

Facilitating Growth, Coordinating Growth: Municipal Policy, City Planning, and Industrial Development in Prewar Japan

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.01. The Argument (Return to Index)

In prewar Japan, the government's principal contribution to industrial development was facilitating and coordinating private sector investment activity. The primary target of this facilitating and coordinating activity was infrastructure. Manufacturing and marketing received far less attention. This statement is valid for the national ministries, though it more accurately characterizes local governments, whether they represented prefecture, city, or village.

Underlying and shaping the role of local governments in Japanese industrial development are four factors: the historical logic of geographic concentration and core/periphery differentiation under industrialization; the concentration of control over tax revenues in the hands of national ministries; the infrastructure-driven character of modern Japanese economic growth; and path dependence. The first factor is thought to be universal. The remaining three hold for Japan but are not necessarily relevant elsewhere. Let us consider each of these factors in turn.

In the early phase of industrialization, industrial activity and innovation tends to be concentrated in a relatively few locales known as the core of an industrial economy. Typically these sites are geographically close to one another. Often they constitute the backbone of a so-called industrial

belt. Concentration occurs because of scale economies in the domestic distribution of goods, the processing of foreign trade, and the recruitment of labor and capital. Infrastructure supporting industrialization – electrical power generation, telecommunications, transport infrastructure like railroad stations and ports – earns its highest rate of return in central conurbations of industrial belts. Hence, infrastructure investment booms in metropolitan centers of industrial belts. In turn, this stimulates further industrial development and industrial concentration in the belt, creating positive feedback.

Concentration also engenders negative feedback, as the relative price of land soars in the conurbations of industrial belts. In turn, the upward pressure on prices for land drives up the relative level of rent, the cost of living, and wages in these locales. Positive feedback promotes continuing concentration in industrial belts; negative feedback promotes dispersion of factories and industrial activities away from the core, into the periphery. The decided strength of economies of agglomeration tends to hold in check the centripetal forces of dispersion, the seeking out of lower land rents and wages in settlements of the periphery. Hence, sharp polarization of core and periphery in terms of real wages and standards of living accompanies nascent industrialization. The relatively high productivity of labor in the core raises real wages and living standards for those employed in industrial pursuits. Lacking these pursuits, the periphery languishes.

Eventually the negative feedback of concentration promotes dispersion. In addition, the polarization of core and periphery fans the flames of political and social unrest. The hinterland strikes back, voicing its discontent through the political process or through social upheaval. As a result, concentration in the core gives way to a process of diffusion of industrial innovations, and a dispersion of factory production, from the core to the periphery.

During the period between the world wars, Japan moved from the phase of nascent polarization toward an era of extreme polarization. This conditioned the politics of local governments in both core metropolitan areas and in village and town administrations within the periphery.[1]

A second factor conditioning the role of local city governments in prewar Japan was the virtual monopoly exercised by the national government over taxation authority.[2] Because the capacity of prefectures, cities, and towns to amass resources through taxation was extremely limited – they were allowed to collect surtaxes and user fees for certain designated purposes and the great six cities of Japan's nascent industrial belt were allowed to float bond issues – they relied heavily on subventions and subsidies from the coffers of the national ministries. For this reason the freedom of action of local governments was seriously constrained.

A third factor was the crucial role played by infrastructure investment in prewar Japanese industrial development. In a recent book, I argue that economic growth in Japan between 1887 and 1969 was infrastructure-driven.[3] In the course of this eight and a half decades, Japan's

industrial expansion took place through a series of long-swings. In a long-swing, growth surges during an upswing when investment in infrastructure and/or new plant and equipment in manufacturing is buoyant. Upswings took place in 1887-97, when the emphasis was on steam based infrastructure and steam engine using textiles; in 1904-11, when the stress was on energy generating infrastructure, especially on hydroelectric power, and on electrically driven intercity railroads; in 1911-9, when emphasis was on investment in private manufacturing, especially in heavy industry and machinery production; in 1930-8, when emphasis was on airplanes, trucks and buses, and military hardware; and in 1955-69, the so-called Miracle Growth long-swing, when investment in machinery production and the manufacturing of consumer durables drove growth. During each upswing, the expansion of manufacturing capacity was promoted by earlier, or concurrent, investments in infrastructure. For instance, the industrial expansion of the World War I period would not have been as thoroughgoing and sweeping as it was, had it not been for buildup of electrical power generation and domestic transport that took place in the first decade of the 20th century.

