

Natural Resources and Economic Outcomes

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1. Introduction

Why do some countries grow and others do not? This is one of the most important questions that economists face. Literally thousands of papers have been published on this topic. And it is of enormous policy significance, because the current understanding of the answer to this question affects the behavior of a variety of organizations including the World Bank, the International Monetary Fund, the Inter-American Development Bank and the Gates Foundation.

Economists have recently begun to recognize that growth may well be path dependent. Thus, for policy purposes, it is not enough to understand the current state of economic development. One needs to understand the historical evolution of the economy or economies in question. Only then can appropriate policies be formulated.

During the 1980s there were widespread concerns regarding declining United States industrial competitiveness in the world economy. In response, in his 1990 paper in the American Economic Review Gavin Wright sought to understand the basis for American industrial success prior to 1940. In a later paper (1992) with Richard Nelson in the Journal of Economic Literature, he would examine the postwar period as well. Strikingly, Gavin's 1990 paper tackled a question that economists and economic historians thought they already knew the answer to. Economists tended to assume that American advantage had always been technological. Among economic historians, some of whom had thought more carefully about the issue, the conventional wisdom was slightly more nuanced. The build out of the transportation network during the nineteenth century in the United States allowed the creation of a single national market. This single national market then enabled the rise of large-scale manufacturing enterprises. And that these enterprises were the origin of American industrial success, both nationally and internationally. Gavin showed that the conventional wisdom missed an important part of the

story. He found that “the most distinctive characteristic of U.S. manufacturing was intensity in nonreproducible natural resources.”¹ Technology was certainly important, but it was a technology build on national markets and natural resources.

In Wright (1990), Gavin also addressed a second issue: “whether resource abundance reflected geological endowment or greater exploitation of geological potential.” He argued that “it was mainly the latter.”² The 1990 paper set the stage for two quite different later papers, David and Wright (1997) and Clay and Wright (2005). Although the focus and methodologies were quite different, each examined the institutions that supported this greater exploitation.

This new interpretation of American pre-war economic success as being based on natural resources would shortly come into apparent conflict a new literature that grew out of Jeffrey Sachs and Andrew Warner’s 1995 NBER Working Paper. Both Wright (1990) and Sachs and Warner (1995) explicitly examined exports. Drawing on data from 97 countries, Sachs and Warner demonstrated that during the 1970s and 1980s “economies with abundant natural resources have tended to grow less rapidly than natural-resource-scarce economies.”³ The subsequent literature has further documented this regularity and begun to explore its origins. As we will discuss in more detail later, some scholars have found that the empirical regularity is sensitive to how natural resources are measured.

If we step back, a broad interpretation of Wright (1990) and the later literature on resource curses suggests that they are not necessarily inconsistent. Suppose countries with good institutions were the first to develop their natural resources. The United States and England would be good examples of these early countries. Other countries developed the necessary infrastructure later and began to exploit their natural resources in the early part of the twentieth

¹ Wright (1990), p. 651.

² Wright (1990), p. 651.

³ Sachs and Warner (1995), abstract.

century. Following World War II markets became less national and more international. Thus the discovery and development of natural resources became less dependent on country-specific infrastructure. For example, multinational corporations could effectively develop resources in countries even if they had weak institutions. Certainly by the 1970s and 1980s, the countries with the largest as yet undeveloped resources were also the countries with the weakest institutions. Thus, a coherent story can be told that integrates these apparently disparate results.

To return to the question that we began with – Why do some countries grow and others do not? –much more work remains to be done to understand the role of natural resources in economic growth. Drawing on a wide variety of contemporary and historical cases, Wright and Czelusta (2004) tried to begin the process of drawing lessons from success and failure. The goal was to answer the question: Under what conditions can natural resources be beneficial? This general approach is positive and stands in contrast to the nihilistic tone of the resource curse literature.

The remainder of this paper is organized as follows. In section 2, we discuss how Wright (1990) and Nelson and Wright (1992) re-shaped our understanding of American industrial growth over the nineteenth and twentieth centuries. In section 3, we consider the contributions of David and Wright (1997) and Clay and Wright (2005) to our understanding of how the United States successfully exploited its mineral resources. In section 4, we discuss the literature on natural resources and growth, including the contribution of Wright and Czelusta (2004). In section 5, we briefly conclude.

2. American Industrial Growth

What was the source of American industrial success during 1879-1940? This is a dauntingly large question for a book, much less for a paper. Yet, Gavin skillfully brought together the findings of a large historical literature and new empirical results to convincingly argue that natural resources played a key role in American success.

Gavin started by setting the scene. American exports burst onto the international scene in 1890s. Most American exports were producer goods, which dominated European goods in their quality and technical specifications. Although success was the culmination of a long historical process, American export growth was not particularly visible. That changed in the 1890s, when United States became the largest producer of world industrial output. Europeans noticed and were suddenly concerned. Yet American industrial success continued to grow. Shortly before 1913, the United States became the largest producer of industrial output per capita. It would maintain dominance in both categories into the 1950s.

He then sought to understand the characteristics of U.S. exports into world markets. To do this, Gavin brought together data from Mary Locke Eysenbach's dissertation and newly collected data to study 165 manufacturing industries at six times between 1879 and 1940. For imports and exports, Gavin computed absolute and relative capital-labor ratios, measures of skill intensity, and measures of the intensity of use of nonrenewable natural resources. Throughout, the comparison group was U.S. imports. He found that the United States was exporting relatively more capital intensive and skill intensive goods than it was importing. The differences, however, were generally modest.

