This chapter is part of:

The Dynamics of Industrial Location: The Factory, the Firm and the Production System
by Roger Hayter, Department of Geography, Simon Fraser University, Burnaby, 2004
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Or Roger Hayter 1997: The Dynamics of Industrial Location: The Factory, the Firm and the Production System. Chichester: John Wiley and Sons.

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Chapter 5

Factory Location as a Cost Minimizing Exercise

Conventional neoclassical theory explains the location of factories principally in terms of spatial variations in cost structures. The rationale for this view ultimately rests on principles of competition. In neoclassical economic landscapes, competition is the great regulator of economic behaviour, including locational behaviour. If competition is strong and fair, according to neoclassical theory, rational patterns of economic behaviour, whether with respect to price, production, technology or location, will inevitably result as the forces of competition eliminate the weak or incompetent. From this perspective, there is no (or limited) need to examine decision making processes or the internal structures of firms in order to understand general patterns of economic activity. So long as competition exists, the conditions of production and markets impose an economic reality on firms that they cannot ignore if they wish to survive. In the context of location, this economic reality takes the form of spatial cost and revenue structures or surfaces; to survive, firms need to locate where revenues cover or exceed costs.

Put crudely, neoclassical location theory is a form of economic determinism in which economic forces 'dictate' the location of factories (see Table II.1). In essence, neoclassical location theory interprets the firm as an Economic Man or Person (*Homo Economicus*) who has the perfect information and perfect rationality necessary to compute an 'optimal' location in the sense of minimizing costs or maximizing profits. In this formulation, the firm is a 'mental construct' or 'black box' which, acting as if were a superfast computer, analytically and instantaneously links location conditions, as represented by cost and revenue surfaces, to locational outcomes. The presence of competition, preferably 'perfect competition' featuring large numbers of independent suppliers and consumers linked by 'arms length transactions,' ensures that only economically rational outcomes survive. Over time, factories may need to adapt to changing location conditions, or risk failure.

Within geography, neoclassical location theory has been developed along two main lines, namely the 'profit maximizing' (or 'locational interdependence') and 'cost minimizing' schools. Both approaches are based on
Homeus Economicus and both derive ideal patterns of location fundamentally from a consideration of transportation costs and scale economies. Profit maximizing models focus more on transportation costs to (spatially distributed) markets (distribution costs) and incorporate the effects of rival behaviour on location. Cost minimizing models focus more on the transportation costs of (spatially distributed) inputs and incorporate the effects of location conditions on spatial variations in cost structures. Traditionally, but by no means exclusively, profit maximizing models have been applied in the context of personal and retail services while cost minimizing models have evolved primarily with respect to manufacturing. But profit maximizing models can be applied to manufacturing and attempts to synthesize the two approaches have been made (Smith 1971).

Following tradition in the context of the location of manufacturing factories, this chapter emphasizes the cost minimizing version of neoclassical thinking. In particular, the chapter follows the tradition originally rooted in the work of Alfred Weber (1929), a German economist who sought to determine general principles of location. In broad outline, the first part of the chapter outlines the key elements of his cost minimizing or 'least cost' industrial location theory, even more briefly comments on profit maximizing approaches and then notes how locational evolution is treated in neoclassical thinking. The second part of the chapter examines the nature of cost 'structures in selected primary and secondary manufacturing industries and a concluding comment refers to the nature of industrial location policy in a neoclassical landscape. Fuller discussions are provided by Smith (1966, 1971) who also extensively reviews profit maximizing models. As a final point of introduction, it might be noted that 'neoclassical' location theory is derived from neoclassical economics which developed in the late 19th century as an extension of the pioneering 'classical' economists, such as Adam Smith (1986). Thus neoclassical economics emphasized the importance of competition, especially perfect competition and related principles such as free trade, and refined the abstract, deductive approach to theorizing that remains the basis of conventional economics. As neoclassical thinking evolved, however, it tended to become increasingly abstract and increasingly less inclined to recognize political, social and historical context. Thus neoclassical thinking is 'abstract' in at least two ways: first, it emphasizes deductive reasoning and, second, it focusses narrowly on 'purely' economic considerations.
FIRMS AS BLACK BOXES: LANDSCAPE AS SPACE COST (REVENUE) SURFACES

Alfred Weber (1929) wrote his pioneering least cost approach to industrial location at the beginning of the 20th century when manufacturing was dominated by heavy industry in which transportation costs were a significant consideration and the Ruhr one of the world's great industrial districts. Weber considered transportation, classified as procurement and distribution costs, to be the most important general principle of location. In the Weberian approach, the first step is to (deductively) assess the effect of transportation costs on location and then once a minimum transportation cost location is derive, successively and deductively assess the effect of other ('economic') location conditions. For Weber, given the primacy of the general principle of transportation, the two most important regional principles of location are labour and external economies of scale.

The effects of transportation costs on industrial location

According to Weber, if freight rates are assumed to vary linearly with distance, *ceteris paribus*, the effects of transportation costs on industrial location depend upon the nature of the physical characteristics of inputs or raw materials. Weber classified inputs as ubiquitous, pure (which experience no change in physical characteristics during processing) and impure (which experience change in physical characteristics during processing). In this regard, it might be noted that even under highly simplified transportation cost conditions location matters in terms of minimizing costs (Figure 5.1).
Figure 5.1 Simple Weberian Transportation Cost Surfaces

a. Region with one market (M), ubiquitous inputs

b. Linear region with several markets (A-F), ubiquitous inputs

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>15</td>
</tr>
</tbody>
</table>

Optimal location is D (‘median location’)

Kilometres

Notes: Factory location is based on minimizing transportation costs. 4.1b is based on Alonso (1964)

Table 5.1

Types of Input-oriented and Output-oriented Activities

<table>
<thead>
<tr>
<th>Process characteristic</th>
<th>Orientation</th>
<th>Examples*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical weight loss</td>
<td>Input</td>
<td>Smelters; sawmills</td>
</tr>
</tbody>
</table>
Physical weight gain | Output | Soft-drink bottling; manufacture of cement blocks
Bulk loss | Input | Compressing cotton into high-density bales
Bulk gain | Output | Manufacturing containers; sheet-metal work
Perishability loss | Input | Fish processing
Perishability gain | Output | Newspaper (and job) printing; baking bread
Fragility loss | Input | Packing goods for shipment
Fragility gain | Output | Coking of coal
Hazard loss | Input | Deodorizing captured skunks
Hazard gain | Output | Manufacturing explosives; distilling moonshine whiskey

Source: Based on Hoover 1971: 47. Notes: In some of these cases, the actual orientation reflects a combination of two or more of the listed process characteristics. Thus, some kinds of canning and preserving involve important weight and bulk loss as well as reduction of perishability.

Thus, *ceteris paribus*, in a region in which a factory serves one market and which utilizes ubiquitous inputs, the optimum (cost minimizing) location for the factory is at the market which is the only location which minimizes distribution costs while procurement costs are zero everywhere (Figure 5. 1a). On the other hand, in the case of a region in which a factory serves one market and utilizes one pure input, the optimal location is anywhere between these two locations (Figure 5. 1c). Alonso's (1964: 60) linear market location problem is slightly more complicated (Figure 5. lb). In this example, seven consumers (A to G) are distributed at locations along a linear highway which is 15 kilometres long. The factory (for example, a bakery) wishes to locate along the highway so as to minimize distribution costs whether measured by consumer trips or by a salesperson making deliveries to each consumer separately. A measure of centrality is the mean centre found, for example, by summing the distances each consumer is from either end, say A, and dividing this total (42 units) by the number of consumers (7) to give the mean center in terms of number of units from A, which is 6 units or E. In fact, the best ('least cost') location is D which is the median centre, that is, the location which bifurcates a distribution in half. Indeed, for Alonso (1964), this
simple example reinforces the advantages of large cities, which in many regional contexts constitute the median location, for market oriented activities.

