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The Changing Parameters Of Frontier Economic Development

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INTRODUCTION

In our attempt to understand the economies of Alaska and the northern regions of Canada we view these regions from a number of different perspectives. Our view of the region is important, since it determines the regions we use for comparison. It also determines the questions we ask, the assumptions we make, and the way we answer those questions. Our analytical framework, and our policy prescriptions are the result of the perspective from which we view the region.

Two common views the regions of Alaska and northern Canada are, as part of the North or as remote and sparsely settled regions. Both of these are correct and offer insights into the constraints to the development of the region. Using the North as an organizing principle suggests the importance of the physical determinants of development such as weather and the limited productivity of the land. While in the North we find similar climate we find a wide variety of both economic systems and levels of development (Armstrong, et al, 1978).

Emphasizing the remoteness of the region focuses our attention on the location relative to the world's markets and the limited local markets. This view may also emphasize the political and economic dependency of the North's population. The remote region paradigm provides a broader geographical perspective which includes many regions of the world in addition to the north.

This paper suggests an additional perspective to view the development of Alaska and northern Canada. An additional way to examine the development of this region is as a frontier, a region on the edge of development.

This view provides us with a historical as well as a broader geographical perspective for analysis. The frontier perspective may also be useful in other areas of the north, such as the Soviet north. It may also apply to the analysis of more developed Northern regions which, more than likely, were historic frontiers.

The purpose of this paper is to understand the process of settlement and development in frontier regions and to interpret Northern development (or lack of it) in terms of this process. To do this we will focus on the development of the American West and the development of Alaska. Comparison of these two cases will allow us to examine whether or not the development of Alaska is simply a continuation of the process which occured in the West or whether certain important parameters of development have changed.

One reason for this inquiry is the different rate at which Alaska and the West have been settled. Table 1 compares the population growth in Alaska and in states of the frontier West. The western states experienced rapid growth during the early years of settlement. Even if we assume only one tenth of Alaska can be settled, Alaska has taken over 100 years to reach a level of density most states reached in less than 50 years.

The notion that the development process is different is supported by what seemed to have been a change in attitude toward the frontier in the U.S. One example of this is the notion that the American frontier was closed in the late 19th century. In 1890 just over 20 years after Alaska became a U.S. possession the census bureau suggested that the period of frontier development was over (Ellis, 1968). This announced closure pre-ceeded slightly the first major American development boom in Alaska, the

Gold Rush. While the closure of the frontier is much debated by historians it does suggest a change in the process of development after this period.

THE FRONTIER PARADIGM

The dictionary defines the frontier as the region beyond or at the edge of settled territory. While this may be true it does not provide much more than a physical description. We would like the definition to suggest some economic characteristics.

Watkins (1972) in his description of the Staple Theory describes characteristics of the frontier. First, the frontier has a low man to land ratio. The frontier is lightly inhabited and its most important resources are natural resources. The second characteristic of frontier regions is that growth and development are the result of production of some natural resource product. This focuses our view not just on the locational characteristics but also the importance of a natural resource in their development.

Higgins (1972) provides a more general definition of a dynamic frontier. He defines a frontier as a region of net immigration associated with the utilization of new resources and the growth of new industries and urban areas. This definition suggests that the frontier development may occur in previously settled regions. This dynamic view also suggests that frontier resource development is no guarantee for continued growth and economic development. Higgins' definition also emphasizes the role of cities in the development of frontier regions.

In the U.S. the frontier was a region of active, dramatic development. The historic movement west played an important role in U.S. history and in our economic development. Western settlement was a result of resource exploitation; development occurred as a result of this settlement. Using population growth as an indicator of settlement, the rapid settlement can be seen; Tables 2 and 3 show the rate of settlement. Population in the West increased its share of U.S. population rapidly. By 1900 the region that was the frontier West in 1840 contained approximately 70 percent of the U.S. population. During the period 1840 to 1900 the population in the region west of the Plains increased its share of population from close to zero to 24 percent.