A schematic picture of the three prewar long-swings is presented in Table 1. The table provides key points concerning infrastructure, agriculture, manufacturing, energy, trade, and geographical concentration. As is apparent from the notes concerning geography, an industrial belt known as the T_{okaido} developed during the first long-swing. Also apparent from Table 1 is the broad ranging nature of infrastructure buildup in Japan. Capital formation in physical infrastructure was extremely important. Investment in human capital enhancing infrastructure (e.g.: schools, hospitals and medical clinics), and in financial infrastructure (e.g.: central banking, emergence of the great zaibatsu financial cliques) was also crucial.

Most of the capital formation in manufacturing was carried out by the private sector. This is not surprising. What is perhaps surprising is that a great deal of infrastructure buildup was also due to private sector investment: Japan's steam railroad network before nationalization in 1906-8 was built by a combination of national investment and private investment; the intercity electric railroads and the early electrical power generating companies were largely private (they were nationalized in or after 1938); governments took responsibility for constructing and maintained roads and ports, but the private sector participated in these projects.[4] Because government lacked the wherewithal to completely fund the massive investment necessary to buildup infrastructure crucial for industrial growth, and because the nascent zaibatsu were eager to participate in projects that seemed to offer high rates of return on capital, a pattern emerged whereby private and public sectors worked in tandem in constructing much of the transport and energy generating infrastructure in Japan after the 1880s.

The fourth factor is path dependence. Path dependence refers to the importance of the past for shaping the present and future. Societies and economies evolve along distinct paths. For this reason the spawning of hybrids occurs. Innovations imported from abroad and new products or

new marketing approaches are wedded to those inherited from the past. As a result, a new product or new marketing ploy emerges.

An excellent example of path dependence is afforded by the emergence of the T_kaid_ as Japan's industrial belt. Already during bakufu rule, the T_kaid_ was a magnet for innovations in marketing and mercantile activity and for the diffusion of proto-industry (craft production in food products – soy sauce, sake, mikan oranges – and in textiles as exemplified by the fashioning of cotton textiles and silk fabric under the putting out system). Thus, the Japan that was opened up by the West in the 1850s boasted a proto-industrial base (in terms of a populace well versed in marketing and in knowledge of techniques in wood working, weaving, and spinning) that was deeply entrenched within the T_kaid_. Population densities were accordingly high in this region. Here were the great bakufu controlled metropolises of Edo (later Tokyo), Osaka, and Kyoto.

For this reason, during the 1850s and 1860s, foreigners interested in trade and in constructing factories in Japan naturally sought entry into the great conurbations of the T_kaid_. Hence, the natural deepwater ports of Yokohama and Kobe emerged in the aftermath of Japan being pried open for treaty port settlement: Yokohama was near Tokyo, the new capital, and Kobe was in the vicinity of Osaka where many of the high powered merchants of the Tokugawa period resided and carried on their business.

Once established as the center of innovation in adapting Western technology to infrastructure and manufacturing, the T_kaid_ emerged as the industrial belt of modern industrial Japan. Its geographic extent is captured in Map 1. Only in the aftermath of World War II, and especially in the aftermath of the Miracle Growth long-swing (1955-1969), has diffusion of manufacturing and innovation out to the periphery occurred on a major scale. The emergence before industrialization of, and continuing dominance over economic affairs of the T_kaid_ region during industrialization is an excellent example of geographic path dependence.

Underpinning geographic path dependence are environmental and topographic factors. This is best illustrated by comparing the Osaka/Kinai area with the Edo (Tokyo)/Kant_ region. The Kant_ plain serves as the northern axis of the T_kaid_; the Kinai and the Yodo River basin emptying Lake Biwa and the rivers flowing out of Kyoto and Nara, is the southern axis of the T_kaid_. As the reader can glean from Table 2, the ecology of Kant_ and Kinai are radically different. Because of these differences, land was less intensively utilized in Kant_ than in the Kinai during the reign of the bakufu. In the Kinai, the soil was rich. Rainfall being abundant, rice cultivation flourished. In the Kant_, it was far more difficult to extract output from agriculture. Much land was left in forest, reserved for hunting, or was otherwise undeveloped. Hence, when road development assumed critical importance during the first three decades of the 20th century, the Tokyo/Kant_ area had a marked advantage over the Osaka/Kinai region.[5]