In the case of impure inputs or raw materials, the changes in physical characteristics that occur during processing affect the structure of procurement and distribution costs and just how the physical characteristics of materials change will determine the optimal location (Figure 5.1d). Thus, in activities that utilize impure inputs which lose weight or bulk or perishability, procurement costs are more significant than distribution costs. Accordingly, the sources of these inputs exert a stronger 'pull' on location than the location of markets. Conversely, in activities that utilize inputs which gain weight or bulk or perishability, distribution costs are more significant than procurement costs. Consequently, the location of markets exert a stronger pull on location than the sources of inputs.

Indeed, Weber (1909) developed a simple index, the Material index (MI) to predict input or output orientation.

Thus the $\text{MI} = \frac{\text{weight of localized raw materials}}{\text{weight of final product}}$

If $\text{MI} > 1$ then activity is input oriented, if $\text{MI} < 1$ then activity is output oriented.

As Hoover (1971:47) has noted, there are a number of manufacturing activities which utilize one principal input, normally a raw material, whose physical characteristics change considerably during processing so that their location remains strongly constrained by transportation costs (Table 5.2).

Table 5.2

<table>
<thead>
<tr>
<th>Cost</th>
<th>Southeast Region</th>
<th>Pacific Northwest Region</th>
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<tbody>
<tr>
<td></td>
<td>Large</td>
<td>Medium Size</td>
</tr>
<tr>
<td>Wood</td>
<td>67.7%</td>
<td>59.2%</td>
</tr>
<tr>
<td>Labour</td>
<td>3.4%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Maintenance</td>
<td>9.1%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>
### Table

<table>
<thead>
<tr>
<th>Description</th>
<th>Overhead</th>
<th>Energy</th>
<th>Total ($000)</th>
<th>Cost/MBF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.2%</td>
<td>17.6%</td>
<td>11,135</td>
<td>$111</td>
</tr>
<tr>
<td></td>
<td>7.8%</td>
<td>15.4%</td>
<td>3,195</td>
<td>$128</td>
</tr>
<tr>
<td></td>
<td>1.4%</td>
<td>5.9%</td>
<td>18,014</td>
<td>$180</td>
</tr>
<tr>
<td></td>
<td>5.1%</td>
<td>5.4%</td>
<td>4,916</td>
<td>$196</td>
</tr>
</tbody>
</table>


Thus, activities which process one principal raw material which loses weight, bulk, perishability, fragility and/or even hazardousness are input-oriented in the neoclassical view since procurement costs are greater than distribution costs. Activities which illustrate input-orientation for one or more of these reasons include sawmills, smelters, cotton compression, and fish processing. Conversely, activities which process one principal raw material which gains weight, bulk, perishability, fragility and/or even hazardousness are 'output oriented' because distribution costs are more significant than procurement costs. Examples of output oriented activity include paper box manufacture, soft drink bottling, bakeries and the coking of coal.

In the slightly more complicated case in which an activity utilizes more than one impure input from different sources (and possible serves more than one market) than the minimum transportation cost location will be 'intermediate' between input sources (and markets). One method of calculating the least cost location in such a situation is provided by so-called isodapane analysis (Figure 5.2).
The first step in the analysis is to calculate isotims which are lines of equal transportation cost around each location factor and which are derived from the procurement costs for each input at all locations (or some subset of locations such as communities) in the region under consideration and the distribution costs to the market(s) from all possible locations (or some subset of these locations). In other words, a transportation cost surface is calculated for each location factor (Figure 5.2a and b). Next, for all (or some) locations in the region, the transportation costs relevant to each location factor are summed to create total transportation costs surface and the least total transportation cost location ('P') identified. Around P, lines ('cost contours') linking locations with the same total transportation costs define isodapanes which show the transportation cost penalty of not locating at the least transportation cost point (Figure 4.2c). In this particular case, input C has a relatively stronger pull than input O or the market M reflecting the fact that its procurement cost is relatively more important than the procurement cost for O or the distribution cost to M.

The simplified assumptions employed in this example can be readily extended to incorporate more realistic notions of transportation costs. Thus, because of fixed or terminal costs, the average cost of transportation tends to decrease with distance and this is particularly true for rail and sea transportation. Consequently, transportation costs in such situations 'taper' with distance, the effect of which is to reduce
the pull of intermediate locations such as P where the benefit of the taper might be lost or reduced. Indeed, it was to offset this problem, that some 'intermediate communities' between agricultural supply regions and markets in the US offered 'in-transit privileges to flour millers which allowed the latter to get the benefit of the taper. More generally, from the perspective of individual factories contemplating new locations, the form of the transportation cost surface is determined by the rates charged.

**Labour, external economies and other costs** - Given transportation cost surfaces, similar cost surfaces for other location factors can be derived and combined. ('overlaid') to form a total cost surface. For Weber (1929), after transportation, the two key location factors to be considered are labour and external (or agglomeration) economies of scale. As Weber's analysis formally recognises, for any particular activity, the location which minimizes labour costs (L) or maximizes external economies (E) may not be the same as the minimum transportation cost location (P). If so, the question arises as to whether a factory should locate at P or L (or E) or somewhere between Analytically, this question can be pursued by reference to isodapane analysis.

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**Figure 5.3**
The Incorporation of a Cheap Labour Cost Location Within the Weberian Triangle

- **a.**
  - P = minimum transportation cost point
  - L = cheap labour location

- **b.**
  - If L is inside the critical isodapane the factory should re-locate to L.
Assume an already derived transportation cost surface and the question is whether or not our factory should locate at P or move to a cheap labour cost location, L (Figure 5.3a). For Weber, the answer to the question depends upon the location of the critical isodapane which is defined as that isodapane which equals the labour cost savings. If L is outside the critical isodapane the neoclassical factory should relocate there since the savings in labour costs more than offset the increases in transportation costs. If L is inside the critical isodapane then the factory should chose P. Similarly, if a factory is faced with a choice between P and a location which maximizes external economies of scale, E, if the cost savings at the latter more than offset the transportation cost penalty then the optimal location is at E (Figure 5.3b). In this iterative fashion, other location factors, which minimizes energy costs, taxes, environmental costs or infrastructure costs, can be assessed. Alternatively put, in this model, each location factor can be mapped as a cost surface and each cost map overlaid on one another and aggregated to to derive a total cost surface.

Spatial margins to profitability - For a plant to survive, a factory need not necessarily find the optimum location; so long as revenues exceed costs plant locations are viable. Plant locations which are viable are defined by 'the spatial margins to profitability' (Rawstrom 1958; Smith 1966 and 1971). Spatial variations in costs may be graphically summarized by a space cost transect, A-B, derived from a cost surface (Figure 5.2c and d). Whether or not any of these locations are viable depends upon revenues exceeding costs. In the hypothetical example shown, revenues are assumed the same regardless of location and where revenues exceed costs defines the spatial margin to profitability. The spatial margins to profitability also provide one answer to the question of the validity of explanations based on costs when actual location choice is strongly influenced by intangible and non-cost considerations. Quite simply, personal locational preferences can be exercised so long as they remain within the constraints of profitability.

