CHAPTER ONE

AN INTRODUCTION TO PATH DEPENDENCE

AN INTRODUCTION TO PATH DEPENDENCY

WHAT IS MEANT BY PATH DEPENDENCE

Path dependence refers to resource allocations where an apparently insignificant event has had a controlling influence on the outcome. "An economy is said to be path dependent when the effect of a shock on the level of aggregate output is permanent in the absence of future offsetting shocks"[1] Path dependence incorporates a dynamic process that exhibits sensitive dependence on an initial condition. The impact of the apparently insignificant event, even if it existed for a short period, was sufficient to have an irreversible influence on the market allocation of resources. This outcome occurs despite individual maximising behaviour and voluntary decision making [2]. With high sunk costs, the cost of altering the system, even if there is the discovery of a more efficient system, is prohibitively high and ineffectual to prevent the abandonment of the present system.[3] Path dependent outcomes are considered to be non-linear or non-equilibrium dynamic models [4].

The positive feedback mechanisms include: scale economies; research and development commitments; complementary investments; and product acceptance by end consumers. [5]

[1] Balmann, Odening, M, Weikard, HP and Brandes, W.,, 1996, "Path-dependence Without Increasing Returns to Scale and Network Externalities", *Journal of Economic Behaviour and Organisation*, Vol 29, 1996, pp 159-172; referencing Durfauf, 1991

[2] Liebowitz and Margolis, "Path Dependence, Lock-In and History", *The Journal of Law, Economics and Organisation*, Vol 11, No.1, 1995, p 205

[3] Balmann et al 1996

[4] Vega-Redendo 1994, Liebowitz and Margolis 1995, Arthur 1994, 1995

[5] Goodstein, 1995, p1030

Technologies, as an example, compete for market share and apparently

insignificant events may give particular technologies advantages over their

competitors. However, which market outcome eventuates will vary, and multiple

outcomes are possible as the result of the impact of random events.

Increasing returns to adoption exist, with the more technologies used, the more

experienced is gained, and the more they are improved. Potential to reinforce the

'lock-out' of competing technologies is enhanced. Within locked-in situations,

the outcome maybe inefficient, and it can also only be abandoned at extremely

high cost. Thus, the path, once lock-in has occurred, offers little flexibility. [6]

Persistence of inefficient technologies might be explained through path

dependency in that, even if the long-term marginal costs of the alternative

technology are lower, a switch-over may not be profitable due to high start-up

costs. This may particularly be the case for infrastructure investments. However,

for the firm, existing low profit margins may not justify the large switch costs

required for investment in the new technology. [7]

[6] Balmann et al, 1996
[7] Goodstein, 1995, p 1031

INCREASING RETURNS AND POSITIVE FEEDBACK MODELS

Positive feedback models exist where path inefficiencies occur due to increasing

returns. [8] 'Lock-in' occurs as an undesirable consequence of increasing returns.

Cameron (1991) notes that lock-in is encouraged by two effects relating to

experience and uncertainty. The more an action is trialed, more experience with it

is gained and uncertainty surrounding that action decreases.[9] In this example the

successful technology is the one which is most understood.

Timing is important. A superior technology that has an earlier run of

disappointing results, may find itself abandoned for other 'inferior'

technologies.[10] When one or more technologies are competing for scarce

resources, the technology that triumphs will be the one that establishes a

significant foothold. Reasons for success in establishing this foothold vary from

the unexpected success of an early proto-type, whims of developers, or even

political machinations. While applied by Goodstein (1995), and Arthur, (1989) to

technology, the impact of establishing a foothold might be readily applied to the

economic infrastructure of city building.

Goodstein (1995) [11] uses technological development as an example of where path

dependency can occur due to positive feedback mechanisms. Goodstein quotes

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[8] Arthur, 1989
[9] Cameron, R, "Tortoises and hares: Choice among technologies of Unknown Merit", *Economic Journal*, Vol 101, 1991, pp 801-14
[10] Arthur, 1989, p127
[11] Goodstein 1995, p1030

Arthur (1989) when noting that increasing returns to scale dominate 'knowledge-based' technologies. 'Knowledge-based' industries require high sunk costs, particularly with heavy investment in research and development. Goodstein also relates how environmentally supportive technologies could also be included in this category. To include city building and urbanisation in this genre may be difficult but not impossible. Goodstein sees path dependence in technological choice as being a facilitator of environmental decline. At any given moment technological advancement can move along a variety of paths - but once a path is chosen, positive feedback mechanisms following the adoption of the technology lock society into that path. That path may prove, in the long-run, to have negative environmental outcomes.

Boulding (1981), as noted by Goodstein, presents increasing returns on a wider scale by characterising the rapid pace of technological change from 1860 to 1930 as being heavily influenced by increasing returns[12]. Rapid initiation of products created new niches that were rapidly filled. These in turn opened up new niches elsewhere to be filled by an expanding industry.

Goodstein's paper relates path dependence to environmental decline. Reasons given for the relationship includes:

(1) all externalities are not internalised;

(2) private discount rates may exceed social discount rates;

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[12] Boulding, *Evolutionary Economics*, Sage USA 1981, p 139 - as noted by Goodstein, 1995, p 1032

(3) government infrastructure, subsidy, and research and development

may already have affected market decisions; and

(4) 'dirty' technologies may already have achieved market dominance

through path dependence [13].

He notes "in the presence of positive feedbacks, this process (technological path

dependence) becomes a serious challenge to sustainablity, because once the

technology becomes entrenched, there is no easy corrective action".[14] Inefficient

urban form, in which environmental decline is one of the consequences, might

draw a similar conclusion.

Goodstein, with reference to path dependence theory, lays down his

environmental challenge as the need to identify superior technological paths and

then to craft a strategy to promote clean, cheap options. The obstacles to better

environmental outcomes once again relate to a lack of knowledge - and perhaps

ability to apply that knowledge. For governments the obstacles include having

poor information about:

(1) environmental consequences of a given technology;

(2) future production costs and markets;

(3) political - economic machinations to deviate.

[13] Goldstein, 1995, p 1032
[14] *ibid*

Yet, even if these obstacles can be overcome, hindsight may still reveal a better

course of action was possible. The limitations of information available at the time

lead to an environmentally poorer outcome than that which might otherwise have

been achieved. Path dependence theory indicates that while technology may be

locked-in, the challenge seems really to be able to stimulate environmentally

sustainable technologies given improved information.

MODELS

Models incorporating path dependencies have included the application of

probability theory through to econometric interpretations of neo-classical

economics. Mathematical processes using 'sensitive dependence on initial

conditions, or making allowance for 'memory' have been incorporated for path

dependence.[15]. For outcomes that are non-linear and have non-equilibrium

dynamics, non-predictability of events and potential inefficiency of the outcomes

will all need to be taken into account.

