expected to specialize in resource production in conformity with the notion of comparative advantage. Second, other things equal, possession of more resources boosts the potential output of the region.

With respect to the rate of growth, however, the results are mixed. Natural resources have at times been instrumental in providing a catalyst for rapid and sustained growth. In other cases, a resource boom has crowded out other industries to the detriment of the region's longer-term prospects. Moreover, while natural resource industries may provide strong growth at early stages of a region's development, the advantages associated with those industries are more questionable as the economy matures.

III. Relative Performance and the Role of Prices

As indicated in Section II, the relationship between natural resources and differential regional economic growth is complex. In this section, evidence from the GSP data is presented to address two aspects of this relationship. First, gross statistics on the relative economic performance of resource-dependent and non-resource-dependent states are presented. Second, simple regression results are presented to determine whether resource price shocks or resource industries *per se* influence relative performance more.

Relative Performance

For the purpose of this analysis, the 50 states are split into two groups for each natural resource industry based on their resource dependence. Those identified as "resource dependent" are listed in Table 2.[7] As shown in Charts 1–5 earlier, resource dependence is highly skewed across states. In the case of agriculture and energy, the top 10 states are selected as resource dependent. In contrast, because the number of states with significant mining or forestry activity is small, only the top five states are categorized as resource dependent.

The performance of resource-dependent states has differed from that of other states during the 1964–86 period. As shown in Table 3, resource-dependent states ("high") grew more rapidly than did other states ("low"). Over the whole period, the top ten resource states grew at an average annual rate of 3.35 percent, compared to 2.56 percent growth for the other 40 states.[8]

This difference in growth rates was not constant over the whole sample period. Resource industries, particularly the energy sector, have faced significant changes over this period. Accordingly, the sample period was split into three sub-periods—1964 to 1972, 1973 to 1981, and 1982 to 1986—that are divided by the major oil price shocks in 1973–74 and 1979–80.

Although these periods are selected to capture changes in energy industry activity, the shocks were sufficiently traumatic to overall economic activity to make those dates important to the other resource industries. Economic slowdowns early in each of the last two sub-periods, while not necessarily causally related to the oil price shocks, were associated with sharp changes in many of the industries. Higher interest rates dampened the demand for lumber by slowing construction activity, and changes in inflation affected mineral prices and had significant impacts on agricultural land values.

These periods also were characterized by sharp changes in natural resource price behavior. In the early period, natural resource prices were fairly stable. In the middle period, however, energy prices surged. Overall, mineral, lumber, and agricultural prices showed little trend growth over the period, but sharp increases in precious metals

Table 2

Average Share of GSP Contributed by Natural Resource Industries

(1964–86, for the States with the Largest Shares)

ALL RESOURCES*	Avg. Shr.	AGRICULTURE	Avg. Shr.
Wyoming	46.6	South Dakota	17.8
Louisiana	38.9	North Dakota	15.5
Alaska	34.1	Iowa	12.0
New Mexico	30.0	Nebraska	11.7
Oklahoma	26.8	Idaho	10.5
North Dakota	26.3	Montana	8.4
Texas	23.7	Arkansas	7.2
Montana	22.3	Kansas	6.4
South Dakota	20.3	Minnesota	5.9
West Virginia	19.4	Mississippi	5.4
FORESTRY	Avg. Shr.	MINING	Avg. Shr.
Oregon	8.2	Wyoming	3.8
Idaho	4.8	Arizona	2.6
Washington	3.0	New Mexico	2.1
Maine	2.9	Utah	2.1
Montana	2.6	Nevada	2.0
ENERGY	Avg. Shr.		
Wyoming	39.5		
Louisiana	36.4		
Alaska	31.8		
New Mexico	24.9		
Oklahoma	23.0		
Texas	21.0		
West Virginia	17.8		
North Dakota	10.2		
Montana	9.5		
Kansas	8.5		

*Combined output from agriculture, forestry, mining, and energy.

prices at the end of the 1970s and sharp agricultural spikes in 1973 and 1980 were important events shaping industry activity.

As indicated in Table 3, resource industries have had major changes in the pace of economic growth over the whole period. In the 1973–81 period, resource states posted growth that exceeded other states' growth by nearly 1.75 percentage points. Conversely, in the 1982–86 period, resource states grew more than four percentage points *slower* than the remaining 40 states.

The more rapid growth in the resource states was accompanied by greater variance. The weighted average root mean square error around trend growth was 0.57 percentage points higher for resource states than for non-resource states. Comparing sub-periods, however, it is clear that this higher variance largely is the result of the last period, during which growth in resource industries slowed dramatically. In the earlier periods, differences in variances were relatively small.