Alaska meets the definition of a frontier region. While it may not be the richest resource region measured in terms of resources per acre its large size suggests it will have a number of economic resources (Tussing, 1984). Compared to its relatively small population it can be assumed that the resources per capita is quite large. Historically the growth of the region has come from the exploitation of its resources beginning with the Russian harvest of furs through the development of the petroleum resources at Prudhoe Bay. While growth has occurred in response to resource developments throughout Alaska's history, the developmental consequences of this resource production have been limited. This paper will examine whether the limited development may be a consequence of a change in the parameters of frontier economic development. Because of the limited development effects, Alaska can assumed to still be a frontier region.

A MODEL OF FRONTIER DEVELOPMENT

The development of a frontier region can really be seen as a two part process. First, the region is settled, settlement implies the initial movement into the region and does not mean settlement is permanent. In much of the American West the first settlement was by trappers and traders and settlement was seasonal and a function of the location and abundance of animal resources. While some settlement has historically been a result of noneconomic factors such as religious or political persecution, this paper focuses on the economic determinants of settlement.

Settlement implies no guarantee that a region will be developed. The number of ghost towns in the West and the economic problems of regions which were one prosperous resource producers reinforce this point. The second stage is development itself, the promotion of the long-term growth of the region. Economic development requires some change in the structure of the region which permits or encourages future development. This may suggest two types of policy problems, economic development in the settled and unsettled frontier.

In this section we briefly outline a model of frontier development. This model will treat each stage independently and discuss the relation between them. One purpose of this section is to isolate those factors which are important in the development process. We are interested in how changes in these factors may have changed the pattern of frontier development over time.

Settlement

Economic settlement occurs when the settler can receive a positive return on his effort. This notion of the determinants of production at the edge of development is far from new; the frontier is Ricardo's extensive margin of development. For this to be true the farm gate of wellhead price must be greater than the cost of producing the product. Market price must cover both the cost of production and the cost of transportation to the market.

Evidence suggests that this was an important consideration in the settlement of the west. Lewis (1981) has shown this idea to describe the settlement of the Canadian praires. The movement into the U.S. West and the development of agriculture commodities has been shown to be correlated with the movement of agricultural prices (see Throne, 1964 for an example).

Three factors will affect the feasible region for settlement: The market price of the product; the cost of transportation between the production site and the market; and the cost of production in the frontier region. Each of these factors has changed over time. The rate and pattern of frontier development has been affected by these changes.

The market price net of transport costs will determine the wellhead price. Transport costs have changed as a result of investment and technological innovation; one example was the introduction of the railroads which replaced rivers as transport systems. They will also change as a region's production grows through economies of scale. One other way transport costs changed in the West was the change in the market; with the growth and development of regions in the frontier the market center moved westward. Wellhead price will also be affected by changes in the market price. Since market price is determined by the interaction of supply and demand it will be affected by changes in the determinants of these. One important change is the shift in supply from the introduction of frontier production.

Costs of production depend on the quality and size of the resource, the level of settlement, and transportation costs. The size and quality of the deposit or of the land will determine how much effort is required to produce resource products. Larger deposits may be able to achieve economies of scale. For a given resource deposit the costs of production will be affected by the level of inputs available locally. In an unsettled region all inputs must be imported so the costs of production will depend on the costs of transporting inputs into the region. In addition the level of settlement will determine the available infrastructure, such as housing, which will affect the cost of production (Huskey, 1985).

For many types of resource developments labor costs will be the major cost of production; the alternatives available for labor outside the frontier region will be important in determining the costs. One factor that may affect labor costs are the tastes and preferences of the settlers. Frontier regions may differ in climate, but they are all similar in terms of man made amenities; these are limited. The importance of these to the settler will affect the return required to move into the region. In addition the general preference for risk will affect the rate of settlement. The distance and unknown character of frontiers will increase the level of uncertainty in any venture.

The possibility of a positive return will not guarantee settlement. Limited information about the frontier region may limit development. Certain types of developments may require substantial exploration before development. The requirement for exploration suggests that capital may be another limit to development. A final limit may be government regulation which may restrict the use of certain areas for settlement; government laws and regulations may also increase the cost of production. One example of this may have been the size of the original land grants in the early frontier and on the plains. These were not consistent with either available capital or production technology (Lavender, 1985 and Diamond and Guilfoil, 1973).