Vega-Redendo, among others, has incorporated a number of path dependent

properties into the pattern of technological change. However, it is noted that

changes in the 'knowledge' based sectors do not leave the same 'physical' legacy

of a superseded urban form. It is the physical application of the technologies that

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[15] Liebowitz and Margolis, 1995

creates the inefficiencies and externalities that need to be incorporated into the wider urban system.

Vega-Redendo (1994) in his approach to modelling technological change stresses its path dependent nature. He has graphed technological change to show the direction induced by change, thus creating a 'structure' for path dependence. The magnitude of switching costs in any shift in technology is also shown. Vega-Redendo factors in innovation and lagged diffusion with quite different qualitative behaviour arising depending on the extent time lapsed since inital adpotion, and in particular the magnitude of the diffusion lag. The resultant effects include arbitrarily large differences in development patterns despite similar economic patterns. Vega-Redendo develops a second model that introduces more independent firms that "innovate, imitate and compete in the world markets, entering and exiting as determined by particular fortunes". [16] In this second model he notes that "as time proceeds, one will witness a never-ending Schumpterian process of 'creative destruction', firms exiting and entering markets as their respective technological trajectories, too mature to be redirected, become obsolete" . [17]

Balmann et al, (1996) have attempted to model locked-in situations. While their model is simplistic, they do conclude that under certain conditions, complementary and sunk costs cause inefficiencies leading to a locked-in situation of infinite duration. In their model, even if increasing returns to scale

[16] Vega-Redendo, 1994, p 164
[17] *ibid*

and net exernalities are absent, path dependency can still occur. This is due to the

time structure necessary for reinvestment, and due to the sunk costs. [18]

In Arthur's analysis, he constructs a neo-classical model where the supply

functions and the demand functions are known and simplistic. It contains two

options and two agents choosing options - only the historical events that lead to

the determination of the sequence in which the agents make their choice is to be

determined. He considers it important to ensure the inclusion of two properties

"(1) that choices between alternative technologies may be affected by the

numbers of each adopted at the time of choice, and (2) that small events 'outside

the model' may influence adoptions, so that randomness must be allowed for."[19]

Under a general framework, with the above properties included, technology

adopted is a factor of the 'probability' of each of the technologies being chosen.

Arthur (1991) has noted that allocation problems within increasing returns have

exhibited multiple equilibra (and possible inefficiency). Unike markets with

constant or diminishing returns where reflects endowments, preferences and

transformation possiblities, allocations within increasing returns may be

influenced by small events. Many differirg outcomes are possible when

equilibrium is achieved minor events may become magnified by positive

feedback and may 'tip' the system towards the actual outcome.[20] Arthur has

concluded that a 'dynamic' approach, by incorporating the possibility of 'random

[18] Balmann, et al , 1996
[19] Arthur, 1991, p 123
[20] *ibid*, p 127

events' will help assisting in identifing which outcome will be selected. Through static analysis, the multiple equilibra can be highlighted. But this analysis will not further assist in answering questions surrounding resource allocation. Arthur attempts to develop a simple model to help explain how a set of random events might drive some adoption processes towards particular outcomes. Two other features of increasing returns 'non-predicability' and 'potential inefficiency' are also considered. The first, 'non-predicability'; relates to how increasing returns may act to magnify random events as adoption occurs, despite the knowledge of preferences, and potential of the technology. The second, 'potential inefficiency', refers to increasing returns leading to the lock-in of a technology that may be inferior in the long term. [21]

Arthur notes that under constant return and diminishing return regimes, the evolution of a priori endowments, preferences, and transformation probabilities occurs. Small events do not sway outcomes. He suggests that in these circumstances, this reduces history to the status of a "mere carrier - the deliverer of the inevitable". However, this is not the case under increasing returns - many outcomes are possible. With positive feedback, small events of history become important. [22]

[21] Arthur, 1989
[22] *ibid*, p 127

THREE DEGREES OF PATH DEPENDENCE

Liebowitz and Margolis (1995), have characterised path dependent outcomes as involving three different types of conditions. These outcomes are referred to as degrees of path dependence - first, second and third. [23]

First Degree Path Dependence is an intertemporal relationship that has no implied inefficiency as a result of the path dependence process. The event that has lead to the path dependent outcome may or may not have had a major influence, however, the early decision is understood and taken into account. Outcome efficiency may not have been negatively influenced at all.

Second Degree Path Dependence is an intertemporal effect that produces an unavoidable error. Given hindsight, the decision that lead to the inefficient path dependent outcome would not have been taken. The inferiority of the path chosen was unknown at the time. Both first and second degree path dependent outcomes are not considered by Liebowitz and Margolis to be inefficient in any meaningful sense given the assumed limitations of knowledge. The path dependent outcomes may be seen as inefficient in retrospect, but this is now recognised and future decision making will take this into account.

Third Degree Path Dependence is seen as the critical definition and the focus of discussion on path dependency in general. Like second degree path dependence,

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[23] This section is based on Liebowitz and Margolis' (1995) categorisation of path dependecy.

an intertemporal event leads to inefficient outcomes. However, in the third degree

path dependent version, not only was this error known, it was known to be an

error at the time of decision making and was therefore avoidable. A feasible

arrangement existed for achieving a better outcome, yet it was not pursued. The

predictability of third degree path dependent outcomes is limited, even given the

starting position and the knowledge of preferred outcomes. The market failure

occurs as a result of persistence with certain choices, despite knowledge that

indicates the availability of other more suitable choices. These market failures

appear to be in conflict with the neo-classical approach of profit maximisation. In

analysing third degree path dependence, questions raised include: Why were all

the costs and benefits not taken into account during the decision making process?

Why was the information that would lead to a more efficient outcome not acted

upon?

In the First Degree Path Dependence form, where the locked-in situation being

the efficient outcome, little interest is held in further examination. Any economy

with durable characteristics will at least exhibit this form of path dependence. As

Liebowitz and Margolis note, "all dynamic models that specify a capital stock

that is constrained to change according to a continuous differential equation use

this notion of path dependence". [24] In First Degree Path Dependence, firms

become locked-in to inferior technology until the average total costs of investing

in new technology is lower than the average variable costs of continuing with the

old. This example is illustrated in a spatial form in the inner industrial suburbs of

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[24] *ibid*, p 210

Sydney. Older-style industrial premises become obsolete, but still hold some

profitability - average variable costs of the old technology are lower than the

average total costs of the new. However, when the opportunity costs of

maintaining the presence on the old site, as compared to selling and moving to a

cheaper more remote site, are factored in, the result is that many of these firms

will move westward.