Considerable differences in the relationship between resources and growth are apparent across natural resources. Agricultural states generally grew at the same rate as other states, with faster growth in the 1973–81 period offset by slower growth in the other periods. The variance in growth also was smaller for agricultural states during most time periods.

In the case of forestry, growth rates were higher overall, although the variance was considerably higher in forestry-dependent economies. As in the case of agriculture, the middle period stands out as the period of relative gain, with slower-than-average growth registered in the other periods.

Mineral states have out-performed the rest of the nation in all sub-periods except the last period, and even there, they performed nearly as well. The variance was higher in

Table 3

Average Growth Rates and Variances of State GSP Stratified by Resource Dependence

(Averages weighted by GSP)

	1964–86	1964–72	1973–81	1982–86
All Resource Industries				
High Dependence	3.35	4.00	4.04	0.99
	(4.61)	(2.44)	(2.76)	(2.56)
Low Dependence	2.56	3.03	2.29	5.03
	(4.04)	(2.43)	(3.13)	(1.13)
Agriculture				
High Dependence	2.68	2.76	2.80	3.32
	(3.76)	(2.37)	(2.58)	(2.02)
Low Dependence	2.68	3.21	2.53	4.52
	(4.16)	(2.44)	(3.12)	(1.29)
Forestry				
High Dependence	2.96	2.33	3.96	3.62
	(5.24)	(3.56)	(3.53)	(0.88)
Low Dependence	2.67	3.22	2.49	4.46
	(4.07)	(2.39)	(3.06)	(1.37)
Mineral Mining				
High Dependence	4.33	3.80	5.40	4.13
	(5.30)	(2.77)	(3.60)	(1.90)
Low Dependence	2.62	3.16	2.46	4.44
	(4.09)	(2.43)	(3.06)	(1.33)
Energy				
High Dependence	3.28	3.92	3.93	1.12
	(4.44)	(2.37)	(2.69)	(2.47)
Low Dependence	2.56	3.04	2.29	5.05
	(4.07)	(2.45)	(3.15)	(1.14)

Growth rates are estimated for each state in each sample period, weighted, and summed. Weighted average root mean square errors from the regressions for each state are reported in parentheses.

the mineral-dependent economies, but the growth rates were the highest registered by any resource-dependent category.

Energy-dependent states had the most dramatic variations relative to the rest of the nation over the whole period. Growth during the pre-1982 period exceeded that in the nation, particularly in the 1973–81 period when oil prices rose sharply. The collapse of oil prices in the 1982–86 period caused growth to plunge to one-quarter of the rate of growth experienced in the rest of the country. Furthermore, after enjoying lower-than-average variance in the early periods, the variance rose to twice the national average in the later period. The volatility of the energy states during this period is not surprising given energy's relatively large share of output in these states (see Table 2) and the large swings in prices observed in the period.[9]

The data in Table 3, therefore, suggest that the better-than-average performance of resource industries largely was the result of gains made during the 1973–81 period. Mining and energy states were clear winners overall, while forestry and agriculture also registered some gains.

Separating Price and Share Effects

The results in Table 3 point to strong gains in resource industries during the period of sharp gains in natural resource prices—particularly in the prices of oil and minerals. In this section, an attempt is made to disentangle relative price effects from output effects associated with the growth of resource industries apart from the price shocks.

Ordinary least squares (OLS) and generalized least squares (GLS) regression results are presented in Table 4 for a simple model relating prices and resource shares to relative output growth. The data are estimated in pooled cross-section time series form, using all 50 states and 23 time periods. In the GLS case, the data are corrected for cross-sectional heteroskedasticity. As indicated by the low degree of explanatory power, these estimations fail to capture most of the differences across states in economic growth. The results are useful, however, in the sense that they provide partial correlation statistics for share and price variables, which are better measures than those from simple bivariate correlations between relative growth and prices or shares separately.[10]

Table 4

Estimated Relationships Between Relative State GSP Growth, Natural Resource Shares, and Natural Resource Prices

Dependent variable: Relative State GSP growth*

	OLS Results		GLS Results**	
Variable	Coefficient	t-statistic	Coefficient	t-statistic
Agriculture Share***	−0.0683	−2.92	−0.2629	−2.38
Agricultural price effect****	0.5474	2.44	0.0023	2.04
Lumber Share***	0.0874	1.33	−0.0743	−2.99
Lumber price effect****	0.0424	0.08	0.0069	3.52
Mining Share***	0.1822	1.43	−1.1975	−1.99
Mining price effect****	0.7747	0.77	0.0178	2.96
Energy Share***	−0.0166	−1.68	−0.0320	−1.42
Energy price effect****	0.5391	11.74	1.84E-7	0.15
Relative Per Capita Income in 1963	0.3582	2.49	0.0476	0.50
Adjusted R^2	.12		.06	

* Defined as the difference between annual percentage changes in state GSP less the weighted average annual percentage change in national GSP.