The principle of substitution

Isodapane analysis reveals a fundamental principle of neoclassical location theory and that is the principle of substitution. Indeed, it may be argued that in a neoclassical landscape, the location of factories is an exercise in substitution as 'trade-offs' are made among the various location factors. Thus procurement and
distribution costs are substituted for one another; a location at the market means that procurement costs substitute for distribution costs while a factory location near raw material sources substitutes, or trades-off, distribution costs for procurement costs. In the case of a cheap labour location (Figure 5.3), the factory compares the effect of lower labour costs for higher transportation costs (or lower transportation costs for higher labour costs). Indeed, the thesis of the product cycle model (chapter 4) is that firms will be encouraged to disperse production to low wage regions to make exactly this form of substitution as products mature; the low wage region is not expected to be either the source of inputs or the market for mature products and so is not the 'least transportation cost' solution. In this context, there is an argument that the multinational corporation (MNC) provides a close representation of *Homus Economus* in the real world (Dicken 1977). In this view, MNCs have the abilities to collect and rationally assess data on literally a global basis and in effect have globalized isodapane (and substitution) analysis.

Similarly, it might be noted that neoclassical factories can substitute the cost savings of locations offering cheap energy, lower taxes, lower building costs, lower financing costs and government subsidies with increased costs in other location factors. The landscape is a cost surface and movement to the least (total) cost location is compromised only by the forces of capital inertia. Thus, once paid-off and still operational, old plant and equipment does not have a supply price while new plant and equipment does. While operating revenues cover operating costs factories can rationally remain in present locations even when superior locations are known (Auty 1975).

As an exercise in substitution, neoclassical location theory is readily incorporated within neoclassical production theory as a whole thus establishing the interdependence of location, scale (or size) and technology (Moses 1958). Thus, for a factory of a given size, it may be possible to combine, that is to substitute among, the factors of production, in different ways. These factors of production are usually generalized in terms of land, labour and capital (and sometimes entrepreneurship) and many manufacturing operations, for example, within limits, can substitute capital for labour, and vice versa. According to production theory, whether or not a factory should be more or less capital (labour) intensive depends upon the relative cost (price) of capital and labour within the realm of substitution possibilities. In turn, choices over particular combination of inputs affect location to the extent that input costs vary by location. If labour is substituted for capital (or for more expensive labour), cheap labour cost locations, *ceteris paribus,*
become more attractive. It may also be expected that with increasing size of factory new combinations, as well as increased amounts, of inputs become optimal. For both these reasons decisions regarding the size and location of factories are related.

This argument is graphically illustrated in production theory terms (Figure 5.4a). In this particular (hypothetical) situation, an isoquant, or line of equal output or scale, shows how a factory can utilize different combinations of two inputs, X and Y within certain limits of substitution. The factory, in other words, can substitute X for Y, and vice versa. According to production theory, the choice of the optimal combination of inputs depends on their relative cost or price as revealed by isocost lines which are lines of equal cost for different combinations of inputs. The slopes of the isocost lines vary depending on whether X is relatively cheaper than Y (Figure 5.4b) or Y is relatively cheaper than X (Figure 5.4c). The best combination of inputs for a given size of factory is defined as that point on the isoquant where costs are lowest (Figure 5.4d). In the case illustrated, the optimal combination is provided at the intersection of X* and Y* since any other combination will be higher cost. The particular combination of inputs chosen in this way in turn influence the optimal location in the neoclassical landscape. We might further note that at
higher scales of output, new technologies may define different input substitution possibilities (as expressed by differently sloped isoquants) so that, even with the same relative costs, the optimal location may change.

In a neoclassical landscape, especially if location, scale and technology are allowed to vary, there is potentially an endless variety of substitution possibilities. In other words, the neoclassical landscape is infinitely divisable as economically rational firms trade-off the pros and cons, or more strictly the opportunity costs, of every possible location.

In this context, a comment might be inserted regarding labour. From the neoclassical perspective, labour is considered as an input to the production process just like any other input and, as costs dictate, is to be substituted for, or by, other inputs. The critical isodapane precisely defines this interpretation; the advantages of a low labour cost location are to be substituted with the disadvantages of higher transportation costs (Figure 5. 3). Indeed, more generally, neoclassical production and price theories interpret labour as a commodity to be traded, like other commodities, according to the laws of demand and supply. If price and other characteristics are appropriate firms hire labour while the 'free' movement of labour among firms ensures that demand and supply is properly regulated by the principles of competition. In this view, unions are often interpreted negatively because they are seen as a cause of rigidity in wage levels (at least in terms of downward movements) and as constraints on managerial discretion in a range of matter pertaining to employment conditions. In other words, in this view unions increase costs and restrict mobility and substitution possibilities. Fundamentally, from the neoclassical perspective, labour is an instrument of production, no more and no less.

**Locational interdependence and revenue surfaces**

In the locational interdependence school of neoclassical location theory, explanatory emphasis is on how competition among rival firms affects the location and market areas of factories. The traditional theories illustrating this approach recognizes spatial variations in demand and typically ignores spatial variations in costs. The best known theory of this type is Christaller's central place theory (1966). While conceived in the context of service activities the focus of central place theory on distribution costs and inter-firm rivalry
introduces general principles of location which are relevant to manufacturing activities. Indeed, in
neoclassical terms, there are numerous manufacturing activities whose locational orientation, like that of
many services, is dominated by the need to access spatially distributed demand. The location problem of
the factory utilizing ubiquitous inputs and serving one market is the simplest hypothetical example in this
respect (Figure 5.1a).

Central place theory -- The point of departure for central place theory is the location of a factory
producing a single good, for example, bread or beer and serving a spatially distributed population (Figure
5. 5a). Assuming *Homus Economicus* and a homogenous plain in which inputs are ubiquitous and transportation (distribution) costs are the same in all directions, the factory can locate anywhere the *range* of a good incorporates the *threshold* population. In central place theory the range of a good defines the maximum distance consumers are willing to travel to purchase the good or, alternatively stated, the maximum distance the good can be economically transported to consumers. Since transportation costs add to the price of the good, according to the law of demand, demand will decrease with distance from the factory. The threshold population defines the minimum level of demand necessary to sustain factories of at least the minimum economically viable size, which may be considered as the size where economies of scale are first fully realized (the 'minimum optimum size' or MOS; see Figure 2.5). The inner range of a good defines the distance in which the threshold population exists.

If one factory cannot satisfy all demands within a region, or if surplus profits are made, under competitive conditions, additional factories are possible until all demands are met, and surplus profits eliminated. In a Christallerian landscape in which demand is distributed evenly over a homogenous plain and there are numerous rival factories each producing an identical good, additional factories disperse to ensure that the threshold population exists within the (inner) range of the good (Figure 5. 5b). This 'marketing' model predicts an optimal location pattern in the sense of minimizing distribution costs from a set of factories which serve market areas which are hexagonal in shape, thus ensuring all possible demands are met within a spatially distributed market (Figure 5. 5c). In more complicated situations where there are factories producing different goods, each with distinctive thresholds and ranges, Christaller's marketing principle predicts a hierarchical structure of production. Thus, the most accessible locations will attract factories which produce goods with the largest threshold/range requirements, as well as goods with lower threshold/range requirements. Less accessible locations only attract the latter.