Development

The effect of settlement in a region may be simply a short term increase in economic activity. Settlement based on resource production may become uneconomic for either physical or economic reasons. The settlement process may be reversed when the resource on which settlement is based is physically eliminated. Nonrenewable resources can be mined out, and renewable resources may be harvested beyond their ability to regenerate. Natural causes such as drought or disease may eliminate the physical base of settlement. Changes in market conditions may also result in the elimination of the basis for settlement. Changes in the demand or the actions of other producers may eliminate a region's comparative advantage. Virginia City is an example of a major settlement where the settlement process was reversed when the resource on which it was based became uneconomic to produce. These changes will result in outmigration from the region unless some replacement resource is found or government transfers can be obtained.

Regional development implies long term growth and a change in the structure of the economy to achieve this. Long term growth does not have to be based on further resource production. Once a region is settled three types of growth can occur. First, growth occurs as more resources are produced; this might include expansion of the initial resource or the development of new types of resources. Secondly, import substituting growth may occur. A frontier region initially produces nothing that it consumes. Once settlement occurs local production of the goods and services used by the new residents and the resource industry will result in an increase in the level of economic activity. One result of the process of import substitution may be the rise of communities which provide these goods over a broader region, the process of central place development. Finally, there is innovation based growth. This type of growth may include new resource development; the use of the initial resource in a new way (i.e. as an input in some production process); or an entirely new activity not linked to resource development. Innovation based growth may have no direct relation to the initial resource development, but instead by based on the human or capital resources attracted to the region.

The model of development on the frontier follows closely one developed by Pred (1966) to describe metropolitan growth in the late 19th century. this model describes development as a circular process repeating the following steps:

1. Expansion of the resource industry
2. Multiplier expansion of support sector
3. New support sector activity enters as thresholds are crossed
4. Expansion of the multiplier effect
5. Development of broader central place activity and broader market
6. Increased contact and interaction results in innovation and invention

These steps on the frontier are not as direct as in a settled place. In a newly settled region thresholds must be crossed prior to any multiplier effect. This is a dynamic process and each step may be going on at the same time.

While the proportional expansion of economic activity is the most familiar effect in regional economics, it is not the most important in frontier development. More important for development are the consequences of expanding markets crossing thresholds and introducing new production. The import substitution which occurs with expanding markets may lower costs since more goods are produced locally. This will have two development consequences. First, it will lower the cost of resource development and expand either the type or quality or resource produced; it may also extend the life of existing resources. A second effect may be to increase the competitive position of one city over another which will increase the central place functions performed in the region.

There is no guarantee that resource development will initiate this process of economic development. The major determinants of the strength of the development process are the way the resource is developed and competition from other market centers. The interaction of these will determine the development consequences of settlement.

Staple theory recognizes that how a resource is developed is important in determining the linkages from resources production to economic development. The production function and the size of the resource determine the size of markets for both inputs and final demand products. The production function also determines how much of the income generated by development stays in the region. It will also determine the qualitative dimension of development; the kind of people brought into the region will affect economic development. The importance of settlers with long term ambitions has been shown by de Silva (1982).

The developmental effects of resource production are also determined by the strength of competition with other areas. The threshold for any activity depends on its production function and the delivered price of the imported product. The delivered price is a function of the transport cost of the product from the nearest rival, the ability for production to achieve economies of scale, and the size of the nearest market. Economies of scale tend to concentrate production and work against frontier development.

Competition has two components in frontier communities. First, frontier towns may compete with each other to be the region's service center. Town competition was an important component of the development of the West (Boorstin, 1965). This competition is based primarily on location and access to transportation facilities. The second type of competition affects the development process more directly; this is the competition with centers from the developed regions over the production of inputs and support sector goods and services. Development on the frontier has to face the initial advantage of the developed region. Initial advantage includes the benefits of economies of scale and the existence of fixed facilities. Each of these may allow the developed city to provide goods and services more cheaply than on the frontier even when transport cost are considered.