For natural resources, however, the story was quite different. United States exports were much more natural resource intensive than its imports. Table 1 shows that the relative resource intensity was high and generally rising from 1879-1914. For example in 1914, the peak year for

resource intensity, manufacturing exports were 7.4 times more natural resource intensive than imports in direct use and 2.4 times more intensive in direct and indirect use. In comparison, capital-labor ratios for exports were 1.8 times higher than for imports, and skill intensity for exports as measured by average wages was 1.2 times higher than for imports. The natural resource intensity of exports relative to imports was lower in 1928 than it had been in 1914 and had fallen dramatically by 1940. This basic pattern holds up in a regression framework, where net exports are regressed on the capital labor ratio, natural resource intensity, and a measure of skill intensity for each of the six periods. The result is strengthened when the capital labor ratio is interacted with natural resource intensity. This suggests that over the period up to 1928, capital and natural resources were complements in production.

Gavin linked the rise in natural resource intensity back to American success in world export markets. “This trend [in natural resource intensity] was growing both absolutely and relatively over *precisely the historical period when the country was moving into a position of world industrial preeminence.*”⁴

Gavin next asked how important natural resources were really were for American industrial success, given that many factors contribute to success. The answer would seem to be that natural resources were important. Despite contemporary concerns regarding resource exhaustion, input prices in the United States were falling – not rising – following the Civil War. As we will discuss in more detail in the next section, falling prices reflected more intensive and efficient search for new deposits, greater efficiency in extraction of existing deposits, and falling costs of transportation. The United States dominated world production of nearly all economically important minerals. These minerals were important inputs into mass production. For example, cheap steel was increasingly important as an export, both in its own right and as an input into

⁴ Wright (1990), p. 658. (Emphasis in original.)

machinery and automobiles. In Table 2, we see that by 1913 steel, machinery, and automobiles accounted for 28 percent of American exports. Adding in petroleum products lifted the total to 38 percent of exports in 1913. By 1929, steel, machinery, automobiles, and petroleum products accounted for 51 percent of American exports. Doug Irwin in his 2003 paper in Review of Economics and Statistics linked the surge in American exports in iron, steel, machinery, automobiles to the commercial exploitation of the Mesabi iron ore range. The availability of Mesabi ore caused domestic ore prices to fall by 50 percent. This, in turn, made American exports increasingly competitive in the world market.

American resource abundance eventually diminished, not because of a scarcity of natural resources domestically, but because natural resources were discovered and developed elsewhere in the world. As Gavin concluded, “The country has not become “resource poor” relative to others, but the unification of world commodity markets (through transportation cost reductions and elimination of trade barriers) has largely cut the link between domestic resources and domestic industries.”⁵

American industrial success during the post-World War II era built on the earlier natural-resource based success. Technology, fostered during the earlier era and boosted by the war itself, helped maintain American leadership. The initial absence of rivals, most of whom were significantly impaired by the war, helped. Eventually they recovered, eroding the American lead.

To address the broad question of why American technological leadership had faltered by the late 1980s, in their 1992 paper Richard Nelson and Gavin Wright asked what the sources of this leadership had been. They recapitulated the main themes from Wright (1990) – strength in mass production prior to World War II “grew out of unique conditions of resource abundance and

⁵ Wright (1990), p. 665.

large market size.”⁶ They then argued that a second, largely post-war, technological lead in high technology industries stemmed from “investments in higher education and in research and development, far surpassing the levels of other countries at that time.”⁷ Erosion of the first technological lead came with falling trade barriers after World War II. Markets transformed from national to transnational, which gave other countries access to resources and markets. Erosion of the second technological lead came as other countries made huge investments in higher education and research and development.

These two papers represented a huge increase in our understanding of the development of American industrial success. Despite the large amount of work on American industrial success that preceded Wright (1990) and the work that has followed, there is still a lot that we do not understand about the American experience. One could easily write an entire book that combined a synthesis of existing work with new empirical work to understand different dimensions of American economic success, including industrial success, for the earlier pre-war period, 1879-1940. For example, one would want to examine developments in natural resources, labor, physical capital, capital markets, the organization of production, and technology in an integrated way. One might want to also investigate changes in the legal and political environments at the state and federal levels to better understand what effect, if any, they had on American economic success.

3. Successful Exploitation of Natural Resources

An important question received limited attention in the previous two papers: Why was the United States able to exploit its geological potential at an earlier point in history than many other

⁶ Nelson and Wright (1992), p. 1960.

⁷ Nelson and Wright (1992), p. 1960.

nations? In their 1997 paper in Industrial and Corporate Change, Paul David and Gavin Wright addressed this question directly. They identified a number of factors that enabled rapid exploitation including incentives, public knowledge as embodied in geological surveys, mining education, and an ethos of exploration. In our 2005 paper, Gavin and I further explored incentives in the context of the California gold rush. I will discuss public knowledge, mining education, and the ethos of exploration, and then return to the issue of incentives.

Public Knowledge

The section on geological surveys and public knowledge infrastructure is fascinating and begs for further work by other scholars. Paul and Gavin briefly mention state surveys, highlighting the Michigan state survey of the copper region that led to federal purchase of the land from the Chippewas and federal survey, before moving on to discuss other federal surveys and the formation of the United States Geological Survey in 1879. Their discussion raises a number of questions: For publicly provided surveys, who supported and helped extract funding for the surveys? Was the United States more willing than other countries to invest in publicly provided surveys? And if so, what explains the greater willingness of the United States?