It is important to keep these four points – the polarization of core and periphery, the dominance of national ministries in fiscal matters, the infrastructure-driven character of Japanese long-swings, and the impact of path dependence – in mind in assessing the impact of local governments on industrial development in prewar Japan. Local governments found themselves hemmed in: hemmed in by fiscal constraints, hemmed in by the political and social consequences of polarization, hemmed in by the demands placed on them by national ministries and the private sector to facilitate and promote the development of infrastructure within their boundaries, and hemmed in by the legacy of the past, that is by path dependence.

Still, despite being hemmed in, local governments in prewar Japan accomplished a great deal in terms of promoting industrial development. Metropolitan governments were resourceful, and they responded to the challenges that confronted them. Osaka's experience between the Meiji Restoration of 1868 and 1938 provides us with a host of examples of what local governments could and did accomplish during the prewar period.

Before we turn to an accounting of some of Osaka's most salient accomplishments, however, a word is in order concerning the range of policy options available to local governments. This discussion is general, and in principal applies to all local governments regardless of country or administrative structure. The discussion is meant to demonstrate that creativity in promoting industrial development can only be judged in terms of the efforts local governments made in coming up with approaches and policies that they actually could formulate. Some policy instruments and some approaches were simply unavailable to them. Some options were reserved by the national authorities. Thus, in evaluating how resourceful local governments like that of Osaka were in coming up with approaches to promote industrial expansion, we must keep in mind the range of options theoretically open to them.

.02. Options Available to Local Governments (Return to Index)

Governments can and do intervene in economic matters using a variety of modes. These modes are: command and direct control; stabilization through fiscal policy; stabilization through monetary policy; transfer policy that redistributes income and purchasing power; regulation; and coordination. In Table 3 I give examples of these various modes. As can be inferred from the table, national governments have access to a variety of modes unavailable to local governments. For instance, local governments typically cannot use command and direct control (except under specified circumstances like states of emergency), and are usually barred from employing monetary policy. In the Japanese case, local government's ability to use fiscal policy was tightly constrained by regulations governing taxation authority. Tokyo controlled the "purse strings." Japanese local authorities were clearly hemmed in from above.

Japanese local authorities are also hemmed in from below, in this case by the “tyranny” of local groups, neighborhood associations, and the need to secure political consensus. The power of Japan’s local villages and neighborhood groups in cities and towns should never be underestimated. Because securing consensus is so important to decision making in Japan, local groups can exercise considerable authority, especially by vetoing decisions made from above. A celebrated case of this “tyranny of local groups” is the violent confrontation over the construction of Narita International Airport in Chiba prefecture north and west of Tokyo. Farmers in one small locality refused to sell their land to the airport development authority. Politically active groups mobilized support for the farmers. The national authorities finally had to back down. Only after decades has a negotiated settlement of the dispute been worked out.

For these reasons, local governments in Japan have tended to eschew regulatory approaches. Groups adversely affected by sweeping regulations often vociferously voice their opposition – or outright bribe officials in order to stop their promulgation – in order to keep as free a hand as possible in pursuing their own interests. Only when general consensus exists – or is fabricated through bribery or political wheeling and dealing – is regulation a favored remedy in Japan.

Thus, Japan’s local governments have favored the coordination mode. Coordinating the plans and demands of national ministries, neighborhood groups, business federations, manufacturers’ associations, and the like has been the preferred modus operandi of municipal, township and village authorities. Because infrastructure has played a crucial role in Japan’s industrial and economic growth, local governments in Japan have tended to focus on coordinating the demands and resources of national ministries, the business community, and local neighborhood groups in developing infrastructure projects.

Osaka’s history offers a number of examples of this general principle governing the role of local governments in Japan’s industrialization. Let us briefly review some salient illustrations.[6]

.03. Osaka’s Municipal Government as Coordinator and Facilitator, 1868-1938 (Return to Index)

In this section I discuss four examples of prewar Osaka’s initiative in developing infrastructure through coordination: promoting the national government’s construction of a deepwater harbor; working with local zaibatsu, and carrying out direct investment, in order to fashion an electrical railroad/tramway network for the metropolis and its suburbs; facilitating the building of a central wholesale market in the 1930s; and developing research institutes that served the interests of small businesses in the Osaka region. The first project was directly linked to the first long-swing that centered around the use of steam power (although it was not fully completed until 1929); the second was integral to the first upswing of the second long-swing that centered around applications of electrical power; and the third and fourth were characteristic of the downswing of

the second long-swing when government and the market responded to the demands placed upon infrastructure by the second upswing of the second long-swing.