Second Degree Path Dependence resembles more closely the neo-classical model

- everyone seeks a wealth maximising outcome - within the constraints of current

knowledge. However, there is still a know edge deficit. The inefficient outcome

results from incomplete information. If the inefficient path continues to be

followed as it has been, it becomes locked-in, and the resultant inflexibility to

change would appear to have similarities with the redistributive inefficiencies

associated with institutionalism. [25]

In the Third Degree Path Dependence exa mple, at some time there is an

alternative action where the discounted present value of the total social benefit of

selecting that action as opposed to another action, are known to be greater than

the discounted present value costs, yet the other action is still taken [26]

Reasons given in the literature on path dependence as highlighted by Liebowitz

and Margolis as to why the wealth maximising action was not taken include: (1)

[25] Liebowitz and Margolis, 1995, p 211, noting Williamson (1994) "The Politics of Redistribution and Inefficiency" Working Paper, University of California
[26] *ibid*, pp 211-2

Minor decisions are made that have major consequences, yet the makers of the

small decisions (that have significant impacts leading to inefficient outcomes to

be locked-in) do not have to face the consequences of their decisions; and (2)

Varied aspects of market failure - lack of coordination; markets too immature to

function adequately; some of the affected parties were not in the market when the

decisions were made.

While noting these aspects, Liebowitz and Margolis's central tenement is that in

some cases: (1)Agents making the small but significant decisions are confronted

with all the consequences of their actions; (2) Losses implicit in any path

inefficiency may prompt the seeking of better arrangements. Why maintain the

inefficiencies?; and (3) The cause of the inefficiencies may not be corrected by

private action, or any other form of action - it is permanent [27]

Examples of Third Degree Path Dependence include the introduction of the

QWERTY keyboard, as discussed by David (1985), where premature

standardisation and decentralised decision-making has subsequently had the

decision locked-in - despite the efficiencies apparent by using an alternative

layout. [28] While used here as an example of technology and path dependence -

"premature standardisation" and the consequences of "decentralised decision

making" are two elements that may warrant further examination in the context of

urbanisation processes.

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[27] *ibid*, p 212

[28] David, Paul "Clio and the Economics of QWERTY", *American Economic Review*, Vol 75, May 1985

Knowledge or information is a critical determining element of Liebowitz and

Margolis' degrees of path dependence definitions. For Third Degree Path

Dependence to occur there must be decision-makers with enough information to

know that the course of action purposed will not lead to the most efficient

outcome - that alternative choices will lead to better outcomes. However, they do

not use this better information. If rational decision making is to be assumed, and

it is assumed that rational decision making includes profit-maximising decisions,

the question to be answered remains why, n Third Degree Path Dependency, has

the inefficient course of action been allowed to proceed? This highlights one of

the concerns associated with applying path dependency theory.

AGGLOMERATION ECONOMIES AND PATH DEPENDENCE

The properties of path dependence theory appear to be readily applicable to

location decision making, including those influenced by agglomeration

economies. As Krugman (1991) notes, "if there is one single area of economics

in which path dependence is unmistakable, it is in economic geography - the

location of production in space". [29] He illustrates the relationship between path

dependence and the location of firms through historical examples such as the

case of the manufacturing belt in the USA. Manufacturing within the

Northeastern corridor remained locked-in despite the movement of resource

extraction employment westward. Krugman presents a core-periphery model to

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[29] Krugman, 1991, p80

describe manufacturing location and notes the interaction of increasing returns, transportation costs and demand.

As an illustration of locked-in decision making, decision-making involving the location of firms when agglomeration economies exist could be used. The choice between site A and site B is made by the first few firms to move to the locality and initially site A is favoured. This will then attract others to locate at site A. Site B may be a more suitable site for regional efficiency, given the importance of agglomeration economies for individual firms, ans so site A could be considered effectively locked-in - despite site B being optimal on efficiency grounds [30]

Property ownership is highlighted as a critical condition within the location decision-making process. The owners of an important location gain advantages, through rents or access, from owning that site. An important resource, such as transportation, could also be a critical condition. Under agglomeration economies, property ownership and the ability to internalise these economies through rents, enable the process to be initiated. If no advantage was available to the initiating firm, then the only advantage would occur to those entering the location at the end of the process when agglomeration economies are clearly evident. The incentive would be to delay locational decision-making until the last. As a recourse the property owner may offer incentives to encourage firms to

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[30] Liebowitz and Margolis, 1995, pp 217-8

initially locate at their site, with the intention of recovering the initial losses

through the gains made possible once agglomeration economies take hold [31]

LOCATION DECISION MAKING - CHANCE, NECESSITY OR CHANCE AND NECESSITY

Arthur (1994) discusses three conditions or stylised 'locational models', affecting

location decision making. These conditions he refers to as 'chance', 'necessity'

and 'chance and necessity'. Chance centres around small random events in

history, while necessity is determined by economic forces.

The first model he refers to as 'pure necessity', where location is determined

under independent preferences, and each firm choses the location with the

highest return. [32] In this model there are constant probabilities of choice. Random

events, while important at the start of the process, are progressively averaged

away. The resultant locational patterns are the result of economic forces alone.

Historical events cannot influence outcome.

Location in the second model is driven by 'pure chance'. It is referred to as

location spin-off where spin-off firms chose to locate nearest the 'parent' firm.

Under this model chance events become all important and include the 'chance

historical events' where parent firms 'spin-off' new firms. The US electronics

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[31] *ibid*
[32] Arthur, 1994, p 101

industry is given as an example. Firms are incrementally added to each region -
the probabilities being equal to the proportion of firms in each region. Each time
the spin-off process occurs, it is likely that a different locational pattern will
result. Industry location is highly path dependent in this model.

The third model, a combination of the first and second models, is titled 'chance
and necessity': location under agglomeration economies. Under this model,
chance events act to select the location pattern that will finally become fixed.
Industry grows, firm by firm, as in the pure necessity model, however one region
will have physical advantages that will lead it to get ahead. New firms entering
will then choose this region to take advantage of the agglomeration economies.
Under this model a monopoly of an industry by a single region occurs. [33] The
region that is initially the most economically attractive and has the 'chance'
build-up of firms at the start, will have a higher probability of gaining
dominance.

In determining location pattern history in this case, random small events become
determining factors when there are multiple solutions and multiple fixed points.
By applying the three models in a proportions-to-probability mapping exercise,
Arthur notes "history counts when expected notions of a region's shares do not
always lead the location process toward the same share" .[34]

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[33] *ibid*, pp 103-5
[34] *ibid*, p 107

EVENTS - SEQUENCE OF EVENTS - THE ROLE OF HISTORY?