Whole papers could probably be written on state surveys alone. Hendrickson (1961) has an intriguing discussion of state geological surveys beginning with surveys that Stephen Van Rensselaer commissioned for of his land (1821) and the route of the Erie Canal (1824). Hendrickson finds: “In some states- Maryland, Connecticut, Virginia, Georgia, Indiana, North Carolina, South Carolina and Massachusetts- there was a close tie between the demand for systems of internal improvements and the authorization of geological surveys. In all states a major purpose was to locate, describe, and publicize such natural resources as salt and mineral

springs, building stones, shales, clays, slates, coal, and ores."⁸ In a 2006 working paper, David Prentice discusses the importance of state geological surveys for the American cement industry.

The ties between internal improvement and geological surveys are noteworthy, because they link the build out of the transportation infrastructure, the creation of the national market, and the development of natural resources. This occurred both at the state and at the national level. Following a Congressional appropriation in 1853 of \$150,000 for surveys to determine the best route from the Mississippi to the Pacific Ocean, the Corps of Topographical Engineers examined four potential routes and collected considerable scientific information. As Paul and Gavin noted, federal exploration was also linked to the transportation infrastructure in the Geological Exploration of the Fortieth Parallel (the route of the Pacific railroad).

Although largely dismissed by oilmen, the geological surveys would gain sudden acceptance following the discovery of oil in Oklahoma in the Cushing Field in 1911. Knowles (1959) linked the success of public investment through the geological survey to new private investment in knowledge. The Cushing Field was a key turning point, because it demonstrated what a few geologists had already believed. Oil was associated with anticlines. And in the west, locating the anticlines was a key to discovering new oil. Knowles writes: "The majority of discoveries during the next fifteen years resulted from the industry's sudden acceptance of petroleum geology as a science. ... Most of the large companies established permanent geological departments. Universities began to offer four-year petroleum-geology courses."⁹

Education

⁸ Hendrickson (1961), p. 361.

⁹ Knowles (1959), p. 149.

As the oil example illustrates, American universities quickly saw the utility of establishing mining courses. Sometimes their actions were prompted by rich donors who had made their money in mining while others were prompted by state legislatures or responsiveness to state needs. Columbia University was dominant, graduating nearly half of the mining engineers trained prior to 1892. Many other schools established departments of mining or metallurgy. And many civil and mechanical engineers received some training in mining through coursework at their university. Unlike some foreign universities, American universities emphasized practical training. American responsiveness to market conditions and the desirability of their end product also led to the export of American trained engineers to oversee mining operations abroad.

The conditions that led universities to respond to the need for mining education warrant further exploration in their own right. Indeed, universities' responsiveness to business-oriented education and the degree to which this supported industrialization is another area that begs for more attention. Why were American universities so responsive to the need to train mining engineers? Were they equally responsive to the need to train other skilled workers who played important roles in industrial success? Were American universities more willing than universities in other countries to respond to business needs by creating or expanding programs to train skilled workers? And if so, why were they more responsive?

Many scholars discuss the education of workers often focusing on increases in the number years of education. But as Gavin pointed out in Wright (1990), most of the workers in the manufacturing sector were foreign born and thus likely to have had limited education. What likely mattered more for American industrialization was the relatively sophisticated practical education that many American universities offered in areas such as accounting, business, chemistry, metallurgy, civil and mechanical engineering. Although the numbers of students

involved were small in absolute terms, their impact was large. They entered at comparatively high levels, managing, designing and improving manufacturing processes. It is worth noting that an analogous contemporary discussion has arisen regarding community colleges' responsiveness to local business needs. Of course, now the focus is on educating workers.

Ethos of Exploration

Paul and Gavin discussed the American ethos of exploration and contrasted it with British and Australian cases. They linked the differences largely to differences in beliefs. Americans believed that minerals were there, while the British, and to a greater extent the Australians, did not believe that minerals were there. One reason the British spent 70,000 pounds per year prior to World War II on its geological survey to the American 1,000,000 pounds might have been different views on public-private expenditure. British mining companies were now large, extremely profitable multinational corporations. Faced with the expense of maintaining the empire, the British may have assumed, perhaps incorrectly, that private expenditures would suffice.

The reliance on beliefs is somewhat unsatisfactory, because it begs the question of where they came from. Clearly beliefs were not everything, since the United States was rather late to establish a geological survey (1879). The British Geological Survey was founded in 1835. Canada established a geological survey in the 1841. India established a geological survey in 1851. Australia established a geological survey in 1868. Certainly all of these governments expected to benefit from the results of these surveys, yet the United States was somehow uniquely successful in leveraging surveys and other information into natural resource development and industrialization. A broader and more detailed comparative study of the ethos

of exploration could help us better understand why the United States experience differed from that of other countries.

Perhaps American success was the result of manifest destiny or the American can-do attitude. But at least part of the explanation may lie in federal ownership of the public domain. Legislation to establish the U.S. Geological Survey identified its mission as “classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain.”¹⁰ The wording may have come from Congressman A.S. Hewitt of New York, who had spoken “most eloquently about the value of the study of mineral resources to the future development and prosperity of the Nation.”¹¹ Hewitt was not entirely disinterested. He had made a fortune in iron and steel.¹² To the extent that one goal was to maximize federal revenue from the public domain – a goal that was never realized – investment in geological surveying made perfect sense.

Incentives

The discussion of incentives in David and Wright (1997) makes an important point. Rules and incentives should not be thought of as coming from federal and state governments. They largely emerged from the parties on the ground and were codified ex post by Congress or legislatures. Moreover, miners and oilmen often became effective lobbyists, shaping the rules and incentives that governed them. Paul and Gavin conclude “laws did not function as an exogenously defined incentive system, but as flexible and tolerant instruments, responsive to the changing demands of the mineral industries. State courts and legislatures did not merely define legal rules to encourage the release of private entrepreneurial energies. Instead, they actively

¹⁰ Quoted in Rabbit (1989).