In central place theory, including the marketing model of this theory, products of a given category are differentiated only by distance and consumers are assumed to prefer nearer (and cheaper) sources of supply than more distant (and expensive) sources of supply. Under these conditions dispersed patterns of product are to be expected. Product differentiation in terms of quality, style, taste or function, however, may encourage forces of concentration as markets are less restricted by distance but more uncertain. Each factory, with a slightly different product, may need access to a larger threshold population and her may be
uncertainty as the extent one product can be substituted for another. Similarly, uncertainty over rival behaviour in a neoclassical landscape may encourage concentration. In the well known Hotelling duopoly model, for example, two sellers supply a homogeneous product to a spatially distributed but linear market (Figure 5.6a).

Assuming *Homus Economicus*, Hotelling deduced both sellers would locate at the centre of the market. Any other location, Hotelling claimed, would be unstable because of uncertainty over rival behaviour. If one seller located 'off-centre, for example, the other seller could locate 'next door’ but with closer access to a larger share of the market. Distribution costs would of course be minimized if the sellers dispersed and located at the quartiles (Figure 5.6b). On the other hand, it is not clear why the bakers do not talk to each other - after all Homus Economicus has perfect information and rationality.

In neoclassical theories of location the presence of uncertainty, including that regarding rival behaviour, has elicited different responses. In one argument, uncertainty denies the possibility of single optimal outcomes allows that locations which are individually rational (e.g. Figure 5.6a) may not be socially optimal (Webber 1972). Another argument is that while uncertainty is relevant at the level of the
individual firm and factory economic costs and revenues nevertheless limit the range of permissable outcomes in the long run. This argument is traditionally expressed in the form of the adapt-adopt dichotomy.

**Uncertainty and the principles of adaption and adoption**

With few exceptions, the issue of uncertainty is not a central concern of neoclassical industrial location theory, especially least cost theory, even when dealing with the question of factory location (see Webber 1972). Yet, location itself is one dimension of a broader investment decision which involves a significant commitment of resources, including fixed capital, over long run time horizons. Over time, possibly even before an investment has generated sufficient returns to recoup fixed expenditures, the assumptions underlying the investment can change as a result of, for example, technological innovation, rival behaviour, market dynamics and resource depletion and discovery. Firms also miscalculate, if no other reason that in practice they do not have perfect information

Least cost industrial location theory argues that such uncertainty can be ignored because in the long run only those factories that behave in an economically rational manner will survive. In a neoclassical landscape, the location (and closure) of factories is therefore ultimately to be found in underlying spatial variations in cost (and revenue structures). Firms may be ignorant about such cost structures and they may choose in practice to locate in an area for apparently non-economic motives related to place of birth and recreational opportunity. While there have been some attempts to to interpret such preferences as maximizing 'psychic income,' thereby broadening the motivations of *Homo Economicus* without undermining rationality, non-economic considerations are of little importance in a neoclassical landscape. Whether for reasons of good luck or judgement, to survive in the long run, neoclassical factories need to be viably located within the spatial margins of profitability. Even if once rationally located, as environmental conditions change, factories will have to adapt, be adopted or risk failure. Thus, this adapt/adopt dichotomy provides a rationalization for theories which do not incorporate uncertainty or consider the 'details' of decision making processes (Alchian 1950).

While adaptation implies some deliberate response on the part of the firm adoption implies the
factory has been saved as a result of the actions of others, notably governments. Thus, uneconomic factories that are maintained, for social and political reasons, by government subsidies is a form of (environmental) adoption. In this regard, the chances of a government 'bailout' are doubtless much greater in the case of large factories and large corporations which operate numerous factories than for small plants and firms. The adoption of geographically marginal plants may also occur because of entirely unforeseen changes and as an unintended consequence of government action. Thus an unexpected devaluation of a currency may boost the chances of survival of a marginally located export oriented plant.

**Location adjustment possibilities**

The adaption or adjustment possibilities available to firms in response to changes in their economic environment vary. Firms can relocate, open branch plants, adjust their existing operations in some ways, rely on contracting out, or merge or acquire existing firms. According to Krumme (1969), adjustment possibilities can be classified along the three dimensions, of *space, organization and time*. In terms of the space dimension, firms can adjust their operations on-site, change them between sites ('inter-site adjustments') or develop new sites. On-site, in-situ, changes to expand, contract, modernize or change a factory's operations in terms of product-mix, technology, markets and/or input patterns, represent 'location' decisions in the sense of reinforcing or qualifying past location decisions and because of the opportunity costs involved. Inter-site, in situ changes occur when firms reorganize their production among a set of existing locations. Although data are not recorded systematically, investment at existing locations is often greater than at new locations (Stafford 1969). In terms of new site adjustments, firms can either re-locate or establish branch plants.

As economic circumstances change, factories are continually modified, sometimes radically. Well known examples of comprehensive in situ shifts in technology and products are provided by the cotton textile mills in Lancashire, England. As cotton manufacture became increasingly uneconomic in this region in the 1950s, many factories were converted to entirely new uses in a wide variety of activities ranging from electronic products, toy manufacture, rope and twine manufacture and poultry processing (Bale 1983: 24-5). With respect to inter-site changes, many examples are provided by multinational corporations who
have re-organized their existing factories in response to changes in tariff levels. The 1965 Auto Pact between Canada and the US, for example, eliminated tariffs between the two countries in the industry and permitted the auto companies to specialize their factories on products serving continental rather than national markets (Holmes 1991). Progressive decreases in the tariff along EC countries have likewise provoked MNCs to re-integrate their factories in different, usually more specialized ways, including in the auto industry (Dicken 1991). At the same time, it is investment in new locations that give the clearest indications of geographical shifts in cost structures. With respect to the organizational dimension, the main distinction is between small single plant firms and large multi-plant firms. In terms of on-site change, the small firm may have greater discretion in responding to change in the sense that it will likely be able to make faster decisions in comparison to a branch plant manager whose autonomy is tightly circumscribed. On the other hand, the multi-plant firms has inter-site adjustment possibilities unavailable to the small firm. Moreover, it has been argued that the decision making characteristics of multinational corporations most closely resemble the relentlessly rational capabilities of *Homus Econornicus* than is the case with small firms (Dicken1977). In this view, for the multinational firm, cost and revenue surfaces are global in scope while the effect of continuing improvements in transportation costs has been to widen ('push out') isodapanes. Consequently, other locational considerations, such as pertaining to labour, become more important and cheap labour cost locations within poor countries become more viable.

With respect to the time dimension, Krumme (1969) distinguishes short, medium and long run planning horizons. Thus, in the short run, for the single plant firm, spatial adjustments are limited, for example, to using plant more intensively by hiring more labour or offering overtime, using more inputs and running down inventories (or vice versa). A multiplant firm may make some adjustments among its plants in the short run, for example, shifting an order from one plant to another. In the medium run, spatial adjustments are again limited for the single plant firm but for the multiplant firm some expansion and/or consolidation is possible, as it may be possible to lease production facilities, and develop subcontracting. Long run plans for locational adjustment are dominated by new site location options and by mergers and acquisitions strategies which also provide firms, especially large firms, with opportunities to geographically expand their operation (Fleming and Krumme 1968; Leigh and North 1978; Green and Cromley 1984).
Locational evolution in neoclassical perspective - A new optimal location pattern does not instantaneously replace an old, 'obsolete' one. In a neoclassical landscape such shifts are at least slowed by investments in fixed capital both in the form of infrastructure and capital equipment. The capital costs of building new infrastructure and factories are significant. An old factory operating in an increasingly marginal location, may survive for a considerable period because its capital costs are zero. In effect, old factories substitute low capital costs for high operating costs (Auty 1975). Thus patterns of locational adjustment may be expected to be complex with survival factories adjusting in various ways over periods of many decades. In this regard, examples of case studies of adaption, adoption and failure are provided by Auty's (1975) and Watt's (1971; 1974) analyses of the sugar beet industry in the Caribbean and England respectively and Hunter's (1955) examination of the North American pulp and paper industry. In the latter case, for example, the development of new wood pulping technologies in the latter part of the 19th century radically altered location conditions and new rounds of investment overwhelmingly shifted the pulp and paper industry to northern locations accessible to softwood forests. Yet, while many plants failed in the established centres of the paper industry, such as New York, other plants continued to survive half a century later, typically on a small scale, utilizing old infrastructure and by serving, higher value market niches. More recently, as recycled paper has become an increasingly important input to paper making locations within major urban agglomerations are again viable for major new plant in paper making.