In the very first year of Meiji, Osaka's business and political communities embarked upon a campaign to build a deepwater harbor for Osaka. Osaka Bay is part of the Inland Sea, and the mighty Yodo River that empties many of the rivers of the Kinai, flows into it within the confines of Osaka. Because of the heavy silting on the Yodo and its tributaries, Osaka could not accommodate steamships with deep hulls that began to enter Japanese ports in the late 1950s. Rather, Yokohama near Tokyo, and Kobe near Osaka, emerged as natural deepwater ports for Japan during the first long-swing and the buildup to that swing. Osaka's project was daunting. For to successfully carry it out, the national agencies responsible for port construction had to dredge out the harbor and the Yodo River itself, providing a floodway to siphon off turbulent water flow and a new widened channel to carefully direct the waters spilling down the Yodo during the monsoon rainy season.

Finally, after a major flood wiped out 57,000 houses in Osaka and its immediate environs in 1885, the combined governments of Osaka city (actually the governments of the four wards or ku that were amalgamated to form Osaka City in 1889) and Osaka Prefecture successfully lobbied the national government. In 1897, the national authorities began to build the port, dredging the Yodo River and Osaka Bay, redirecting the flow of the Yodo into Osaka Bay (thereby creating the Shinyodo River and the Kema Floodway), and laying down two massive breakwaters and an huge jetty jutting out at Tempozan. In creating the new harbor, Osaka worked hand and glove with the most powerful zaibatsu based in the Kinai, Sumitomo. Sumitomo built an impressive set of warehouses as part of the project. And Osaka City also invested in the project, building an electrical tramway line in 1903 with two legs: one out to the jetty at Tempozan; the other designed to link Tempozan to two of the other great rivers flowing through Osaka, the Aji and Shirinashi Rivers.

In short, to accommodate steamships, Osaka coordinated the interests and resources of the national government and its own business community. Furthermore, it directly invested its own resources in the project.

Beginning in the early 1900s, the buildup of electrical power generation and the interurban/intracity electric railroad/tramway system fueled the first upswing of the second long-swing. Selling electricity and offering rides on intercity rail lines went hand in hand. Many of the companies that offered one service offered the other. This infrastructure phase paved the way for the second upswing of the second long-swing, which was characterized by the rapid diffusion of electrical motors and the wholesale mechanization of factories large and small.

During this period, Osaka became the hub of a massive railway system binding together all of the major conurbations of the Kinai. And as with port development, Osaka's municipal

coordinated the activities of the national government and of zaibatsu, as well as directly investing in the project. For instance the Japan National Railways offered steam service along the T_kaid_ connecting Tokyo/Yokohama to Nagoya and to Osaka/Kobe. And regional zaibatsu sprang up offering electrical train service between Kobe and Osaka, between Kyoto and Osaka, between Nagoya and Osaka, between Sakai and Osaka, and between Wakayama and Osaka. Thus a number of powerful Kinai based electrical railroad cum electricity supplier cum real estate developer cum department store creator – Hanky_, Hanshin, Kintetsu (originally Osaka Kido), and Nankai – emerged during this epoch. Out of this feverish activity emerged the massive Umeda and Nanba train station/shopping center complexes that anchor the northern and southern axes of downtown Osaka. Osaka City also invested directly in the electrical railway infrastructure. It built an electrical tramway that linked together the great railroad station complexes at Umeda and Nanba, and also tied them to the terminuses of other train lines and to key points along the major rivers flowing through the city's environs.

A third major project, the building of the Central Wholesale Market in Noda ward reveals how Osaka coordinated the interests of small businesses, national government, and consumers. After the Rice Riots of 1918, spurred on by the slowing down of productivity growth in domestic agriculture, the Ministry of Home Affairs became increasingly concerned about providing cheap rice to consumers, especially in the great industrial cum service sector conurbations of the T_kaid_ industrial belt like Osaka. It offered municipalities subsidies for the construction of central wholesale markets, where private vendors got barter and truck over foodstuffs. The aim was to streamline distribution of food. Osaka moved rapidly to set aside land along the Aji River, and was the first city to secure a subsidy from the Ministry of Home Affairs, the funds being released in the mid-1920s.