The sequence of events, even if they are apparently insignificant, may have an important impact on final outcomes. Liebowitz and Margolis note this as one of the appeals of the path dependency concept - the importance of history over other conditions such as technology and endowments. In this view, 'history' is seen as the tool to help understanding. [35] However. under this view, if the sequence does not affect the outcome, then history becomes merely the "deliverable of the inevitable"[36]

Accepting the limitations of this view sees history as seeking purpose in past actions. However, for the purposes of a path dependent analysis of the "sequence of events" and its impact, history holds importance. Still the events themselves can leave a persisting influence. David (1994) notes that economic models need to specify what happens away from equilibrium. Attention needs to be given to characterising reactions of agents to unpredicted changes in the environment. [37]

A BRIEF NOTE ON INSTITUTIONALISM AND PATH DEPENDENCY

While it is not intended to examine the way institutions impact on the performance of economics, a brief explanation of institutionalism and it's similarities with path dependence (lock-in, increasing returns, positive feedback

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[35] Liebowitz and Margolis , p 223
[36] Arthur, 1989, p 127; Liebowtiz and Margolis, p223
[37] David, 1994

mechanisms) might prove useful. However, at the end of the day, the impact or implication of institutions may further complicate an already complex system.

Institutions, by providing a structure to everyday life, reduce uncertainty. They define and set limits to the set of choices available to individuals. They provide the framework within which human beings interact. Individuals make choices within the constraints institutions place on those choices. While institutions have been created to reduce uncertainty, they themselves are always changing. Norms of behaviour are evolving, as are codes of contact, laws and contracts - continual evolution which alters available choices. [38] As institutions are not static, the changes faced by them may be influenced by similar changes faced by technologies or urban form - path dependence, lock-in, increasing returns may all be of relevance.

Institutions set the rules of the game in a society which creates constraints on human interaction and affects the performance of economies.[39] Institutions are devised by human beings to create order and reduce uncertainty in exchanges. They assign individual agents to well defined roles where it is anticipated that their actions will be consistent with the actions of other agents. Membership of an organisation requires a tolerable level of conformity, and behaviour is limited to parameters established by a well specified role. Institutions need methods to maintain this order and require ways to enforce the 'contract'. This might be

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[38] As developed by North, 1993
[39] *ibid*, p 3

done through members of the organisation holding similar values, or alternatively by having some externally imposed sanction.[40]

The information channels and codes that are part of institutions, and on which a great deal of resources can be expended for their maintenance, are a form of 'sunk' organisation capital. These channels are durable and have been developed over time through experience gained from human interaction. As an organisation can acquire more information than any individual agent, the filtering process, coordination and interpreting are crucial. At the same time, the learning of organisational codes are irreversible investments[41]. Firms train staff in operational procedures. While firms can 're-train' staff to 'un-train' staff presents greater difficulties and the precedures can become intrenched. Initial success in the type of code or information channelling being operated by the institution could be considered to be a form of positive feedback - locking in a code despite the possibility that more efficient versions may exist. The use of a particular channel once locked in leads to path dependent outcomes.

Conventions could operate in a similar way to that of codes and information channels. Conventions refer to 'common knowledge' and consistent expectations of the ruling conventions. Rational actions and preferences enable the conventions to work - through reinforcement, through precedent, through being a part of the agents' shared history. 'Accidents of history' that actually help assist

[40] David, 1994, p 207, 210, 211
[41] David noting Arrow, 1974, p 55 - Arrow, K. J , *The Limits of Organisations*, W.W. Norton, New York, 1974

coordination may acquire durability in human social arrangements.[42] Events early in the path, even if at the same time seeming insignificant, determine outcomes.

Institutional systems differ from technological systems in that they are not composed of sensate, volitional actors[43]. Institutions and organisations are required to coordinate the actions of human beings into a defined role. Institutional structures are more rigid and less able to passively adapt to environmental pressures. As a result they create incentives to alter the external environments. The success of the institution may be determined by how well it copes with the external environmental pressures.

Information channels and their use for organisational goals will impact on the success of the institution. Paradoxically, as institutions can collapse or can be taken over, knowledge and information structures are more at risk than the linear, cumulative technological development. Much effort (and waste) goes into a knowledge base that can fluctuate. For technologies the knowledge is, in effect, captured within the technology itself. David notes "much human ingenuity and effort is continually being poured into the reinventing and the rediscovery of organisational techniques and institutional arrangements that have been lost and found several times over".[44]

[42] David noting Lewis, 1969,
, Harvard University Press, pp 39, 41-2
[43] David, 1994
[44] *ibid*, p 219

Institutional path dependency can be driven by the mutually consistent expectations needed to enable individual decisions to have some coordination with the need for a central organising function. For large organisations to operate, and with durable capital assets, consistent codes and information channels are required if the organisation is to function with any level of efficiency. Pressure to maintain consistency and compatibility within larger structures place constraints on choices available, particularly on roles and procedures.

David (1994) suggests a close similarity in the underlying fundamental microeconomic conditions between the positive feedback dynamics typical of the path dependent processes involving technological evolution. David does caution the application of this suggestion saying that there are parallels, but these parallels should not be projected all the way to the conclusion that 'institutions, after all, are just like technologies" [45].

David concludes that history does really matter to institutions when certain conditions obtain the following:

(1) The durability of learned modes of communications and role types;

(2) The multiplicity of solutions that may be found to yield coordination benefits; and,

(3) The complementarities are created when organisations add mutually adapted procedures, and institutions evolve precedent-based rule

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[45] *ibid*, p 218

structures to maintain consistency in expectations and minimise the obsolescence of organisational capital" [46].

LIMITATIONS OF PATH DEPENDENCE THEORY

Path Dependence could be a useful descriptive mechanism by which to highlight the impact of a sequence of events, but as Liebowitz and Margolis have noted, path dependence is no "new economics" [47](p224). The actual reason behind Third Degree Path Dependence may be a market driven element previously unnoticed and undescribed. The example of consumer preference of a lengthier recording time is give as the critical aspect of VHS becoming the industry standard over Beta. It was not a case of Third Degree Path Dependence because Beta produced a better recording quality and this was known at the time [48].

In the case of First Degree and Second Degree Path Dependence, the outcomes may be readily explained within conventional neo-classical economics. Information, or rather incomplete information, when applied, produces less than optimal outcomes. Once this has been discovered, corrections are made in accordance with profit maximising objectives.