Innovation led growth on the frontier is another dimension of development. Innovation occurs in larger places; Pred hypothesizes it is a result of increased contact. Innovation is primarily an urban phenomenon, and this type of growth will occur as frontier cities develop. Increased contact as a transport node may increase the level of innovation.

There is no guarantee that development will follow settlement. One type of policy problem faced by Alaska and other northern regions concerns frontier settlements which have outlived their initial reason for settlement and have found no replacement. The same problems exist when the national government has a settlement policy which attempts to settle regions prior to their becoming feasible regions for development.

Summary

The pattern of change in frontier regions will be importantly/ determined by changes in those factors affecting settlement and development. If these factors have changed significantly over time the pattern of frontier development will also have changed. Two sets of factors are important, those which determine regions of feasible settlement and those which define the extent of economic development. Determinants of settlement are the price of resources at the market; cost of development; government regulation or subsidy; and transport costs from the market. Determinants of the pattern of development are the production function of the resource; cost of producing inputs; and imported price of inputs. On the frontier the process of settlement and development are importantly linked. Not only will the type of economic development reflect the parameters of resource production, but the forces of development can make further resource production profitable.

ALASKAN AND WESTERN FRONTIER DEVELOPMENTS

Alaska has recently experienced rapid growth. Between 1970 and the early 1980s population increased by almost sixty percent while employment and personal income increased by over 100 percent. This growth was a result of the development of oil resources and the spending of state revenues generated by this production. Recent declines in oil prices and the state's ability to create growth have focused attention on questions of economic development. These changes have dampened the recent optimism about the inevitable development of the Alaskan economy. It is useful to view this potential from a historical perspective, and consider the recent growth from this longer term view. The purpose of this section is to examine the pattern of development and see how it differs from development on the Western frontier. Then we will examine possible explanations for the difference in the pattern of development.

Alaska was a relative latecomer to the U.S.: its purchase from Russia in 1867 came almost 20 years after the Mexican Cession in 1848, the previous large acquisition. Only the Hawaiian acquisition in 1898 came after Alaska. Although Americans had exploited Alaska's resources earlier, this marked the beginning of the territory as a place for potential American settlement.

By almost any measure the timing of settlement has been slower than in the West. Over the period 1880 to 1970 population grew at an annual average rate of only 2.5%. If we assume that only 10% of Alaska's land is habitable, it took one hundred years for population to reach a density of 5 people per acre. Table 1 compares this Alaska experience to other frontier state's.

Examining a typical Alaska resource development may explain the differences in the pattern of frontier development. Two major differences are the slower rate of settlement and limited economic development response to these resource production. We briefly examine the Kennecott mine development as typical of Alaska resource development.

In 1900 a copper ore deposit was discovered in Southcentral Alaska as a result of the exploration and road building resulting from the gold rush (see Grauman, 1978). The Kennecott copper mine parallels most resource developments in Alaska. The Kennecott deposit was of extremely high grade, requiring less than 1/24 the ore to get copper as comparable deposits. This find occurred when other high grade copper deposits in the lower 48 were exhausted and only low grade ore in the southwest was being mined.

The high grade of this ore justified the development of an expensive railroad from tidewater to get the ore out. The Copper River and Northwest railroad cost $20 million to build and was a great feat of engineering. This required outside capital and labor brought into the region. The copper ore was shipped outside for processing. In 1938 after 30 years of production the mine was closed. The labor left when the mine closed.

The Kennecott production describes a pattern that is typical in Alaska. Resource developments historically have had the following characteristics:

- High grade resource deposit
- Development of a unitary transport system
- Limited population settlement
- Importance of the world market price
- Use of factors of production imported from out of the state

While all resource developments do not follow this exact pattern, these are general elements of Alaska's historic growth.

CHANGING PARAMETERS OF FRONTIER DEVELOPMENT

In this section we briefly examine how the parameters of frontier development may have changed between the period of frontier development in the West and Alaska. Several overlapping stages of frontier movement have characterized the history of the U.S. We are interested in how parameters of this movement may have changed in the late 19th century or been different for Alaska development.