As the reader can see from Photograph 1, the Osaka Central Wholesale Market at Noda brought together small scale distributors and consumers.[7] Most of the vendors brought their produce, fish, and processed foodstuffs to the market in jinrikisha that they pulled. This kind of project is typical of the infrastructure projects of the 1920s, designed to deal with the growing polarization of countryside and city under dualistic growth. As domestic agriculture/proto-industry atrophied, the national government pursued a two-headed strategy of improving the efficiency of retailing and wholesaling food, and encouraging productivity improvements in Japan's colonies, Korea and Taiwan.

Also typical of the downswing of the 1920s was expansion of the educational system. As the demand for graduates of industrial vocational schools and engineering programs in universities and other institutions of higher learning soared during the manufacturing boom of the 1910s, wages for blue-collar workers and professional managers skyrocketed. Thus, in 1918, the Ministry of Education convened a special commission that recommended sweeping revision and expansion of technical education in Japan. As part of this effort, an Imperial University was built in Osaka (Tokyo enjoyed the status of being home to the first Imperial University in Japan).

Behind Osaka's successful campaign was the economic muscle and the intense lobbying effort of the great chemical, iron, and steel companies of Osaka. The Sumitomo zaibatsu also played a key role in the lobbying campaign. So, again, Osaka was working together with national ministries and powerful companies in creating infrastructure.

As part of the program of expanding educational infrastructure, the national and prefecture governments created research institutes that concentrated on practical technical problems like the making of chemicals and plastics, the production of synthetic textiles, and welding. Responding to the demands of small businesses that were especially prevalent in its environs, Osaka's Municipal government built the Osaka Municipal Technical Research Institute in 1916. Technicians and scientists trained in organic, inorganic, and electrical chemistry staffed this research institute. The institute produced original research, but its main focus was on serving small and medium sized businesses. It responded to requests for diagnosis of factory efficiency, recouping its costs for testing and analysis of individual factory data by charging user fees.

In sum, Osaka played an important role in developing physical and educational infrastructure that laid the groundwork for rapid industrialization. In doing so, it mainly relied upon its plethora of skills and its vast reservoir of information as a coordinating and facilitating agent.

.04. Osaka and Prewar City Planning (Return to Index)

Osaka also made an important contribution to Japanese industrialization through its city planning. But, as with the cases we have already examined, Osaka's primary mode of operation in the city planning field was as a coordinating and facilitating agent.

In terms of the theory of planning, Japan's modern city planning owes a great deal to European precedent.[8] The Ministry of Home Affairs studied European experiments in planning and made recommendations for legislation and administrative fiat.

European precedent was variegated.[9] In England, city planning emerged initially as a public health movement responding to the proliferation of slums and the endless maze of dismal row housing that characterized the great industrial conurbations of the Industrial Revolution like Manchester, Liverpool, and Leeds. In part because it was a movement with a strong social agenda, English city planning had a decided utopian cast to it. For instance, the Garden City movement that emerged at the end of the 19th century in England was quite radical in its approach to counteracting the ills of industrialization and excessive concentration of population in large industrial conurbations. French city planning had a more imperial or authoritarian atmosphere. It sprang from Baron Haussmann's program of creating vast boulevards in Paris in the middle of the 19th century. German city planning, which emphasized strict zoning, had a very strong aesthetic flavor. It is no accident that many cities in Western Europe, especially in

western German, resisted the building of electric tramways to cities within their environs a la American design because the power lines and poles giving motive power and direction to the trams created horrible eyesores.

In principle, city planning in Japan emerged out of importing of Western ideas. For instance, the first formal use of city planning in Japan was in Tokyo, which had special status because it was the capital of the country and, commonly, the domicile of foreign diplomats and professionals. In the case of Tokyo, the French emphasis on sweeping boulevards that facilitated the transport of population and goods was an important factor in drawing up planning approaches.

In practice, European experiments in planning played a relatively small role in the actual implementing of city planning in Japan. There are several reasons for this: the strength of neighborhood groups; the reluctance of local governments to use regulatory approaches like zoning; and the focus on infrastructure for industrial development, as opposed to infrastructure designed to meet the welfare or aesthetic needs of the populace. For this reason aesthetics, zoning, utopian, and authoritarian traditions were of limited importance to the development of Japanese city planning.