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[46] *ibid*
[47] Liebowitz and Margolis, p 224
[48] as outlined in Liebowitz and Margolis, pp 218-22

When an apparent market failure has occurred, despite knowledge that an alternative course of action was available, rigorous examination of that 'information' needs to be forthcoming. This examination may reveal other elements, such as communications, planning, and/or market institutions, that may be essential to formulating the correct explanation of the events themselves. [49]

David (1993), says that the success or failure of non-equilibrium dynamic model building in economics, and the recognition or rejection of path dependency as a property of resource allocation processes, will in the end require empirical examples[50].

CONCLUSION - IMPLICATIONS OF PATH DEPENDENCE

As a conclusion, a number of implications associated with path dependence, as highlighted by David (1993) are outlined below. This list may prove useful when further examining the potential of path dependence as a mechanism that has directed actions and lead away from predicted or preferred outcomes. These include:

- 'Events' leave a persisting influence, and minor, apparently insignificant events may have a substantial influence on outcomes. Accordingly, attention

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[49] *ibid*, p 224
[50] David, 1993, p 40

also needs to be directed to examining the reactions of agents to unpredicted changes - examination of non-equilibra.

- Where positive feedback systems operate, greater attention should be directed towards examining the motivation, belief, and ideologies of agents.

- Sudden shifts in structure can be explained in non-linear, positive feedback models. 'Stage theories' of development may be comparable.

- Timing is important. Apparently weak shocks early in a dynamic process can effectively select the final outcome. Later in the process the system with sufficient momentum may be costly to correct. Accordingly, effective intervention involves optimal timing - 'windows' of opportunity may be open only briefly.

- 'Complexity', as a property of the dynamic stochastic systems, constrains the ability to collect relevant empirical evidence. Enough data for suitable time series cannot be generated from consistent probability estimates.

- Finally, David asserts the need for acceptance of the idea that mechanisms of resource allocation and the structure of material life 'evolved' historically, through a sequence of discrete adaptation .[51]

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[51] *ibid*, pp 38-40

CHAPTER TWO

PATH DEPENDENCY AND THREE THEORIES OF ECONOMIC LOCATION

PATH DEPENDENCY AND THEORY THEORIES OF ECONOMIC LOCATION

THEORIES OF ECONOMIC LOCATION - THREE APPROACHES

Economic location theories can be divided into three main theoretical approaches - neo- classical, behavioural and structuralist approaches[52]. These theoretical approaches have been developed to provide insights into the location decision-making made by economic agents. Collectively they attempt to describe and explain the shape of settlement patterns, presenting a theoretical background to urban form. General theories provide basic organising categories for further, more detailed and specific, analysis. They themselves are not explanations but are necessary to them[53]. "Theories are abstract, putative explanations that identify types or kinds of entities, relations and processes and types of casual connection inherent in the world"[54]. As Fogarty (1981) notes, it is difficult to generalise about societies beyond a certain point. "At best a general theory only stimulates investigation, it does not yield explanation nor substitute for close studies of the particular society"[55].

A brief outline of each approach is provided below. While it is expected that the relevance and success of models developed under each theoretical approach will

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[52] Lever, 1987; Healey and Ilbery, 1990

[53] Lloyd, 1995a

[54] Lloyd, C. "Australia's Role in the Evolution of World Capitalism: Towards a Comparative Conceptual Analysis", Unpublished Paper presented to the World History Association Conference, Firenze, June 1995b

[55] Fogarty, J. P. 'The Comparative Method and the Nineteenth Century Regions of Recent Settlement" *Historical Studies*, No. 76, 1981, pp 112-29; quote at page 428

vary, it is hoped that a broadbrush summary will shed some light on the directions other researchers have pursued. This should help to assist in placing the spatial application of path dependency and historical lock-in within a relevant theoretical context.

Neo-Classical Location Theory

Neo-classical location theories share with neo-classical economics a number of common characteristics. In both theories, economic agents are assumed to be rational decision-makers, to have complete knowledge, and to be seeking profit maximisation outcomes. There is market order, and spatial application is uniform. Economic activity is unconstrained and competitive, the economic agents are free to enter, and exist in the market place.

Initial applications of neo-classical location theories examined location in terms of access to inputs, access to markets and the transportation cost minimisation. Later applications also included variations in the production costs associated with land, labour and capital, and the locational impacts on profitability[56].

Initial neo-classical models were the result of deductive reasoning derived from general principles. They were not based on 'real-life' observations, and for this reason have been subject to criticism. The focus of the models was on the interrelationship of a limited number of select factors and the spatial

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[56] Lever, 1987

consequences of these interrelationships. Despite this apparent inflexibility, a number of neo-classical models have proved useful in giving some insight into factors influencing location decision-making.

Earlier models sought explanations for the spatial patterns by examining the details of the spatial patterns themselves. These included Von Thunen's land use model (1826), Weber's industrial location model (1909) and Christaller's central place theory (1933).

Von Thunen's model was developed to describe agricultural land use patterns, and is based on the concept of economic rent. Economic rent refers to the difference between income and rents. This is controlled by the cost of transporting agricultural output to the market, which in turn is a function of distance. In von Thunen's model, the bulky, expensive-to-transport goods would seek to locate closest to the market. This would also be the case for perishable goods where time expended to get to market is critical. This model relies on a linear relationship between distance and travel costs, as well as a homogeneity in physical environment[57].

Weber's theory of industrial location incorporates a 'location triangle' with the market place at one point, and material inputs at the other two points. The optimal location of an industry is then sought within this triangle. The optimal location is the profit maximising location and, as in von Thunen's model,

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[57] Healey and Ilbery, 1990, p 20

transportation costs are a critical factor. The objective is to determine where transporting inputs to the industry, and goods to the market, would be minimised. This model proves difficult to expand beyond the aggregate travel functions, but it is not impossible. Allowance for labour costs can be incorporated into Weber's model by adding an axis (actually circles) that indicates where total transport costs are equal. Optimal industry location is then the point that incorporates transport cost minimisation as well as the point of least labour costs. Agglomeration economies can be incorporated into Weber's model by accepting that firms may be willing to incur increased transport and labour costs if overall unit costs in production are reduced at certain locations.

Smith (1987) highlights the expansion of Weber's basic model outline by incorporating variable-cost approaches, variable-revenue approaches, and the spatial interaction of both cost and revenue approaches. Under the variable-cost approach, other input costs such as power, capital, and land are added to the initial locational figure - Weber's 'triangle' becomes multi-dimensional with each input having a spatial cost surface.

Variable-revenue models incorporate the demand considerations neglected in the variable-cost approach. A conventional demand curve, with a price and quantity access, is expanded by adding a third plain indicating distance (from market). Price rises are proportional to distance from the industry (of the market). The delivered price reflects transportation costs as well as the cost of production.