We examine the determinants of two major outcomes, settlement and development. These determinants are described in our model of development. These have to be taken as initial explanations which will allow further hypothesis development.

Changes in Settlement Factors

1) Change in resource prices and the cost of production. Any decline in resource prices or increase in the cost of producing them will reduce the rate of settlement. Table 4 shows the prices of several resources important in the western movement. Except for cyclical swings the general pattern of movement over the period seems to be a decline in resource prices. Of these only the lumber index rises and this may be because lumber is a produced product.

The decline in resource prices is a direct result of frontier expansion. Brining new resources into production expanded supply reducing the price. In addition changes on the demand side may explain price changes. There are two responses to the high prices required for frontier settlement; in addition to exploiting frontier resources, high prices also bring changes in consumption. High prices may also encourage innovation and invention which reduces the consumption of these resources.

Table 5 shows that over the period the price of labor rose. Real annual earnings rose for farm workers and for nonfarm workers between 1860 and 1900. For many resource developments labor costs are an important component of the costs. The rise in labor costs although compensated somewhat by technological change probably increased the cost of frontier resource production.

If resource prices fell and the cost of production rose the margin to cover transportation and infrastructure development may have declined over the period. As this margin falls frontier projects will become unfeasible. The quality of the resource needed for production must rise; the requirement for bonanza resource development in Alaska is an example of this effect.

2) Changes in Transportation Costs. Transportation costs are really a proxy for all of the transaction costs involved in producing on the frontier. In the West these included not only costs of moving people and goods but also the cost and hardships imposed by frontier life. The difference between the Alaska and Western frontier was not one of increasing costs over time but of a differential effort to reduce transport costs.

Prior to the development of the railroad in the West settlement was constrained to locate on waterways for ease of transportation. During the nineteenth century railroad construction in the US was phenomenal. Between 1832 and 1900 the amount of track build increased 1000 times. Of this a large percent was built in the West. This construction effort was jointly carried out by federal and community subsidy. The federal grants of land are well document. The government also worked to reduce the hazard of settlement through the establishment of frontier military posts.

In Alaska transportation development was less aggressive. Although there were road and communication systems developed during the gold rush, the major transport systems were a series of trails and river ways. The Alaska railroad was one major government improvement.

While the western frontier could be developed with incremental improvements in transportation, Alaska required a major transport effort just to get there. The efforts to develop roads often were met by incredible physical conditions. Because the resource developments were spread out and large distances had to be crossed, the cost of any transport system in Alaska was large. Those transport systems which actually were developed were primarily focused on getting a resource out of the region. The major transport costs require a rich resource to overcome.

3) Population Growth. Two population trends may have affected the different development patterns. The frontier is sometimes described as the safety valve of US population growth. Although this assessment is debated, a slowdown in population growth may explain the different pattern of development. Table 6 shows that the rate of growth of population declined over the period suggesting that the safety valve was less important. Equally important was the change in the location of that population. The US experienced a rapid increase in the level of urbanization over this period.

4) Government Involvement. A government lockup is one explanation of the slow growth of Alaska. While the attitude toward privatizing govern-

ment land seems to have been different, the historical experience in the west shows that government constraints to development were easily overcome when the returns were there.

Changes to Factors Determining Development.

1) Type of Resource Production. Staple theory suggests that different resources because they have different linkages will have different development effects. The primary difference between Alaska and the West is the lack of agricultural development. The importance of the settler in terms of long-term development has been noted in other cases. The long-term commitment to place is important for development. Alaska's resources were developed by populations which were transient in nature either seasonally or because the resource was short lived. The rise and fall of mining towns is a good example of this. Certain industries may require population to be spread out, like fishing and trapping.