¹¹ Rabbit (1989).

¹² Cloud (1980)

encouraged development ... Behind these measures lay a broad local, state and federal consensus on the desirability of mineral development.”¹³ This quote raises a number of questions: How did political economy shape state and federal behavior towards mineral resources? Did the political economy play out differently in the United States than in other countries? If so, why did it play out differently?

Mark Kanazawa has an interesting recent paper (Kanazawa 2008) showing the extent to which mining interests captured the California state legislature by the early to mid-1850s. They used their power to shift the bulk of the burden of taxation to agricultural interests. Some of the problem was not political. The federal government nominally owned most of the land on which mining was occurring. And federal ownership precluded taxation of the land. However, mining interests exacerbated the problem in 1857 by successfully lobbying for the exemption of mining claims and mining machinery from property taxes. Kanazawa finds “The property tax exemptions secured by miners in 1857 were part of an interesting and in some ways quite telling, larger progression in the tax treatment of mining claims and machinery during the Gold Rush. Placed within this context, the 1857 mining exemptions represented the height of tax liberality with regard to miners throughout the entire period from 1849 to 1865.”¹⁴

One question this raises is: Why was the United States system so much more flexible – or perhaps open to capture – with respect to incentives than systems in other countries? Had other countries long since been captured by other interests, such as agriculture? Were colonies less open to capture? How does this literature fit together with the institutional literature that suggests that elites in some colonies engaged in extraction of natural resources? Were some

¹³ David and Wright (1995 manuscript version), p. 13.

¹⁴ Kanazawa (2008), p. 18 of manuscript version.

American states more open to capture than others? What factors determined the extent of capture? Some work has been done on the American states. For example, Paul Brace examines some case studies of capture in his 1993 book State Government and Economic Performance. But much more work remains to be done.

In our 2005 paper in Explorations in Economic History, Gavin and I used the California gold rush as a case study to better understand how property rights in mineral bearing land operated in practice. Many mining camp rules that emerged during the California gold rush were later codified by the federal government in the Mining Laws of 1866 and 1872. Thus, understanding the rules and their operation in practice is important for understanding incentives.

One of the key questions was: How secure were property rights? Since investment is related to the security of property rights, security has implications both for understanding the early stage of mining – which focused on placer mining – and later stages of mining – which focused on quartz mining. During the placer mining phase, levels of investment were generally low. Men progressed from panning for gold to more involved methods such as long toms and cradles. Long toms and cradles required some investment, but the investment could be protected by having one of the miners on site most of the time.

As we documented in our paper, property rights were insecure if miners were absent from their claims for extended periods of time. This often happened if miners left to prospect for gold elsewhere. Claim jumping – seizing of a claim that was not currently in production – was a perennial issue. As population rose – and it rose extremely rapidly throughout 1849 and 1850 – newly arrived miners wanted to mine these claims. Strikingly, claim jumping was institutionalized in mining district constitutions through requirements on how claims must be marked, how many claims could be held, and how often the claim had to be worked for the use

right to be maintained. Exceptions were often made for sickness and lack of water. However, to a first approximation, if the marking and work requirements were not met, others could begin mining the land. Conflict was inevitable, since newcomers often seized a claim first and asked questions later. Previous occupiers, having not met the work requirements, would also sometimes return and try to assert their claim by force. An unattractive variant on this was Americans simply using force to drive Mexican, Chinese, or other foreign-born miners off valuable claims.

Insecurity arose for somewhat different reasons also in riskier, larger scale projects. Damming and river turning projects were common, because they allowed direct access to placer gold in the river bottom. Here, one set of risks arose from the fact that other groups upstream or downstream would engage in similar projects, rendering the existing project infeasible. There was sometimes collateral damage for nearby placer claims, which were either flooded or lost access to customary sources of water. A second set of risks emerged from weather and engineering. Poor weather, particularly excessive rainfall, could sweep away partially completed projects or prevent their completion. Even under normal weather conditions, dams and other projects could fail due to poor design.

Quartz regions had their own issues. Claim jumping was less of an issue, because much of the work was done by corporations. But the apex rule and the possessory nature of claims still led to conflict. In her discussion of one of the most famous early quartz companies, the Mariposa Mining Company, Maureen Jung notes that “Like so many early mining companies, it was also plagued by lawsuits. Mariposa’s legal disputes over mineral and water rights spanned a number of years and a variety of succeeding companies.”¹⁵ The conflict was evident more generally in the number of cases reaching the California Supreme Court from 1850 to 1866.

¹⁵ Jung (1999), pp. 63-65.

Most of these cases were brought by large quartz or water companies. Conflict of this type was not confined to California. According to Goldman (1981) in the Comstock, “Between 1860 and 1865, twelve major mining companies were involved in 245 different lawsuits, generating ten million dollars in litigation fees alone.”¹⁶

The surprise is not that property rights were insecure, but that semi-secure property rights emerged in the midst of the chaos. As Richard Zerbe and Leigh Anderson argued in their 2001 Journal of Economic History paper, cultural concepts of fairness led to the establishment of norms that were acceptable to American miners. These norms were often written down in mining district constitutions. The existence of culturally acceptable norms greatly facilitated the operation of the private-order institutions that governed property rights, by guaranteeing that miners would engage in first-party and second-party enforcement of property rights. In this context, first-party enforcement meant that many miners would choose to obey the norms. Second-party enforcement meant that miners would resolve disputes among themselves, through a combination of reference to norms and threats of punishment (usually violence) for violation of the norms.