The spatial interaction of the cost and revenue approaches involves identifying the least-cost location for a given output. To determine the revenue-maximising location, some assumptions regarding production costs is required, which in turn is dependent on the scale required to maximise revenue at a given location. Difficulty is experienced in determining the maximum revenue at the minimum cost site as each of the three basic production decisions of location, scale and technique are mutually interdependent. As Smith (1987) notes " different levels of demand (in different places) require different volumes of output. Different scales of production can require different techniques, and substitution among inputs can generate different patterns of cost variation in space and a different least-cost location. Thus, there can be a different optimum for each scale of output"[58] . It would almost appear that there is an exponential increase in model complexity with each additional factor included within the model itself.

Christaller's central place theory is a hierarchical model of the size, spacing and function of settlements based on (i) threshold and (ii) range. The 'threshold' is the minimum level of demand needed to maintain a service, while the 'range' is the maximum distance a consumer is willing to travel to purchase the service[59]. Smaller centres provide low-order goods and an increasingly smaller number of higher-order centres providing more specialised goods. Three types of systems were modelled by Christaller, each with a different catchment hierarchy. These systems were based on (i) the market principle, (ii) the transportation principle - where transport costs are particularly influential, and (iii) the administrative

[58] Smith, 1987, p 29
[59] Healey and Ilbery, 1990, p 22

principle - where a greater concentration w thin fewer select higher order centres occurs. Christaller's model works most effectively when applied to the distribution of consumer services. Producer services, which are information dependent, fare unfavorably in comparison[60].

While there is value in neo-classical models that provide insightful descriptions of elements within larger urban systems, these models have been subjected to a variety of criticism concerning their relevance for spatial systems analysis. As an example, critics of Weber's models, as with the critics of von Thunen's model, have noted, that the attractiveness of a two-dimensional mathematical solution to location decision-making disappears when answers to real-world locational outcomes are sought[61]. Healey (1990) lists what he believes the main limitations of neo-classical locational models as:

1. discounting non-economic motives that are also relevant to understanding economic behaviour;

2. being largely devoid of empirical content;

3. principally descriptive rather than explanatory;

4. are static and fail to take account of the social and economic changes that have occurred;

5. ignore both the importance of history and the position of the firm within the total economic system;

[60] *ibid*, p 23
[61] Smith, p 25

6. the social system within which economic activity is modeled is taken

for granted, and are thus culturally and behaviourally independent[62]

Finally, in defence of neo-classical approaches to spatial modeling, Smith (1987)

believes that the criticism of neo-classical theory may be misdirected. He

suggests that this criticism is centred on the neo-classical model's apparent

failure to explain reality, when to explain reality is neither its sole nor principlal

purpose. He also suggests that these critics of neo-classical models are perhaps

expecting too much from them in the first place. These models should be used as

a guide only; however, both private and public location decisions can be assisted

by neo-classical theoretical models. "If neo-classical theory is used

retrospectively to reveal that real industrial plants are not at their economic or

social optimum locations, this would hardly be surprising in a world of limited

human ability and wisdom"[63].

Behavioural Approaches to Location Theory

The incorporation of behavioural approaches to location theory was developed in

response to a disillusionment with the more deductive neo-classical models[64].

Models were sought that more closely reflected the sub-optimal outcomes that

were occurring in reality. These outcomes may have been the result, for example,

of the application of less than perfect knowledge. Alternatively, for larger firms,

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[62] Healey and Ilbery, p 23
[63] Smith, p 36
[64] Healey and Ilbery, p 23

they could reflect the influence these firms had on their external environments, such as the price of input materials, labour inputs and market penetration[65].

Behavioural approaches recognise that locational decision-making should be considered more holistically as part of the general investment decision making process of an enterprise[66]. Consideration of a wider decision making environment would enable all aspects of the location of new productive capacity, including increasing capacity at existing locations and not just plant relocation[67].

Under the behaviourist approach, generalisations on the economic forces are sought on what is actually happening in reality. A wide variety of variables can be examined under the behaviourist approach including motives, values, preferences, perceptions and opinions. Behavioural approaches deal with dynamic environments addressing areas such as innovation, technology and economic development[68]. This approach recognises that locational decisions are only part of a wider decision making environment, and many non-locational decisions will impact on locational outcomes, for example decisions on production mix and production quantity may both influence final locational outcome[69]. Carr (1983) noting Dicken (1971)[70] argues that behavioural theory is

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[65] Wood, 1987, p 39
[66] Carr, 1983, p 390
[67] noting Townroe, 'Some behavioural considerations in the industrial location decision", *Regional Studies*, , Vol. 6, 1972, pp 261-72
[68] Carr, 1983, noting Simon, H.A., "Theories of decision-making in economics and behavioural science", *American Economic Review*, Vol 49, pp 253-83
[69] Lever, 1987, p22
[70] Dicken, P., "Some Aspects of Decision-Making Behaviour of Business Organisations", *Economic Geography*, Vol 47, 1971, pp 426-37

principally applicable to two main areas (i) the firm's organisational structure,

and (2) the goals and objectives of the firm

Carr stresses that if industrial change is to be understood, the size and

organisational structure of the whole enterprise needs to be understood. A wider

view is required than simply examining small-scale production units[71].

Steed[72], as noted by Carr[73], suggests that goal formation was a function of the

external environment. Objectives involved adaptive behaviour to feedback -

although these could be distorted by perception and long-term uncertainty.

Adaptive behaviour was seen by Krumme[74] to be the result of deviations from

the optimal location. He saw a static equilibrium as having little value, and based

locational adaptation on three criteria - space, organisation and time. Steed

(1971a) in considering long-run adaptations, suggests that a firm's survival is

only possible with continuous adaptation - which is not necessarily spatial - made

in response to external environmental pressures[75].

Behavioural approaches argue that businesses are attempting to concurrently

manage multiple goals, of which profit maximisation is only one. Business

survival, business growth, risk minimisation, and self-preservation may be all

[71] Carr, p 388
[72] Steed, "Plant adaptation, firm environments and locational analysis", The Professional Geographer, Vol 23, 1971a, pp 324-28; and, Steed, 'Forms of corporate-environmental adaptation", Tijdschrift voor Economische en Sociale Geographie, Vol 62, 1971b, pp 90-94
[73] Car, p 388
[74] Krumme, G., "Notes on Locational Adjustment Patterns in industrial Geography", Geografiska Annaler, Vol 51B, 1969, pp 15-19, as noted in Carr, 1983, p 388
[75] Carr, p 394

competing goals[76]. Spatial change is examined in the context of firms seeking to achieve a wide variety of outcomes[77]. Behavioural studies have also examined the structures of control adopted by firms and investigated how these control mechanisms have been utilised to attain business goals[78].