** GLS results from a two-step regression that first corrects for cross-sectional heteroskedasticity using a diagonal covariance matrix.

*** Share variables are defined for each state as the difference between the state's share of GSP in that industry relative to the national average share.

**** The price effect variable interacts the percentage change in the price of the resource (national prices) with the share variable.

The dependent variable is measured as the difference between the annual percentage changes in the level of real GSP for each state from the national average percentage change (formed using total GSP summed across states). Thus, it represents the relative growth of a state's GSP.

Share variables are formed by taking the share of a state's GSP accounted for by the given resource industry and subtracting from it the nation's average resource share. For resource-dependent states, this variable is positive and for those with below average shares, the variable is negative.

Price variables are formed in two steps. First, the real annual percentage change in each resource price is calculated.[11] The price change for a given resource is then multiplied by the state's relative share of that resource described earlier. This specification is necessary because price effects depend on a state's relative dependence on a given resource. Clearly, oil price increases had a positive effect on energy-exporting states and a negative effect on energy-importing states. With this formulation, a positive coefficient indicates that a positive price shock will boost the resource-intensive state and slow growth in non-resource-intensive states.

Finally, to account for the possibility that growth also results from factor movements generated by differences in per capita income, the relative per capita income of persons in each state in 1963 (the beginning of the period) is included. If faster growth simply is the result of a state starting from a low base, this variable will proxy for that effect.

Both OLS and GLS results are reported because together, they convey some sense of the robustness of the relationships. Differences between the two estimates arise from the treatment of variances of state growth rates, which can differ because of a variety of factors, including the size and diversity of the state's economy. The GLS model estimates the coefficients after standardizing the variances of the state, while the OLS model makes no such correction. Both methods yield unbiased coefficients, although the standard errors can be biased in the OLS case.

Results from the regressions differ in the size and significance of the coefficients, but several broad characterizations can be made. First, share variables either do not have a significant influence on relative growth, or where significant at the 95 percent confidence level, tend to have a negative influence on growth. These results suggest that, other things equal, having more natural resource production will not stimulate relative economic growth.

Price variables, on the other hand, were positive in all cases. This result suggests that the sharp movements in resource prices during the period did have an important, positive influence on the relative output growth of resource-dependent economies.

The effect of the starting level of the economy, per capita income in 1963, had a positive effect on relative growth in the OLS case and an insignificant effect in the GLS model. To the limited extent that the starting level mattered, therefore, those states with the strongest economies at the beginning grew faster, making the spread between state incomes larger.

Results from the table, therefore, suggest that the superior performance of the natural-resource dependent states shown in Table 3 may be better interpreted as the result of sharp positive price movements during the sample period, rather than advantages associated with resource production *per se*.[12] To summarize, the results in Table 4 indicate that having a large share of natural resources is detrimental to relative growth prospects, unless the relative price of natural resources rises.

IV. Non-Resource Industries and the Dutch Disease

In the previous section the evidence indicated that natural-resource-based economies out-performed the rest of the nation, although the gains appear to be the result of price effects rather than share effects. This finding allows a direct examination of the applicability of the "Dutch disease" to regional economies. In this section, the data are examined to determine whether the gains in resource-based regional economies led to greater concentration in resource industries—and possibly had detrimental effects on non-resource industries—as would be consistent with Dutch disease.

Table 5 presents average changes in the natural resource share of state GSP over various sub-periods (weighted by GSP) calculated for resource- and non-resource-dependent states. Comparing columns, it can be seen that resource-dependent states had much larger changes in the shares of GSP contributed by the various natural resource industries than did the non-resource-dependent states. This is not surprising given the small shares that those industries contribute in non-resource states.

Comparing resource industries in the resource-dependent states, the largest changes in output shares occurred in the energy sector. Energy's share of output *dropped* in each period, with declines of three and six percentage points in the last two sub-periods in the energy-dependent states. In contrast, mining had less than a 0.4 percentage-point change in share in the states that have the greatest output shares in that industry. Agriculture and forestry had slightly larger changes, but those changes in shares were less than two percentage points between any two subperiods.