However, norms in and of themselves were not sufficient to guarantee the successful operation of an institution. Most private-order institutions – including the ones that supported property rights in the gold rush – require the threat of third-party enforcement of property rights. That is, individuals who were not directly involved in the conflict (third parties) need to participate in the punishment in order for incentives to be maintained. Diaries, letters, and other historical accounts from the period offer some examples of third-party enforcement. In some instance, third-party enforcement was simply neighbors helping neighbors. In more complicated disputes, there would be a mining-district meeting or a smaller meeting in which the *alcalde* or

¹⁶ Goldman (1981) citing Spence (1970)

some respected person within the mining district heard the two parties' arguments. Once a decision was made, the parties were expected to abide by the decision. If the loser(s) did not, third-party enforcement would, in principle, ensure compliance. In practice, the assembled miners or *alcalde* might well side with the stronger party, irrespective of the merits of the other party's claims. Or the decision simply might not be enforced. The question is why miners who were not directly involved in the conflict would take costly actions such as taking time away from mining to attend a camp meeting or risking physical injury by helping force recalcitrant miners off of a claim. We argue in the paper that information transmission limited the functioning of third-party enforcement.

Taken together, the combination of public knowledge, education, the ethos of exploration, and incentives proved extremely powerful. The public saw the utility of investing in state geological surveys. And they supported or at least did not impede federal surveys. Individual donors and the public saw the utility of investing in private and public education of mining engineers. Americans believed that minerals were around and so invested in finding them. Incentives were strong in the sense that federal and state governments did little to regulate, tax, or otherwise impeded private exploration and development. And in many cases they supported exploration. The flip side of this is that private-order provided less than complete security of property rights which may have had long run implications for investment.

4. Natural Resources and Growth

In his 1990 paper, Gavin argued that natural resources were a key feature of American industrial success during the late nineteenth and early twentieth centuries. A subsequent literature beginning with Sachs and Warner (1995) has argued that natural resources were actually a curse. While these two papers would seem to be at odds, the difference is more

apparent than real. It is worth remembering that they study different numbers of economies during different time period. Sachs and Warner (1995) examined the empirical effect of high ratios of natural resources to GDP in 1971 on growth between 1971 and 1989 in a sample of 97 countries. In later papers, they explored and refined these results. Their basic empirical relationship is illustrated in Figure 1 (from Sachs and Warner 1997a).¹⁷ Controlling for GDP in 1970, the effect of natural resource exports on growth was always negative, statistically significant and large.

A key question regarding the varied effect of natural resources on growth is: Why? Sachs and Warner evaluated a number of hypotheses: rent seeking and corruption, protectionism, the pricing of tradable and non-tradable goods, and shifts in labor demand from learning by doing sectors. They found limited evidence of natural resources affecting growth through bureaucratic quality. The evidence was stronger for protectionism. In most economies, resource abundance negatively affects the manufacturing sector, which leads to a protectionist response. In a few oil countries, this does not hold. Overall, they found evidence of a U-shaped effect. Other effects were quantitatively small.¹⁸

These results raise questions regarding whether the empirical effect and the possible channels would be similar during other periods and with other samples. For example, it is not clearly what

¹⁷ Their regressions (in Sachs and Warner 1997a) exclude Chad, Gabon, Guyana, and Malaysia that were found to be outliers.

¹⁸ To the extent that resource curses are a feature of the late twentieth and early twenty-first centuries, they need not originate in either institutions or policies. Boyd and Emery (2007) showed that a simple dynamic general equilibrium model of natural resource extraction can generate a resource curse. They write “that in the presence of declining resource prices and lower rates of technological change in the resource sector relative to the rate of technological change in the manufacturing sector, the dynamics of the flow of economic rents yield lower growth rates in per capita incomes for resource intensive economies, while at the same time yielding higher levels of income.” (p. 3) Thus, while their paper does not preclude institutions or policies being important – and they explicitly note this – it does not require their importance to generate a resource curse.

one would find if one replicated the Sachs and Warner analysis for the period 1879 to 1928. This period is when Gavin finds the biggest effect of natural resources on exports.

Mehlum, Moene, and Torvik (2006) studied growth over a longer period 1965-1990 using the sample of 87 countries from Sachs and Warner (1997b). They found that the effect of resources on growth is mediated by institutions. Mehlum, Moene, and Torvik began by examining growth and resources only for countries where resource exports represent more than 10 percent of GDP. These criteria leave them with a data set covering 42 countries. They found that the resource curse only holds for the 21 countries with the worst institutions. In these countries, they argued that rent seeking and production are competing activities. In contrast, in the 21 countries with the best institutions, they argue that rent seeking and production are complementary activities. They then showed that their results hold for the full data set.

Robinson, Torvik, and Verdier (2006) modeled the interaction of natural resource growth with political policies. Based on the model and empirical analysis, they found that institutions were important mediators of the effects of resource booms. Subsequent work by Yang (2008) argued that it was not institutions, but rather policies that affect outcomes. Countries with good institutions can have bad policies and the reverse.

Wright and Czelusta (2004), drawing on a variety of detailed country-level case studies, presented evidence that policies and institutions are critical determinants of how natural resources affect an economy. They began by noting that the measure of resource dependence used by Sachs and Warner (1995) and later scholars was not really a measure of natural resource abundance. It was a measure of export dependency, which may or may not correspond to abundance. They cite the empirical work by Maloney (2002) and Stijns (2005). Brunnschweiler (2008) both surveyed the existing literature and computed new measures of resource

endowments. She showed that endowments were positively related to growth. The basic empirical relationships are illustrated in Figure 2.