Unlike the early neo-classical 'economic man' approaches, behaviourism recognises that decision-makers do not have perfect information when selecting locations. Healey and Ilbery (1990) highlight Pred's behavioural matrix which attempts to conceptualise the relationship between the information available to decision-makers, and their ability to use that information [79]. Pred's matrix aims to illustrate decision-making at the 'margin of transference' - the point of change from one land use to another. Quality and quantity of information form the vertical axis, while the ability to use that information is measured on the horizontal axis. The position on the horizontal axis is influenced by, for example, education levels and aspirations levels. The positions on the vertical axis are influenced by the nature and importance of information flows, and the decision makers location to them. Some entrepreneurs will become more informed over time, and will move through the matrix towards the apex, at which is located 'economic man', where complete knowledge and complete ability to use that knowledge exist[80].

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[76] Healey and Ilbery, p 24
[77] Wood, 1987, p 41
[78] Wood, 1987, p 40 - noting the studies undertaken by Dicken, 1976; Wood, 1978; and Marshall, 1982
[79] Healey and Ilbery, pp 24-5
[80] Pred, Behaviour and Location: Foundations for a Geographic and Dynamic Location Theory - Part 1 1967 and Part 2 1969, University of Lund, *Lund Studies in Geography B,* Numbers 27 and 28.

With regard to the factors of risk and uncertainty, behavioural approaches have highlighted entrepreneurs as more likely to be attempting a perceived demand, rather than seeking to achieve the optimum outcome possible within the constraints of their available knowledge and resources[81]. Under this concept the entrepreneur will do the best they can on the information they have, with the tendency to accept the first satisfying decision from available options - whether the decision results in sub-optimal outcomes or not.

Game theory is also an extension of behaviourist approaches, and takes into account an entrepreneur's incomplete knowledge. This theory incorporates outcome probability associated with uncertainty and rational choice of strategies[82].

Whilst behaviourist approaches have broadened the scope for analysing locational decision-making, these approaches have been open to substantial criticism. A useful summary of these criticisms is provided by Healey and Ilbery[83], and is outlined below:-

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[81] Healey and Ilbery, 1990, noting Simon, H. A., *Models of Man; Social and Rational*, Wiley, New York, 1957
[82] *ibid*, p 25
[83] *ibid*, p 26, citing Massey, D., , "A Critical Evaluation of Industrial Location Theory" in Hamilton, F.E.I. and Linge, G.J.R. (eds.), *Spatial Analysis, Industry and the Industrial Environment, I, Industrial Systems*, Wiley, Chichester, 1979, pp 57-72; and also citing Bunting, T., and Guelke, L., "Behavioural and Perception Geography; A Critical Appraisal", *Annals of the Association of America Geographers*, Vol 69:, 1979, pp 448-63

1. Behavioural approaches have failed to answer the problems associated with the neo-classical approaches- including poor explanatory power. They have highlighted the existence of variations in behaviour but not explained them.

2. Too much emphasis is placed on the attitudes of the individual entrepreneurs rather than on behaviour itself.

3. There is no generally accepted behavioural methodology. This has hindered the search for generalisations.

4. Behaviourism is heavily reliant on choice and inadequately addresses controls - personal or general.

5. Too much autonomy is given to factors at the 'firm' level - wider economic and societal pressures tend to be ignored.

Structuralist Approaches

Structuralist approaches relate industry and employment locations to the underlying structure of society - including economic relations, class relations and social and spatial organisation of production[84]. The interaction between labour and capital is considered a key issue[85]. The way surplus capital is circulated, concentrated and utilised in space is considered crucial under the structuralist approach[86]. It includes the analysis of industry restructuring and the geography of job loss, the analysis of social processes and the spatial organisation of

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[84] Lever, 1987, p 22
[85] *ibid*
[86] Johnson, R.J., *Geography and geographers: Anglo-American human geography since 1945*. Edward Arnold, London, 1987

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production[87]. The structure of the capitalist society provides many of the answers

to labour locational issues[88]. The structuralist approach aims to set the changing

geography of industry and employment within the wider context of the

development of capitalist society[89]. Uneven spatial development is seen, under

the structuralist approach, to reflect the process of capital accumulation with

capital restructuring occurring at a variety of scales - global, national, local[90].

From the spatial viewpoint, the structuralist approach to 'space' is that it is what

the economy makes of it, and the economic landscape is the product of the

overall structure of the economic system[91]. From the system-wide perspective,

individual decision-makers are constrained by external forces such as social,

political and economic processes[92].

The structuralist approach assists explanation, according to Boddy(1987)[93], as it

places emphasis on the analysis of production rather than more simplisticly on

'locational factors'. Production is seen as a social process within a wider political

and ideological context. It examines production processes and the spatial

organisation of production, rather than just spatial distribution of location factors.

It argues that spatial patterns do not necessarily reflect spatial causes, but also

reflect the locational requirements of industry which can change as a result of

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[87] Boddy, M.J., "Structuralist approaches to industry location" in Lever (ed.), *Industrial Change in the United Kingdom*, Longman, London, 1987, pp 56-66
[88] Watts, *Industrial Geography*, Longman, Harrow, 1987
[89] Massey, *Spatial Divisions of Labour: Social Structures and the Geography of Production*, Macmillan, 1984
[90] Healey and Ilbery, 1990, p26
[91] *ibid*
[92] *ibid*
[93] Boddy, 1987

changes to the production process[94]. Production is seen as a social process in that

the process of capitalist commodity production in pursuit of private gain has

integral to it the basic class driver of labour and capital. Noting Massey (1984),

"a real exploration of industrial geography takes one into historical shifts in

national politics, into the vast varieties of social forms of capital, into the whole

arena of gender relations..."[95].

Understanding the macro-scale socio-economic processes that underlie the spatial

patterns is a dominant feature of the structuralist approach. It is felt that

explanations of the economic patterns can rot be found from within the patterns

themselves, thus the structuralist approach focuses attention on the processes

underlying the economic patterns themselves[96]. The overlaying of successive

rounds of investment can lead to the superimposition of different spatial divisions

of labour. Factors of production such as labour and infrastructure are largely the

product of the provision of the spatial division of labour and investment[97].

Timing and the historical consequences of the development of the production

system is also critical to the structuralist approach. As one mode of production is

superseded by another production mode, the economic system will not return to

the same spot. Economic agents are always facing a changing situation.

[94] *ibid*, p 58
[95] Massey, 1984, p 7
[96] Healey and Ilbery, p 27
[97] Boddy, 1987, p 59

Accordingly, locational and land use decisions will be specific to a certain period of time[98].