As shown in the table, agriculture, forestry, and mining shares dropped sharply during the 1973–81 period, despite positive price shocks. Combined with the earlier information that showed those states doing far better than average during that period, this suggests that non-resource industries in those states were the most important source of growth—causing the resource share to fall because of the faster growth of the other sectors.

A direct comparison of sectoral growth is given in Table 6. Comparing the first two columns, it is clear that resource industries lagged in contributing to growth. In all cases—for both high- and low-resource-dependent states across all categories of resources—the growth rate of the resource industries was below that of the total state economy.

Comparing the two groups of states, the growth rates of resource industries were relatively similar. Only in the case of forestry states was significantly faster growth registered in the resource sector of the high resource-dependent states.

Non-resource industries in resource-dependent states registered the fastest growth in all cases. Consequently, in an apparent refutation of the Dutch disease hypothesis, the non-resource sectors were the prime beneficiary of the resource price shocks.

This conclusion is strengthened by comparing the growth of non-resource industries that are directly tied to resource production (resource processing industries such as refining, pulp and paper, food processing, and stone, clay, and glass) with that of other industries with less direct ties. As shown in the last two columns of the table, non-processing industries ("other") had faster growth than all processing industries except in the case of forest products.

Results from the table, therefore, suggest that the Dutch disease did not afflict regional economies. Price effects boosted the economy, but those prices did not result in increased specialization in resource production and declining competitiveness of other industries.

Differences in relative factor mobility may help to explain this difference between regional and national economies with respect to susceptibility to Dutch disease. In the international case, factor flows are constrained by restrictions on immigration and capital movements. Consequently, relative price shifts that encourage the movement of factors to support the resource industry take factors away from other domestic sectors.

In the regional case, few limits are imposed on factor movements. Labor and capital can flow to areas with potential opportunities. Consequently, increased output by the resource sector does not need to reduce factors available to other industries, since those factors can be imported from other regions. Costs of living can rise as labor is attracted, but the cost increases, in turn, will stimulate additional factor movement, such as the inflow of building materials for additional housing.

Results in Table 6 also highlight the inelastic nature of natural resource production. Resource industries were unable to expand significantly even when sharp positive price movements gave them incentive to do so. Energy states often could not increase output as prices rose because of binding constraints on availability. In Texas, for example, the sharp run-up in prices in 1979–80 slowed the secular trend towards declining production and proven reserves, but production could not rise. As a result, oil wealth tended to be invested in other industries or regions.

Table 5

Changes in Resource Shares During Sub-Periods, By Resource Dependence
(Weighted Averages)

INDUSTRY	HIGH DEPENDENCE	LOW DEPENDENCE
Agriculture		
1963–1972	−1.726	−0.703
1973–1981	−1.561	0.257
1982–1986	0.061	−0.172
Forestry		
1963–1972	1.325	0.492
1972–1981	−1.615	−0.017
1982–1986	0.033	0.075
Mining		
1963–1972	−0.399	−0.021
1973–1981	0.114	−0.332
1982–1986	−0.251	0.000
Energy		
1963–1972	−0.228	−0.431
1973–1981	−6.070	−0.015
1982–1986	−3.024	−0.224

Changes in resource shares reported in the table are the difference in the weighted average share of each group in that industry between the two years listed.

Table 6

Growth Rates of Resource and Non-Resource Sectors High and Low Resource-Intensive States

(1964–86 Annual Growth Rates)

	ALL INDUSTRIES	RESOURCE	NON-RESOURCE*		
			Total	Other	Processing**
Resources					
High Dependence	3.34	0.97	4.30	4.46	2.41
Low Dependence	2.56	1.06	2.64		
Agriculture					
High Dependence	2.68	0.59	3.01	2.99	3.30
Low Dependence	2.68	1.08	2.88		
Forestry					
High Dependence	2.96	1.72	3.10	3.18	1.94
Low Dependence	2.66	1.02	2.88		
Mining					
High Dependence	4.33	1.44	4.90	5.00	3.06
Low Dependence	2.62	1.03	2.82		
Energy					
High Dependence	3.28	0.77	4.23	4.39	2.37
Low Dependence	2.56	1.10	2.64		

* Separate growth rates for "other" and "processing" industries are not reported for the low resource-dependent states because of the limited processing activity in those states.

** Processing industries comprise industries that typically take raw natural resource materials and refine them into intermediate or final goods. Those used in this study are food and kindred products, pulp and paper, stone, clay, and glass, and petroleum refining.