For factories that are unwilling or unable to adapt, and are not, adopted, by changing environmental conditions failure constitutes a third option. Despite adjustment possibilities, entire industries die out while others shrink in size and plants do fail. More generally, models of industry evolution typically recognize that over time there will be a shift from locational and organizational patterns dominated by large numbers of small firms and plants, often in agglomerations, to a consolidated pattern in which many fewer, large plants dominate the industry from a more dispersed set of locations (Markusen 1985; 1987). In Markusen's (1985) version of the profit cycle model, for example, these changes are driven by underlying changes in economic conditions, particularly in the nature of competition, market conditions and technology which shifts from an emphasis on product innovation ot process innovation (Utterbach and Abernathy 1975). Such thinking is consistent with the neoclassical emphasis on economic laws governing behaviour. Ultimately, in a neoclassical landscape, the opening and closing of factories, the de-industrialization of
regions and the opening up of new industrial spaces reflects the inexorable power of economic reality.

**Industrial location policy in a neoclassical landscape**

In a neoclassical landscape, capital is viewed as roaming about the landscape looking for the 'best,' usually expressed as 'least cost,' location. Neoclassical theory typically prefers minimal policy interference by government in this locational selection process. Policies that are advocated tend to favour increasing the mobility of capital and workers, less by subsidies than by the loosening of restrictions for capital and proving education and training to workers, so as to increase their scope as economically rational agents. It might be noted that at the beginning of the Industrial Revolution classical economic thinkers strongly advised increasing the freedom of workers then constrained by guild and other types of restriction.

According to some neoclassical theorists, freely operating market forces, unhindered by government interferences, will resolve regional problems (Figure 5.7).

![Figure 5.7](image)

Towards Regional Equilibrium in a Neo-Classical Landscape

In this view, in the core regions, the concentration of investment in factories puts pressure on labour supply and as the demand for labour increases, wage levels increase. As a result, firms are encouraged to seek locations in peripheral regions where there are available labour supplies and where wage rates are lower. Over time, however, as more factories locate in peripheral regions the demand for labour increases which in turn puts pressure on wage levels. In addition, movements of labour from peripheral to core regions reduces pressure on wage levels in the former and increases pressures on wage
levels in the latter. Thus, in a neoclassical landscape, freely mobile capital and labour define tendencies towards equilibrium wage and unemployment rates among regions.

Neoclassical justification for industrial location policy emphasizes those approaches which enhance the mobility of workers and capital or investment. In the context of investment, for example, and to anticipate a behavioural argument in the next chapter, subsidies to factories located in designated regions can be justified as encouragement to firms to investigate cost and revenue structures as fully as possible, including designated regions they would not have otherwise considered. On the other hand, subsidies, especially in the form of ‘one-shot capital grants, may only establish locational viability in the short run. Indeed, an underlying concern of neoclassical theory with industrial location policy is that subsidies based on social and political rather than economic grounds will lead to the factory locations outside the spatial margins of profitability (Figure 5.8).

![Figure 5.8](image-url)

Source: based on Smith 1
Even in the 1950s and 1960s, when it was thought that these policies could be afforded, neoclassical economists and economic geographers interpreted such policies as involving a tradeoff between national efficiency and social and political equity. Even in this context, the location of factories is seen as a substitution problem - more politics and less economics. Such policies are seen as distorting the economically rational pattern because, it was claimed, they promoted inefficiency, an unnecessary duplication of facilities and even undermined the viability of the rationally located. Evidence in support of these charges is available. In Atlantic Canada, for example, industrial subsidies were frequently, indeed mainly, awarded to firms that were planning on investing in the region anyway and in some cases competing firms were all subsidized thus encouraging excess capacity (Springate 1972; Hayter and Storey 1979). In Cannon’s (1975) terms, these studies did not generate incremental effects. On the other hand, there are designated regions, in Canada (Cannon 1980; Hayter and Oföri-Amoah 1989) and elsewhere (Keeble 1980), where industrial incentives did generate substantial incremental effects.

From the 1950s to the 1970s, many national governments rejected market solutions to regional problems. Critiques paid particular attention to the unrealistic assumptions of equilibrium tendencies. Two points are relevant in this context. First, the mobility of workers, including unemployed workers, are inevitably constrained by social and family commitments and highly localized knowledge of opportunities. Migration to other regions involves considerable costs and uncertainties which are further compounded if workers have to change occupation. Second, while continued investments in core regions are likely to increase pressure on wages they are also likely to reinforce agglomeration economies and the effects of inertia. In other words, the regional pattern of growth may be disequilibrating (Myrdal 1957; Krebs 1981).

In the highly competitive times of the 1980s and 1990s, however, many national governments have reduced or eliminated commitments to industrial location policy (McLoughlin and Cannon 1990). Indeed, especially in countries such as the UK, the US, Australia and Canada, the demise of these policies have been associated with a more widespread of neoclassical thinking in which market solutions to socio-economic problems are once again in the ascendancy. The fact that unemployment problems have become national in scope, balance of payments problems and government debt have factors underlying this trend. Moreover, policies which offer subsidies to some regions (and firms) but not to others have been politically
contentious, one result of which was the tendency to continually broaden the geographical and industrial terms of reference of the policies (Alden and Morgan 1974) In the UK and Canada, for example, the areas represented by designated regions progressively expanded to incorporate the larger part of national territory. The market solution, in theory at least, leaves regions and communities to their own abilities and interests in promoting industrial development.

COST STRUCTURES AND LOCATINAL ORIENTATION

In a neoclassical landscape, location matters because costs and revenues vary over space. Since different industries have different cost (and revenue) structures the locational patterns of industries also vary. The well known tradition of classifying manufacturing activities by locational orientation, for example according to 'transport orientation,' 'labour orientation,' and 'agglomeration orientation' is directly derived from Weberian cost considerations, (Berry, Conkling and Ray 1987; Eliot-Hurst 1972; Morrill, 1974). At the same time, such typologies are inevitably relatively crude representations of actual cost structures which are continually subject to forces of change. Indeed, the 'common sense' argument of the neoclassical approach is that revenues must cover costs for factory operations to be viable and that explanations of factory location need to be rooted in an understanding of underlying cost (and revenue ) structures and that over time locational evolution requires adaptation to changes in economic circumstances.

In practice, the cost structures of factories and industries are complicated and detailed, comparative information is often not readily available. In advanced countries, the census typically provides data on costs of production for individual industries. However, apart from information on labour, the census break down of production costs is typically crude and, for example, does not include reference to procurement costs, selling costs or the various items that comprise material costs. Moreover, classification procedures vary among countries. Within census' or statistical abstracts there is often information on some individual cost components which can be readily mapped and tabulated (Smith 1971) although such generalized cost components cannot simply be add to form meaningful cost structures. There are also consulting agencies which have data bases on the locational economics of individual industries, such as Jaako Pourri, a
Finnish based firm which has accumulated considerable information on the cost of production on individual pulp and paper mills throughout the world. Such information, however, is typically confidential and available only for a fee.