After 1919, formal city planning – at first limited to the national capital – was extended to the other great cities of the T_kaid_ including Osaka. As a result, Osaka began to formulate city plans that were forwarded to the Ministry of Home Affairs for review, comment, and eventual approval.

The principal focus of Osaka's city planning during the 1920s and 1930s was the project by project development of transportation infrastructure: rationalizing and extending the rail and tram lines; widening and paving streets so they could accommodate trucks, buses, and cars; and constructing a subway.

In order to meet the exigencies of infrastructure development, and especially the needs of widening streets and expanding road networks, Osaka made extensive use of a technique originally developed for reorganizing paddy fields in rural villages, and exploited by Tokyo in its early experiments in city planning: mobilizing kukaku seiri kumiai (associations for the readjustment of town lots). The city authorities cajoled local neighborhoods to form associations for readjustment of the land held by the members of the association. It encouraged them to apply for subsidies from the Ministry of Home Affairs for carrying out land improvements in the holdings of association members. In this way, the city worked with the associations in allocating privately held land for the widening of publicly managed roads and streets and the laying down of water and sewer lines. The association members benefited because the value of the property they retained, rose. It rose because better water delivery, and better access to customers (in the case of store owners) and better access to public transportation like buses, raised property values.

In short, the Osaka authorities acted as coordinating and facilitating agents, working with the national government on the one hand, and with local neighborhood associations on the other. By contrast, even though Osaka drew up plans calling for strict zoning, it failed to enforce it. For instance, during the 1930s factories proliferated in the Western wards of the city, precisely in those districts that had been set aside for residential housing and services.

.05. Conclusions (Return to Index)

In prewar Japan, local governments made an important contribution to industrialization through their coordination of the activities of national government agencies, of business interests, and of neighborhood associations. Local governments also directly invested their own resources in projects. The main focus of these efforts was the buildup of infrastructure, both physical and human capital enhancing infrastructure.

Osaka's experience between 1868 and 1938 provides an excellent illustration of how creative local Japanese administrations were in their coordinating and facilitating efforts. The revamping of Osaka Harbor, the buildup of the electrical distribution and electrical railway networks, the creation of a central wholesale market, the founding of municipally managed research institutes, and the extensive use of *kukaku seiri kumiai* for improving roads and sanitation, offer excellent examples of Osaka's coordinating and facilitating efforts during the prewar period. Even though they were hemmed in by the administrative structure of modern Japan, and even though they found themselves sandwiched in between recalcitrant neighborhood groups and a fiscally powerful central government, Osaka and the other great cities of *Tokaido* still managed to exert an important influence over the course of Japanese industrialization.

.06. Footnotes (Return to Index)

[1]. For further discussion of this argument, see United Nations Centre for Regional Development (1975).

[2] For the thesis that local governments in Japan are strongly constrained by their lack of authority over taxation, see Steiner (1965).

[3] See Mosk (2001a).

[4] On infrastructure investment in modern Japan, see Mosk (2001a): Chapters 3 and 5, and Nagamine (1981). For a general discussion of the importance of infrastructure investment for economic growth, see Ausbel and Herman (1988) and World Bank. The International Bank for Reconstruction and Development (1994).

[5] For further elaboration of this argument see Mosk (2001a, 2001b). For an extensive discussion of the physical and economic geography of prewar Japan, see Trewartha (1945).

[6] For details see Mosk (2001a).

[7] I am grateful to Mainichi Newspapers Incorporated for the right to use this photograph.

[8] On city and regional planning and city policy making in Japan, see inter alia Bestor (1989); Glickman (1977); Hastings (1995); Honjo (1967, 1971); Mosk (2001a); Murata (1999); Osaka City Government. Planning Bureau. City Planning Department (1997); Shapira, Masser and Edgington (1994); and Tokyo Municipal Government (1978).

[9] For the evolution of city planning in Europe and North America, see Benevelo (1971); Burtenshaw, Bateman, and Ashworth (1981); Cherry (1974); Diederiks, Hohenberg and Wagenaar (1992); Ladd (1990); Osborn and Whittick (1977); Rydin (1993); and Teaford (1984).