V. Conclusion

The GSP data suggest several relationships between natural resources and relative economic performance. Overall, the experience of the 1964–86 period indicates that resource states grew more rapidly than non-resource states. This faster growth was accompanied by higher volatility in growth, however.

The faster growth and higher volatility of resource-dependent states reflects, in part, the significant volatility in natural resource prices observed during the period, particularly in the 1970s. Sharp price increases boosted resource-dependent economies by providing increased investment in the economy.

Contrary to the Dutch disease, price increases in natural resource industries boosted non-resource industries. Resource industries showed little ability to expand output in the wake of favorable price movements and increases in wealth. These increases in wealth, instead, were invested in non-resource industries. Thus, in the states with large resource industries, these non-resource industries expanded most when positive resource price shocks occurred.

Having a large resource sector, therefore, can be beneficial to a region's growth *when* the industry experiences positive price shocks. If prices fall or remain unchanged, the slow growth (or actual decline) in resource industry output can slow the relative growth of resource-dependent states.

This observation suggests an important area for further study. Why does the additional wealth generated by resource price shocks remain within a resource-dependent region and boost local non-resource industries when investment in such industries outside the region is possible as well? Most theories would argue that non-resource industries in a resource-dependent economy would be harmed, as suggested by the Dutch disease, or at least unaffected in a world of freely-flowing capital. The answer to this question may be associated with the information cost arguments discussed earlier, but a full explanation remains to be uncovered.

Finally, differential effects across states may diminish over time. As noted in this study, resource industries have become less dominant in nearly all states. Output shares have fallen sharply, especially in the resource-dependent states, which should make future regional differences in growth less attributable to natural resource price movements.

NOTES

1. For a discussion of the BEA GSP data, see Giese (1989).

2. The data in the table correspond to shares of national *output,* rather than shares of national *reserves* of those resources. Output and reserves tend to be correlated, but particularly in the case of minerals and energy, there may be some differences in the magnitude of the shares based on the length of time the resource has been extracted.

3. The GSP data do not break forestry separately from the industry data. Instead, BEA reports a total for forestry, fisheries, and agricultural services—an aggregation that is not appropriate for this study. Because nearly all employment in forestry is in the durable goods category "lumber and wood products," that category is used as a proxy for the contribution of forestry to output. Although this procedure understates the role of forestry, it is representative of that impact.

4. Often, characterizations of resource industry importance magnify the effect of the industry by counting the employment of all persons in some way connected to resource processing—some figures for agriculture range as high as 25 percent of the economy. Such a claim would be valid only if (1) those services and production were *not* performed if the state did not have resource production—including retail sales of food—*and* (2) those inputs tied up in the resource chain otherwise would be unemployed.

5. This low initial cost is not always the case, of course, as evidenced by the high cost of developing Alaska's oil fields.

6. This advantage is not limited to developing countries. The Soviet Union, for example, earns much of its hard currency to purchase machinery and supplies from sales of gold and oil to the Western countries.

7. GSP statistics and information used in this article are expressed in real terms unless otherwise noted.

8. Growth rates were estimated by regressing the log of total real GSP on a constant and a time trend for each state. Coefficients on the time trend indicate the growth rate, while the root mean square error from the estimation is used to measure the variance. Averages for the high and low groups are weighted by size of GSP.

9. Evidence on real oil prices is presented by Schmidt (1988). As shown in that article, real oil prices have been trendless over the past 115 years, although prices have tended to be volatile. The price spikes in the 1970s, however, were clear outliers, with unusually large deviations from the historical average.

10. The significance of the coefficients supports the inclusion of resource shares in models of regional performance. See Sherwood-Call (1988) for related work that incorporates farm and oil variables into models explaining deviations of state growth from national performance.

11. Prices for the resources were selected from several sources. Lumber and oil prices are based on the wholesale price indexes for lumber and crude oil, respectively. Agricultural prices are based on the series, "Prices Received," published by the U.S. Department of Agriculture. Mineral prices are the weighted average of iron, copper, lead, and zinc prices (using fixed consumption weights derived from average consumption over the period). In all cases, the prices are deflated by the general wholesale price index.

12. This is particularly true in the case of energy. In the other resource industries, although no trend growth in prices was noted, price increases (the percentage increase) were larger in the positive direction than in the negative direction—that is, price declines were more gradual. Since the price variables were formed using annual percentage changes, the positive price movements helped to explain the better-than-average performance of the resource states.

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