As outlined by Massey (1981), a structuralist view will see changes in location of an industry as the function of two main features: (1) changes in economic conditions which affect the needs of production; and (2) the changing geographical environment - for example, transport technology improvements. Location decision-making is seen as requiring an understanding of recent changes in both the industrial production requirements and the industries geographical environment[99].

Criticism of the structural approach, as listed by Healey and Ilbery have included:

1. The examination of wider macro-economic processes have been over-emphasised. Fragments of reality have been used to illustrate theory, rather than providing insights into the real world[100].

2. Individuals within a particular class are assumed to behave in a like manner[101]

[98] Healey and Ilbery, p 27
[99] Massey, 'The geography of industrial change" in D. Potter et al, *Society and the Social Sciences*, Routledge and Kegan Paul in association with the Open University press, London, 1981
[100] Walmsley, D.J. and Lewis, G.J., *Human Geography: Behavioural Approaches*, Longman, London, 1984
[101] Duncan, I.S. and Ley, D., 'Structural Marxism and Human Geography: a critical assessment', *Annals of the Association of American Geographers*, Vol 72, 1982, pp 30-59

3. The importance of variations in economic behaviour at the level of the

    individual or individual firm has been largely neglected[102].

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4. Structuralist approaches may have little value to spatial analysis if they

    concentrate on process and treat spatial outcomes aspatially.

PATH DEPENDENCY AS A LOCATIONAL THEORY

Path Dependence theory includes many elements of the latter neo-classical

theories and also has similarities to both the structuralist and behaviouralist

approaches. This is not surprising as neo-classical theories, behaviouralist

theories and structuralist theories themselves are each closely related.

Behaviouralist theories were developed as a response to perceived weakness in

the neo-classical approaches, while structuralist theories were in turn developed

to address the perceived weaknesses in both neo-classical and behaviouralist

approaches[103]. As discussed previously, the structuralist approaches themselves

are also not free from criticisms. The question remains whether path dependency

theory is a valid substitute or whether its value is principally as an additional

explanatory mechanism to be used in conjunction with the existing theories.

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[102] Walmsley and Lewis, 1984
[103] Lever, 1987, p 22

Neo-classical Similarities

Many of the examples developed to explain path dependency are non-locational in nature. Examples might include the choice of one particular technology over another, or the maintenance of a production process despite available evidence that suggests a more efficient and effective process exists. However, as shown by Arthur (1994) among others, spatial applications are also readily apparent. The common thread running through each of these examples is that the assumed profit maximising outcome has been influenced by one or more 'events' that have lead to a non-predicted result. Like the behavouralist theories and the structuralist approaches, path dependency builds on the foundation provided by early neo-classical theory to find answers to apparent market failure. In doing so it accepts that the static equilbra of profit maximisation is inappropriate, and attempts to utilise a non-linear, dynamic equilibrium model with the non-predictability of the events model.

Neo-classical descriptions, using agglomeration economies and increasing returns to scale, can be both readily adapted to path dependence theory of locked-in decision-making. However, some outcomes might simply be explained by conventional neo-classical models themselves, rather than complicating the explanation further by making it fit a path dependence model.

Behaviouralist Similarities

Like behaviouralist theories path dependency accepts that the profit maximising

'economic man' models are not readily transferable to real world examples. It alos

accepts that a lack of perfect knowledge and the inability to use knowledge are

common elements of both theories. Conceptualising the relationship between

information available to the decision-maker and the ability to use the information

has played a substantial role in behavioural st literature[104].

Behaviouralist approaches sought to produce models that more closely reflect the

sub-optimal outcomes that were occurring in reality. Like path dependent

approaches behaviouralist approaches deal with dynamic environments

addressing areas such as innovation, technology and economic development. The

behaviouralist examinations can adopt a wide variety of variables, for example

motives, values, preferences, perceptions and opinions. It may be one of these

variables that influence 'process', thus leading to a locked-in result.

The role of the goals and objectives of firms, their influence on decision-making

and the impact on outcomes, can be incorporated into behaviouralist approaches.

The objectives are forged by external environments and involve adaptations

based on feedback (Steel, 1971a). This provides the link upon which to apply the

impact of positive feedback mechanisms noted in path dependency theory.

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[104] for example Pred, 1967, 1969

However, questions may remain as to whether linking both approaches at this

point will increase explanatory power.

Structuralist Similarities

In linking the constraints placed on decision-makers by external social, political

and economic processes, structuralist approaches may go some way in providing

explanatory mechanisms for path dependent outcomes. These approaches might

assist to explain the circumstances in which a decision was made and why,

perhaps, the outcome remains locked-in. However, as an explanatory tool of

locked-in processes themselves, the value of the structuralist approaches appear

to be more limited.

By focusing on the basic class divider within labour and capital, and

incorporating the macro-scale socio-economic processes, a better understanding

might be gained of the 'global' environment in which spatial decisions are made.

The change (or evolution) of production processes, as a result of external

pressures, socio-economic changes and class interaction, will impact on

locational outcomes. However, while establishing the environment in which

decisions are made - a necessity in itself - the question remains as to whether

these influences 'drive' the decision-makers to make the decisions they make, or

more simply 'shape' the parameters in which decision-makers operate.

The structuralist approach has significance for path dependence theory as it recognises the importance of historical legacy. Economic agents are always facing a changing structure and as a result understanding the 'time' in which the decision took place will also reveal as much about the outcomes sought, as about the decision itself. Given that locational and land use decisions will be specific to a certain time period, the next readily made step is the acceptance of the physical legacy of spatial outcomes made in an earlier period, and its influence on subsequent decision making. In the path dependent model, decisions made with the best available information could effectively lock-in subsequent activity into a path that leads to less than optimal outcomes.

CONCLUSION

Lever (1987) notes, after comparing neo-classical, behaviouralist and location theories, that each make their own contribution to enhancing our understanding of locational decision-making. Each theory has strengths and weaknesses, and has different value as an explanatory tool depending on the type of enterprise being examined. Path dependency theory might be considered in a similar light. While not providing a universal answer to all locational outcomes, path dependency may assist in providing some explanations for land use patterns that emerge. Elements incorporated into path dependency, such as lock-in, the impact of minor 'events' and increasing returns, are likely to prove very useful in explaining locational outcomes.

The value of path dependency theory may be maximised if it is applied to specific 'real world' spatial outcomes. The dynamics of the spatial system is highly complex, and the 'structured models' have difficulty in relating to 'real world' outcomes. A more fluid approach is necessary and path dependency theory might prove suitable in providing th s approach.