2) Scale and Initial Advantage. One of the major changes which occurred in the second half of the nineteenth century was the increased importance of scale economies. This occurs in relation to two trends, the change from merchantile to manufacturing cities and the change from handicrafts to factory production. Pred shows that these changes are responsible for a decline in importance of certain cities which were important in the urban hierarchy of the early 19th century. The effect of these changes is to concentrate urban and production activities. Improvements in transportation, especially the long haul economies for resource transportation and to reinforce the concentration of production in developed centers. Alaska's late entry into the development means it must overcome a great

deal more to cross thresholds for these activities that can achieve significant scale economies.

3) Government Again. The government can affect development not only by its regulation, but also by its ability to subsidize development. Government expenditures on military bases affected both Alaska and the West. One qualitative difference in the way the government affected development is the way it subsidized transportation development. In the West railroad land grants were made to subsidize the cost of development. This provided an active participant in the development process not only did the railroads need the freight buy they needed to sell the land, so they worked to encourage settlement. In Alaska the government provided the railroad which had the same transport service but not the qualitative development incentive.

CONCLUSION

This paper was intended to suggest that the frontier paradigm may be useful in understanding the development of the North. One preliminary hypothesis is that the pattern of development was different not because of location or climate, but because of importance changes in the parameters of frontier development. The evidence shown here was intended as an initial inquiry along these lines.

Table 1

Frontier Settlement

State	Years for Density To Increase From .1 to 5 (Persons/square mile)	Average Yearly Growth Rate
Ohio	10	10.7*
Illinois	30	13.7*
Michigan	40	9.7*
Minnesota	20	17.6**
Iowa	20	9.5**
Kansas	20	11.8**
Nebraska	20	14.7**
California	30	7.7**
North Dakota	40	10.5**
Oregon	60	9.3**
Washington	30	15.5**
Colorado	40	9.1**
Utah	70	9.0**
Idaho	50	8.2***
Wyoming	-	8.1***
Montana	100	8.5***
Alaska[1]	100	2.5

[1] Assumes 1/10 of land is habitable. Growth rate over 100 years.

* 1800-1830
** 1850-1880
*** 1870-1880

Table 2

Population in the West
(% of U.S. Total)

Region	1840	1860	1870	1890	1900	1910
Great Lakes	17.1	22.0	22.9	21.4	21.0	19.8
South Central	17.9	16.5	29.1	25.5	25.1	23.9
Plains	2.5	6.9	9.7	14.2	13.6	12.7
Southwest	-	2.2	2.5	4.4	5.5	6.6
Mountain	-	0.2	0.4	1.4	1.7	2.2
Far West	-	1.4	1.8	3.1	3.2	4.7

Source: Perloff, et al., 1960

Table 3

Density by Region in the West

	1870	1890	1910
Great Lakes	37.3	55.0	74.5
South Central	21.7	30.1	41.2
Plains	7.6	17.5	22.8
Southwest	1.8	4.8	10.7
Mountain	0.3	1.8	3.9
Far West	1.7	4.5	9.9

Source: Perloff, et al., 1960

Table 4

Resource Prices

	Silver	Wheat	Copper	Lead	Forest
1850	276	-	191	120	43
1860	262	235	184	130	46
1870	182	84	121	103	71
1880	207	101	161	108	59
1890	203	95	126	104	62
1900	128	76	143	110	69
1910	100	100	100	100	98

Source: U.S. Bureau of Census. Historical Statistics of the U.S., Colonial Times to 1970. 1975.

Table 5

Labor Costs

	Average Real Earnings Index: Nonfarm	Average Real Monthly Farm Earnings (with board)
1860	$457	$17.18
1870	375	13.27
1880	395	11.96
1890	519	15.22
1900	573	17.27

*(1910 = 100)

Source: U.S. Bureau of Census, 1975.

Table 6

U.S. Population

	Ten Year Growth (Rate) (000,000)	Percent Urban
1840	4.2 (32.6%)	10.5
1850	6.2 (36.3%)	15.0
1860	8.2 (35.2%)	19.7
1870	8.4 (26.7%)	24.8
1880	10.4 (26.1%)	28.0
1890	12.8 (25.4%)	35.0
1900	13 (20.6%)	39.7
1910	16.3 (21.4%)	45.5

Source: U.S. Bureau of Census, 1975.

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