Calculations of the cost structures of individual industries operating in different regions are either based on actual costs of production or on estimated (hypothetical) costs of production for brand new 'state of the art mills.' In the former approach, most calculations are based on the average costs of all mills operating in a region, which is essentially what the census does, or on a sample of mills operating in a region. Of course, average cost structures may not reflect actual conditions at any one mill and even within a region mill by mill variations can be substantial. Alternatively, individual factories can provide case studies illustrating the 'best case, the 'worst' case or a 'representative' case, assuming such cases can be identified. In the second approach, engineering estimates of the cost structures of state of the art mills may or may not accurately represent inherited locational economics, but they are particularly useful in terms of assessing the location of new investments.

Within the same industry and region cost structures can vary considerably. A basic distinction, however, can be made between primary and secondary manufacturing. In the former, material costs and transportation typically remain important while in secondary manufacturing labour inputs are relatively more important, even if the nature of these labour inputs vary.

Primary manufacturing

Sawmill cost structures - As an example of a primary manufacturing activity, which utilizes one principal raw material, specifically timber, which loses bulk and weight during processing, sawmilling is conventionally classified as input oriented. State of the art engineering estimates of the cost structures for two sizes of sawmills in the Pacific North West (PNW) region of the US and the US South confirm this orientation. In this particular example, the cost structures are hypothetical in that they represent engineering estimates for new, state of the art mills, as of the mid-1980s. As expected, wood costs dominate the cost structures in both regions and although transportation costs are not distinguished as a separate category, it is reasonable to assume that procurement costs are a significant element of wood costs. It might also be
noted that while both regions are within the spatial margins to profitability for sawmilling overall costs are noticeably lower in the South than in the PNW primarily because of lower wood costs. In the PNW wood costs are higher as a result of higher tree growing and harvesting costs while in recent years the decreasing availability of wood in the region, due to environmental legislation, has been a further cost enhancing factor. Indeed, these data reflect that the US South is the least cost location for primary forest product manufacture in North America, if not the world.

On the other hand, while wood costs are relatively lower in the South energy costs are relatively lower in the PNW. In effect, to some extent, the PNW is able to substitute for its relatively high wood costs with relatively cheaper energy costs to maintain its competitiveness. Lumber firms in the PNW have also sought to maintain competitiveness by producing higher value products although this strategy is not evident from the data (and no information on revenues and profitability is presented). In both regions, labour in new mills is anticipated to be a relatively insignificant cost component. At the same time, the average cost of production is less in the larger mills in both regions and important source of economies of scale relates to the use of labour. Thus, the relative importance of labour costs is reduced by half in the bigger mills as bigger machinery does not imply more workers. In addition, overhead is also much reduced in relative importance. In contrast, wood costs become more important in the bigger mills since as the size of mill increases the consumption of wood increases more or less proportionately while economies are achieved in the use of inputs. Indeed, in sawmilling, scale economies have been important for some time in pushing down the average costs of production and threatening the survival of smaller mills in these regions. In fact, as sawmills have become larger there has been a parallel tendency to concentrate in the communities that are most accessible to the timber supply. That is, with increasing scale, technology has become more capital intensive and procurement costs have imposed increasingly stringent locational requirements within each region.

It needs to be emphasized that these estimates are for state of the art new mills and that existing mills typically exhibit higher costs including with respect of labour costs which may also be of greater relative importance. Indeed, new mills provide a significant competitive threat to existing operations encouraging adaptation of more efficient processes.
Newsprint industry cost structures - As another example of primary manufacturing, the cost structures that have been outlined for the newsprint industry in the major producing regions of the world in 1990 are based on average costs for a sample of existing mills in each region (Table 5.3).

Table 5.3

<table>
<thead>
<tr>
<th>Costs</th>
<th>US South</th>
<th>US West</th>
<th>Canada</th>
<th>Sweden</th>
<th>Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other mill costs</td>
<td>$111</td>
<td>$149</td>
<td>$149</td>
<td>$219</td>
<td>$298</td>
</tr>
<tr>
<td>Chemicals</td>
<td>29</td>
<td>36</td>
<td>17</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Energy</td>
<td>98</td>
<td>85</td>
<td>92</td>
<td>114</td>
<td>108</td>
</tr>
<tr>
<td>Labour</td>
<td>88</td>
<td>71</td>
<td>124</td>
<td>87</td>
<td>72</td>
</tr>
<tr>
<td>Other mill costs</td>
<td>109</td>
<td>80</td>
<td>82</td>
<td>104</td>
<td>75</td>
</tr>
<tr>
<td>Corp. &amp; selling</td>
<td>20</td>
<td>15</td>
<td>33</td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>Delivery</td>
<td>32</td>
<td>52</td>
<td>86</td>
<td>83</td>
<td>96</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$487</td>
<td>$488</td>
<td>$538</td>
<td>$628</td>
<td>$690</td>
</tr>
</tbody>
</table>


The Forest Sector Advisory Council (1991) has collected data on these same mills several times now so that trends over time can be made while the use of common procedures facilitates comparison (Holmes and Hayter 1994: 19-21). In 1990, according to these data the South and West are the low cost newsprint producing regions, enjoying significant advantages over Canada and even more so over Sweden and Finland, the traditional optimal locations when softwoods were the desired raw material. The US South now enjoys the crucial advantage in wood costs, almost CAN$40 per finished tonne over Canadian producers and 100% lower than Scandinavian rivals. The US regions also have substantial advantages in terms of distribution costs to markets. To some extent, Canada and the Scandinavian countries offset their higher wood and delivery costs with lower chemical costs. Whatever energy cost advantages these regions enjoyed in relation to the US, however, have been eroded by investment in more energy intensive pulping
Labour costs are approximately similar, apart from Canada which has relatively high labour costs. Indeed, in Canada, labour costs account for 27% of total mill level costs, compared with 17-20% in the US, 15% in Sweden in less than 13% in Finland. Yet wage rates per hour in Canada are slightly lower than in the US and the difference in labour costs per finished tonne is almost entirely due to differences in labour productivity. In Canada, a finished tonne of newsprint required 3.6 operating hours to produce but only 2.5 hours in the US South and 1.8 hours in the US West. Canada's lower labour productivity in turn reflects use of smaller (and older) paper making machines and traditional labour intensive pulping technologies.

Cost structures can change, however, sometimes rapidly. From 1986 to 1990 Canada's competitive gap in newsprint in relation to the US widened considerably. The increasing value of the Canadian dollar was a major factor in this decline in this period and another factor was increasing energy costs. In response to much higher costs, Canadian paper producers, (and even more so Scandinavian producers), have shifted away from standard newsprint to the manufacture of higher value papers, and from fordist to more flexible methods of mass production (Hayter and Holmes 1994a). In Canada, efforts to further reduce labour costs by replacing labour with technology and by adoption of more flexible employment practices is also well under way (Hayter and Holmes 1994b; chapter 12).