Gavin and Jesse then turned to policy. ““Nonrenewables” can be progressively extended through exploration, technological progress, and investments in appropriate knowledge.”¹⁹ They argued that countries with policies that have focused on these dimensions have been successful. Similarly bad policies or institutions can lead to bad outcomes. “Minerals themselves are not to blame for problems of rent-seeking and corruption. Instead, it is largely the manner in which policymakers and businesses view minerals that determines the outcome. If minerals are conceived as fixed stocks, and mineral abundance as a “windfall” unconnected to past investment, then the problem becomes one of divvying up the bounty rather than creating more bounty.”²⁰

Subsequent work by Brunnschweiler and Bulte (2008) explored these themes further. They find “Contrary to the paradoxical result that resource abundant countries tend to invite rent seeking and therefore suffer from worse institutions, we find that countries with certain industrial designs may fail to industrialize – and failing to develop significant non-resource sectors may make them dependent on primary sector extraction.”²¹ Brunnschweiler and Bulte noted that this argument was made by Wright and Czelusta (2004). And that their statistical analysis supported this argument.

I want to advance a slightly different interpretation of the empirical patterns we observe for exports and growth. Suppose countries with good institutions were the first to develop their natural resources. And for these countries, natural resources led to growth. Although some

¹⁹ Wright and Czelusta (2004), p. 35.

²⁰ Wright and Czelusta (2004), p. 36.

²¹ Brunnschweiler and Bulte (2008), p. 250.

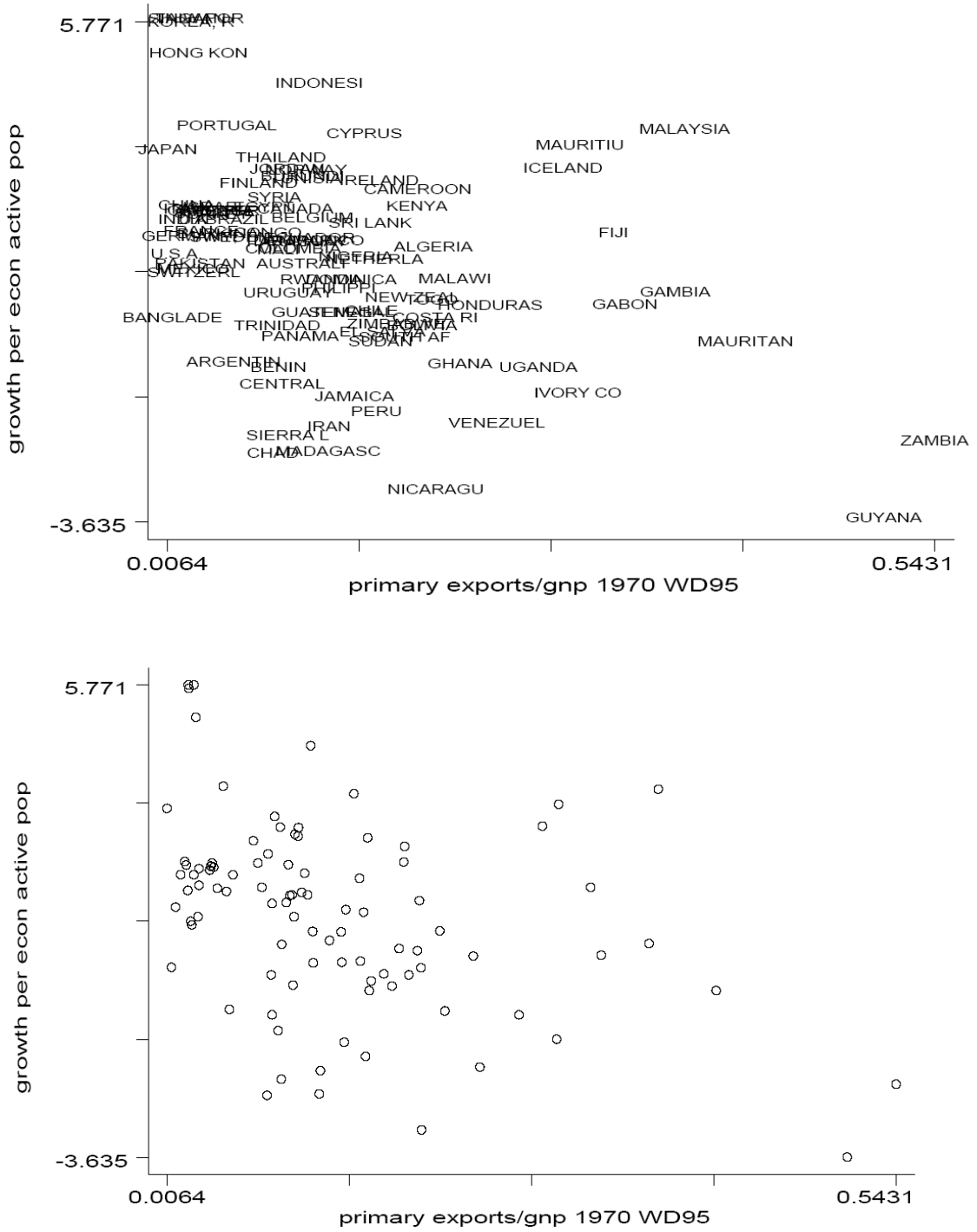
countries may have experienced more success than others for a variety of reasons, the key issue was that natural resources were a complement to manufacturing. One reason was that high transportation costs and limited functioning of world markets made exporting most natural resources without further processing or value added unattractive. Countries without strong institutions and some manufacturing or processing capability simply did not develop their natural resource base. Eventually, particularly after World War II, transportation costs fell and world commodity markets expanded. This made it profitable for many more countries to develop their natural resources, often with the aid of large multinational corporations. But most of the countries with large and relatively untapped natural resource bases were precisely those countries with weak institutions or limited manufacturing or processing capability. To be sure, there were some exceptions. North Sea Oil discoveries in Britain and Norway would certainly be examples. But the vast majority of countries were negatively selected. As Gavin and Jesse note, this did not necessarily doom them. Some countries began to invest in education, technology, and processing. However, many other countries experienced turmoil, because newfound wealth, volatility in world commodity markets, and weak institutions proved to be an unfortunate combination. Hence we observe resource curse.