Other raw material using activities - There are manufacturing activities which utilize one principal raw material which cannot be simply classified as either input or output oriented. In petroleum refining, for example, there is little change in the physical characteristics of the raw material, that is, petroleum is a 'pure' input in Weberian terms, so that a location either at the input source or at or close to markets is feasible without undue transportation cost penalty. In Canada, for example, the traditional concentration of refineries near central Canadian markets has been complemented in recent decades by the establishment of refineries on the Alberta oil patch (Chapman, 1985). Aluminium refining is another example of an activity which utilizes one principal raw material (alumina) whose location is neither input nor output oriented even though the procurement costs of alumina and the distribution costs of ingots are important. In this case, aluminium smelting requires vast quantities of electric power and prefers locations which can guarantee large supplies of relatively cheap hydro-electric power such as Dienes, Iceland and Kitimat, British
Columbia. Both these locations are a considerable distance away from the least transportation cost point; in the case of Iceland's smelter, alumina is imported from the Caribbean and the ingots are shipped to Europe. In Weberian terms, the low cost of power in Iceland more than substitutes for the resulting higher costs of transportation: Iceland is within the critical isodapane as an energy supplier (see Skulason 1994).

The modern iron and steel industry provides examples of transportation orientation at locations intermediate to a range of input sources and market destinations. Thus, Fleming (1967) noted that the major new integrated iron and steel works that had been built during the 1950s and 1960s in the US and Europe frequently favoured tidewater locations to have economical access to alternative supplies of coal and iron ore, including those on different continents such as Africa, South America and Australia, and economical access to major markets. For Fleming, the transportation cost advantages of such locations were reinforced by their 'locational flexibility' to alternative input sources and markets which in turn provided insurance against short run disruptions or permanent loss in any one location factor.

**Secondary manufacturing**

In secondary manufacturing, labour and external economies of scale are widely thought to be the most significant principles of location. Indeed, labour costs are often the major component of the cost structures of individual factories in secondary manufacturing industries. There are also secondary manufacturing activities in which labour, although not the most important cost component, is still the most important locational influence. With respect to industry averages in the US in 1982, wages varied from 11.1% (tobacco products) to 40.0% (leather and leather goods) of value added (Watts 1987: 86). Given that these figures are averages, for individual products and factories the variation will be greater and that in low wage countries labour's share of value added is probably higher.

**Cost structures in the auto industry** - The automobile industry is an example of an industry manufacturing a complex product which requires a high level of value added by labour. The auto industry has traditionally been concentrated in particular regions in industrialized countries to take advantage of larger
pools of higher skilled, productive labour as well as scientific and engineering expertise and other forms of external economies. Even so, the importance of labour in auto production has always encouraged firms to seek ways to reduce labour costs and over the past decade or so firms have increasingly invested in selected low wage countries, such as Mexico and Brazil while South Korea and Spain have also rapidly developed their auto industries.

In the auto industry, labour's share of overall costs is relatively high. Indeed, among 12 of the most important auto companies in the world, labour's share of value added in the 1980s and early 1990s, apart from Toyota and Honda, is around two-thirds (Table 5.4).

**Table 5.4**

<table>
<thead>
<tr>
<th>Company</th>
<th>Labour's Share of Value-added (%)</th>
<th>Company</th>
<th>Labour's Share of Value-added (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota</td>
<td>42.2</td>
<td>Nissan</td>
<td>68.5</td>
</tr>
<tr>
<td>Honda</td>
<td>50.9</td>
<td>Mazda#</td>
<td>64.9</td>
</tr>
<tr>
<td>GM</td>
<td>73.8</td>
<td>Ford</td>
<td>71.5</td>
</tr>
<tr>
<td>Chrysler</td>
<td>76.6</td>
<td>VAG</td>
<td>72.2</td>
</tr>
<tr>
<td>BMW</td>
<td>63.1</td>
<td>Fiat#</td>
<td>64.3</td>
</tr>
<tr>
<td>PSA#</td>
<td>71.9</td>
<td>Ford UK#</td>
<td>66.6</td>
</tr>
</tbody>
</table>

Source: Williams, Haslam, Williams, Johal and Adcroft 1995: 18

Value-added is defined as labour costs (including social benefits), depreciation and net income or profits pre-tax.

#Calculations based on periods other than 1980-91, namely 1987-91 (Fiat); 1984-90 (PSA); 1982-91 (Ford UK); and 1982-91 (Mazda).

Even in Toyota, the most successful major company in recent years at reducing labour inputs, labour's share of value added, while very much lower, is still 42%. Moreover since Japanese companies, other than Toyota and Honda, are similar to American and European companies, Toyota and Honda's distinctiveness in this regard, indicates the importance of company-level factors rather than simple regional differences. At
the same time, national variations in labour costs per employee hour do exist among the major national auto industries (Table 5. 5).

Table 5.5

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>7.40</td>
<td>11.15</td>
<td>18.03</td>
<td>20.52</td>
</tr>
<tr>
<td>USA</td>
<td>12.67</td>
<td>22.65</td>
<td>20.24</td>
<td>21.24</td>
</tr>
<tr>
<td>France</td>
<td>10.03</td>
<td>10.20</td>
<td>15.57</td>
<td>16.42</td>
</tr>
<tr>
<td>Germany</td>
<td>13.70</td>
<td>13.72</td>
<td>26.03</td>
<td>26.95</td>
</tr>
<tr>
<td>Italy</td>
<td>9.05</td>
<td>10.40</td>
<td>16.94</td>
<td>19.13</td>
</tr>
<tr>
<td>UK</td>
<td>7.63</td>
<td>8.70</td>
<td>15.48</td>
<td>16.15</td>
</tr>
<tr>
<td>Spain</td>
<td>6.95</td>
<td>6.76</td>
<td>16.31</td>
<td>17.91</td>
</tr>
<tr>
<td>Sweden</td>
<td>15.70</td>
<td>12.33</td>
<td>26.40</td>
<td>27.52</td>
</tr>
</tbody>
</table>

Source: Williams, Haslam, Williams, Johal and Adcroft 1994: 58

These differences were still strongly apparent in 1980 when the low cost producer (Spain) had hourly labour costs less than half of the high cost producer (Sweden). In 1980, it might be noted Japanese hourly labour costs were just 60% of those in the US. By the early 1990s the wage differentials among countries had clearly narrowed. In the 1991, for example, the low wage producer (the UK) had hourly labour costs that were 59% of those of the high cost producer (still Sweden), a significant differential but much less than previously. It might also be noted that in 1991 Japan's hourly labour costs were almost the same as the US and were higher than several European countries.

In addition to labour costs, national variations in labour productivity in the auto industry have been calculated. In this context, Williams et al (1994: 61) offer 'build hours,' that is the number of hours required to build a vehicle, as a significant measure of competitiveness (Table 5. 6).
Table 5.6

Build Hours per Vehicle: International Comparisons 1970-1989

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>Germany</th>
<th>France</th>
<th>Japan</th>
<th>Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>189</td>
<td>278</td>
<td>267</td>
<td>254</td>
<td>na</td>
</tr>
<tr>
<td>1975</td>
<td>174</td>
<td>279</td>
<td>292</td>
<td>176</td>
<td>1475</td>
</tr>
<tr>
<td>1980</td>
<td>202</td>
<td>318</td>
<td>252</td>
<td>139</td>
<td>1255</td>
</tr>
<tr>
<td>1985</td>
<td>155</td>
<td>258</td>
<td>220</td>
<td>139</td>
<td>572</td>
</tr>
<tr>
<td>1989</td>
<td>170</td>
<td>286</td>
<td>162#</td>
<td>132</td>
<td>352#</td>
</tr>
</tbody>
</table>

#Data are for 1988

Their calculations, based on both auto and truck manufacture, include work performed by suppliers as well as the major companies so the statistics are comparable. The most significant trend in these data is the rapid decrease in built hours in Japan especially during the 1970s. In the US build hours declined noticeably in the 1980s and Williams et al (1994: 62) the US-Japan gap is 'always relatively narrow.' Yet, bearing in mind that in 1970 US built hours were fewer than in Japan, in 1980 Japan required 31% fewer built hours than the US to build a car and in 1991 23% fewer hours. These differences could be interpreted as a significant gap. The unusually large number of build hours in the German auto industry might also be noted; indeed Germany combines both high wages (Table 5.5) with low productivity, a clearly problematical situation.