I end this section by noting the importance of Gavin and Jesse's efforts to draw lessons from success and failure. Under what conditions can natural resources positively or negatively affect growth and income? To the extent that natural resources can positively affect growth and income, which policies yield the highest payoffs? For example, should countries invest in education or infrastructure or manufacturing or institutions? These policy questions have largely been lost in the debate over the resource curse. Yet, understanding the conditions under which natural resources can positively affect growth and income is the main way to move forward.

5. Conclusions

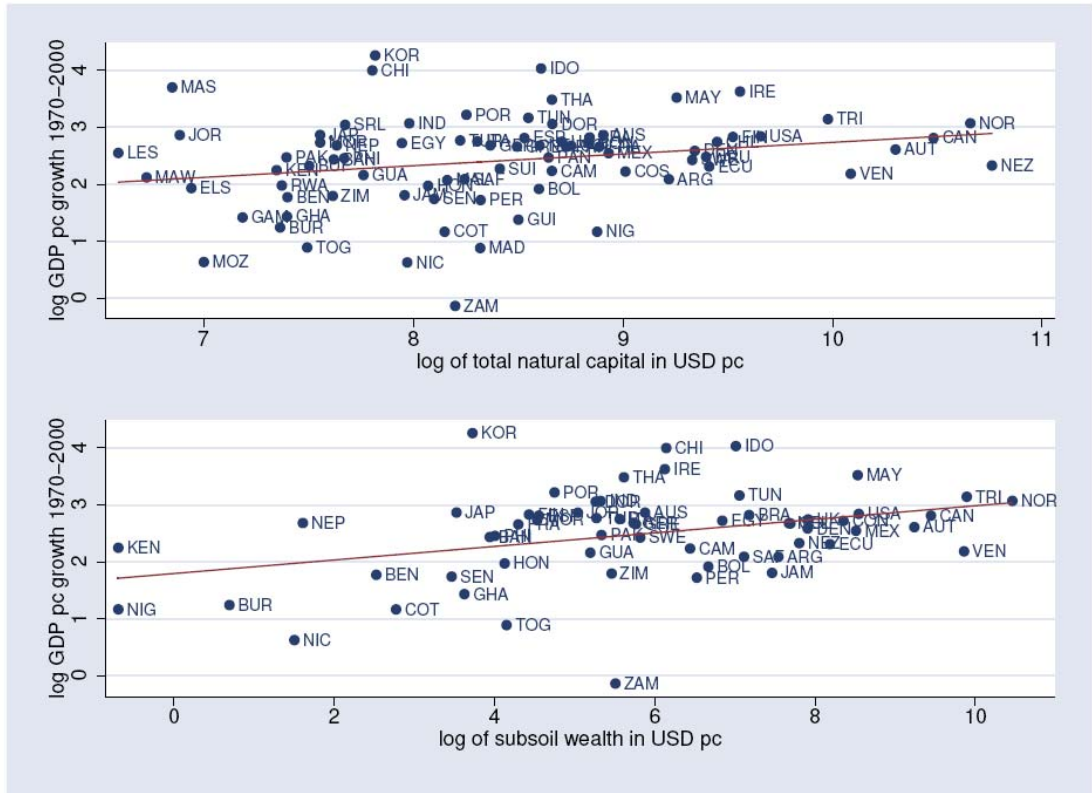
Gavin's American Economic Review paper, together with his Journal of Economic Literature paper with Richard Nelson, fundamentally changed the way economists think about American industrial success. It was no longer a story about technology or about transportation networks, national markets and the rise of large scale manufacturing. Natural resources played a key, if previously overlooked, role in the story. This is indeed a major accomplishment. His later work including David and Wright (1997), Wright and Czelusta (2004) and Clay and Wright (2005) further fleshed out various aspects of the story. Like many topics in economics, in the process of answering one set of questions, this body of work raises many others regarding American success, factors that determine the timing of natural resource development, and the conditions under which natural resources can positively affect growth and income. Scholars will be busy for many years to come.

Figure 1: Natural Resource Exports and Growth



From Sachs and Warner (1997), p. 49.

Figure 2: Natural Resource Abundance and Growth



From Brunnschweiler (2008), p. 4.

Table 1: Nonrenewable Natural Resource Coefficients in Manufacturing Goods
(Table 3 in Wright 1990)

	A. Direct Use					
	1879	1899	1909	1914	1928	1940
Exports	0.0742	0.0677	0.0918	0.0988	0.09984	0.0564
Imports	0.0131	0.0194	0.0170	0.0133	0.0290	0.0369
Exports/Imports	5.66	3.49	5.40	7.43	3.39	1.53
	B. Direct and Indirect Use					
	1879	1899	1909	1914	1928	1940
Exports	0.1107	0.1239	0.1647	0.1800	0.1635	0.1240
Imports	0.0565	0.0747	0.0766	0.0749	0.0934	0.1127
Exports/Imports	1.96	1.66	2.15	2.40	1.75	1.10

Sources: Coefficients from Eysenbach, pp. 297–301; trade figures, see Table 1.

Table 2: Shares of United States Manufacturing Exports, 1879-1929
 (Table 6 in Wright 1990)

	Iron and Steel Products (except Machinery and Vehicles)	Machinery	Automobiles and Parts	SUM (1, 2, 3)	Petroleum Products	SUM (1, 2, 3, 5)
1879	2.1	3.4	–	5.5	12.1	17.6
1889	2.4	6.1	–	8.5	13.3	21.8
1899	7.6	10.7	–	18.3	9.2	27.5
1913	10.9	14.5	2.3	27.7	10.1	37.8
1923	8.8	12.4	6.4	27.6	13.1	40.7
1926	5.6	12.9	11.5	30.0	16.8	46.8
1927	5.1	13.9	13.3	32.3	14.7	47.0
1928	5.3	16.4	15.7	37.5	13.9	51.4
1929	5.4	16.4	15.7	37.5	13.9	51.4

Source: 1879–1923 (1963), Tables A-8 and A-12; 1926–1929, U.S. Department of Commerce, *Foreign Commerce and Navigation of the United States for the Calendar Year 1929*, Vol. 1, Tables XII and XXIV.

References

Boyce, John and J. C. Herbert Emery. 2007. "What Can Exhaustible Resource Theory Tell Us about Per Capita Income Growth and Levels in Resource Abundant Economies?" Working Paper.

Brace, Paul. 1993. State Government and Economic Performance. Baltimore: The Johns Hopkins University Press.

Brunnschweiler, Christa and Erwin Bulte. 2008. "The Resource Curve Revisited and Revised: A Tale of Paradoxes and Red Herrings." Journal of Environmental Economics and Management, 55: 248-264.

Clay, Karen and Gavin Wright. 2005. "Order without law? Property rights during the California gold rush," Explorations in Economic History, vol. 42(2), pages 155-183, April.

Cloud, Preston. "The Improbable Bureaucracy: The United States Geological Survey, 1879-1979." Proceedings of the American Philosophical Society, Vol. 124, No. 3 (Jun. 30, 1980), pp. 155-167.

David, Paul A. and Gavin Wright. 1997. "Increasing Returns and the Genesis of American Resource Abundance," Industrial and Corporate Change, vol. 6(2), pages 203-45, March.

Goldman, Marion. 1981. Gold Diggers and Silver Miners: Prostitution and Social Life on the Comstock Lode. Ann Arbor: University of Michigan.

Hendrickson, Walter B. 1961. "Nineteenth-Century State Geological Surveys: Early Government Support of Science." Isis, Vol. 52, No. 3 (Sep., 1961), pp. 357-371.

Irwin, Douglas. 2003. "Explaining America's Surge in Manufactured Exports, 1880-1913." Review of Economics and Statistics, 85: 364-376.

Jung, Maureen A. 1999. "Capitalism Comes to the Diggings: From Gold-Rush Adventure to Corporate Enterprise." In James J. Rawls and Richard L. Orsi (eds), A Golden State: Mining and Economic Development in Gold Rush California.

Kanazawa, Mark. 2008. "Taxation with (?) Representation: The Political Economy of Public Finance in Antebellum California." Forthcoming December 2008, Research in Economic History.

Knowles, Ruth Sheldon. 1959, 1978. The Greatest Gamblers: The Epic of American Oil Exploration. Norman: University of Oklahoma.

Maloney, William F. 2002. "Missed Opportunities: Innovation and Resource-Based Growth in Latin America." Economia 3: 111-50.

Mehlum, Halvor, Karl Moene, and Ragnar Torvik. 2006. "Institutions and the Resource Curse." The Economic Journal, 116: 1-20.

Nelson, Richard R. and Gavin Wright. 1992. "The Rise and Fall of American Technological Leadership: The Postwar Era in Historical Perspective," Journal of Economic Literature, vol. 30(4):1931-64.

Prentice, David. 2006. "A Re-Examination of the Origins of American Industrial Success." Working Paper.

Robinson, James, Ragnar Torvik, and Thierry Verdier. 2006. "Political Foundations of the Resource Curse." Journal of Development Economics, 79: 447-468.

Rabbitt, Mary. 1989. "The United States Geological Survey: 1879-1989." U.S. Geological Survey Circular 1050.

Sachs, Jeffrey and Andrew Warner. 1995. "Natural Resource Abundance and Economic Growth." NBER Working Paper #5398.

Sachs, Jeffrey and Andrew Warner. 1997a. "Natural Resource Abundance and Economic Growth." CID Working Paper

Sachs, Jeffrey and Andrew Warner. 1997b. "Sources of Slow Growth in African Economies." Journal of African Economies, 6: 335-376.

Stijns, Jean-Philippe C. 2005. "Natural Resource Abundance and Economic Growth Revisited." Resources Policy, 30: 107-130.

Wright, Gavin, 1990. "The Origins of American Industrial Success, 1879-1940," American Economic Review, vol. 80(4), pages 651-68, September.

Wright, Gavin and Jesse Czelusta, 2004. "Why Economies Slow: The Myth of the Resource Curse," Challenge, vol. 47(2), pages 6-38, March.

Yang, Benhua. 2008. "Resource Curse: The Role of Institutions versus Policies." Applied Economics Letters.

Zerbe, Richard O. and C. Leigh Anderson. 2001. "Culture and Fairness in the Development of Institutions in the California Gold Fields." Journal of Economic History. 61: 114-143.