The assembly plant productivity data obtained by Womack, Jones and Roos (1990: 84-9) for 1989, based on the hours required to assemble autos in various countries, also suggest that, on average, Japanese producers in Japan enjoy a productivity advantage (Table 5.7).
Table 5.7

Auto Assembly Plant Productivity: International Comparisons
Productivity (hrs/vehicle) 1989

<table>
<thead>
<tr>
<th>Region</th>
<th>Origins of Firms</th>
<th>Best Practice</th>
<th>Weighted Average</th>
<th>Worst Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Volume Producers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>Japan</td>
<td>13.2</td>
<td>16.8</td>
<td>25.9</td>
</tr>
<tr>
<td>N.A.</td>
<td>Japan</td>
<td>18.8</td>
<td>20.9</td>
<td>25.5</td>
</tr>
<tr>
<td>U.S.</td>
<td>U.S.</td>
<td>18.6</td>
<td>24.9</td>
<td>30.7</td>
</tr>
<tr>
<td>Europe</td>
<td>US/Japan</td>
<td>22.8</td>
<td>35.3</td>
<td>57.6</td>
</tr>
<tr>
<td>Europe</td>
<td>Europe</td>
<td>22.8</td>
<td>35.5</td>
<td>55.7</td>
</tr>
<tr>
<td>NICs</td>
<td>Various</td>
<td>25.7</td>
<td>41.0</td>
<td>78.7</td>
</tr>
</tbody>
</table>

Luxury Producers

<table>
<thead>
<tr>
<th>Region</th>
<th>Origins of Firms</th>
<th>Best Practice</th>
<th>Weighted Average</th>
<th>Worst Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Japan</td>
<td>16.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>U.S.</td>
<td>33.3</td>
<td>35.7</td>
<td>37.6</td>
</tr>
<tr>
<td>Europe</td>
<td>Europe</td>
<td>37.3</td>
<td>57.0</td>
<td>110.7</td>
</tr>
</tbody>
</table>

Source: Womack, Jones and Rees: 1990: 85 and 89
Note that the volume producers refer to the Big 3 in North America, Fiat, PSA, Renault and Volkswagen in Europe and all companies in Japan. Luxury autos from Europe include Daimler Benz, BMW, Volvo, Saab, Rover, Jaguar, Audi and Alfa Romeo; from the US, Cadillac and Lincoln; and from Japan the Honda Legend, Toyota Cressida and the Mazda 929.

However, their data shows that within each region, including Japan, assembly plant productivity does vary between best and worst plant practice. In general assembly plant productivity of auto plants in Japan are better than in the US although best plant practice of US firms in the US are better than the worst plants in Japan. According to these data, plants in Japan and the US are both notably higher than those of European based plants owned by European countries. In addition, the variation between best and worst is much greater in Europe and the NICs than in either Japan or the US.

Even among advanced countries, labour costs and productivities underlying auto production vary from location to location. Moreover, over time, costs and productivity differentials between locations have
changed. In 1970, for example, labour costs in the Japanese auto industry were among the lowest in the world; by the 1980s they were among the highest. Labour productivity in Japan, however, rapidly shifted in the other direction. Simultaneously, following tendencies in other high cost regions, such as Sweden, Japanese firms have continued to shift to higher value production. Indeed, although hourly labour costs have risen rapidly, Japan has become the most competitive auto producing region in the world, forcing other countries to adapt in some way to the Japanese challenge. Indeed, using data for the early 1980s, Bloomfield (1991) reports that Japanese firms could deliver a typical compact car in the US that was over $1700 cheaper than rival products made in the US (Figure 5.9). If transportation costs are ignored, the manufacturing cost advantage was even greater. It is also important to recognize that these estimates identify the major source of Japan's cost advantage to be 'management systems and techniques' (organization) while wages and fringe benefits are the second but much less important source of cost advantage. Shop floor labour relations are other sources of cost advantage. But why should Japanese firms have such an advantage in organization and what is its nature? Suffice to say that recognition of the organizational basis of cost advantages implies that cost structures are not simply 'given' datum but can be created.

Figure 5.9
Japanese Manufacturing Cost Advantage for Typical Compact Car, Early 1980's

Source: Bloomfield 1991: 28
In an increasingly competitive global economy, companies in many industries, including the auto, garment and microelectronic industriers, are looking to reduce costs including by locating branch plants in low wage regions. The ability to do so, however, is limited by skill and productivity constraints (Figure 5.10). In general, it is the labour intensive components of these industries which locate in low wage locations such as export processing zones. In the case of microelectronics, a particularly important distinction is between the design and wafer fabrication stages on the one hand and the assembly stage on the other. Each stage has different production characteristics and there is no particular advantage for geographical proximity. Traditionally, it has been the assembly stage which has been located in low wage regions.
However, it might be noted that in this industry the relative importance of labour costs has been substantially reduced from 47% of the industry's total costs in the early 1960s to 30% in 1976. Labour costs are much less important in the production of complicated and high value integrated circuits than in simple devices. One US estimate, for example, suggests that labour costs for assembly operations were 33% for simple integrated circuits and 4% for complex integrated circuits (UNIDO 1981). In general, the product cycle dynamics of semi-conductors is becoming more complicated with each 'stage' showing diverse locational trends. In contrast, the production of TVs is following a more conventional life cycle experience as automation is vastly reducing the number of components in a TV set, so that production is much simply and attracted to low wage regions (Scott 1987).

CONCLUSION

In essence, the neoclassical view is that factory location is driven by powerful forces of economics and industry can only ignore economic reality at their own peril. This view has had a pervasive influence in economic geography. Practically, the neoclassical approach has a strong 'common sense' appeal in that it stresses the axiom that for factories to be viable revenues must exceed costs and that explanations for factory location should accordingly emphasize costs and revenue considerations. Moreover, at a time of rapidly globalizing competition, the neoclassical emphasis on the relentless and rational pursuit of lower costs and more profits captures an essential dimension of contemporary economic dynamism.

Yet, the neoclassical approach towards industrial location dynamics is controversial and it has received extensive criticism (Krumme 1969; Massey 1976; 1979; Storper 1981). In a recent paper, for example, Barnes (1987) has noted that the assumption of *Homus Economicus* means that economic agents do no more than respond to universal laws of rationality. There are no other motives. Indeed, the neoclassical approach assumes that the competitive process, if left to itself, allows for the most socially beneficial allocation of resources. In this model, the interests of firms and communities are the same. But as Barnes (1987) notes, in a neoclassical landscape places are no more than spaces where capital may or may not be deposited. As such, the neoclassical model, by denying or simplifying roles for local agency and local social and political context, demeans the richness of economic geography, an enduring theme of which is its variability.
There are also many interesting questions concerning industrial location dynamics that are unaddressed by neoclassical frameworks with their underlying assumptions of universality and economic rationality. In the next two chapters, two alternative approaches to industrial location are explicitly concerned with the processes underlying the location of factories.