

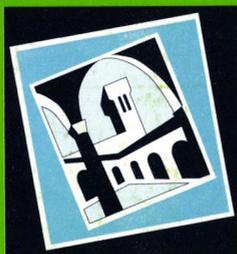
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Breaking the Path of Institutional  
Development?  
Alternatives to the New Determinism

COLIN CROUCH and HENRY FARRELL

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# Breaking the Path of Institutional Development? Alternatives to the New Determinism\*

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**Abstract.** The concept of path dependence is being used in highly deterministic ways in neo-institutionalist analysis, so that studies using this framework have difficulty in accounting for, or predicting, change. However, the original Polya-urn model from which path dependence theory draws predicts that alternative paths will be possible. It can then be argued that actors will be able to use these when they perceive a need to change. This article seeks to capture this possibility through accommodating a Bayesian parametric decision maker, interacting with an environment. This makes it possible to examine how change may involve such processes as: the use of past or redundant institutional repertoires; transfer of experience across action spaces; or from other agents, through networks of structured relationships; the emergence of perceived 'one best' solutions. This approach points to the need to change how typologies are used in neo-institutionalist research, so that those features of cases which do not fit the pre-conceived framework of a type are not disregarded as 'noise,' but properly evaluated as potential resources for change.

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Path dependence has become a key concept in social-scientific debates about institutional evolution over the past decade. Political scientists, sociologists, economists and geographers have sought to use the concept as a means of understanding institutional stickiness; that is, why actors may fail to respond to changes in the environment, even when such responses would lead to a better overall outcome.<sup>1</sup> Thus, path dependence serves explicitly as a counter to those forms of economic theory which posit that interactions between economically rational actors will lead to efficient outcomes (North 1990b; Pierson 2000b), and argues instead that inefficient equilibria may be stable. This broad claim stems from the basic theoretical foundations of path dependence theory, which seeks to model situations in which there are increasing rather than decreasing returns. In such situations, inefficiencies and sub-optimal allocations of resources can persist over time, even when actors are aware of them and are economically rational. But path dependence theory cannot strictly speaking be used to address actors coping with changes to their environment, because it does not explicitly model that possibility. We plan here to remedy this by providing a simple account of how individual actors may seek to respond to an environment with increasing returns, through patterns of behaviour that are themselves subject to increasing returns, as most patterns of behaviour are. Our central focus is therefore on how path dependent development trajectories interact with exogenously changing environments.

Path dependence theory needs this adaptation: since major change does sometimes occur, the theory is in danger of becoming excessively determinist and incapable of coping with major innovation except as behaviour derived from imitation or completely exogenous learning.<sup>2</sup> In itself it offers little insight into the conditions under which paths may change; it takes its fundamental inspiration from mathematical processes (Polya urn models) in which initial conditions may have a determinative effect on subsequent paths of development. Some scholars recognize the need to address path dependence theory's deficiencies here, but have few direct solutions to offer (Pierson 2000a). Others have more or less excluded the possible force structuring outcomes over the long term (Putnam 1993).

This has relevance for the study of institutions' effects on actors' ability to respond to unexpected crises or changes. By far the greater preponderance of work in the social sciences has emphasized how institutions may involve 'lock in' - i.e., how they may hamper actors in their efforts to respond to changed environmental circumstances, not only including the literature on path dependence, but also some of the sociological literature on embeddedness.<sup>3</sup>

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<sup>1</sup> For a representative sample, see North (1990), Putnam (1993), Pierson (2000a, 2000b), Thelen (1999), Deeg (2001).

<sup>2</sup> "Exogenous" here means exogenous to the specific environment within which the actors operate. We develop this point in the body of the paper.

<sup>3</sup> Broadly speaking, there are two explanations of lock-in in the literature. First, path dependence theory itself provides a theory of lock-in. Insofar as the mechanisms of increasing returns apply, actors may find themselves trapped in a sub-optimal institutional setting, even when other sets of institutions would clearly be more efficient, and when these

When applied too simplistically, these accounts underestimate the possibilities of change and innovation; i.e. how actors may respond imaginatively to new sets of circumstances, and employ previously unconsidered institutional resources in their responses. This is a problem of application rather than fundamental theory. Path dependence, in its original formulation, implies the existence of alternative paths of development than the one taken, which may be 'rediscovered' when actors face a changed environment which makes new demands. Embeddedness theory, for its part, was formulated precisely in order to provide an alternative to both 'oversocialized' and 'undersocialized' conceptions of human action (Granovetter 1985), and, properly speaking, examines how social ties may enable social action as well as constraining it. However, empirical work has tended to stress how increasing returns to scale and embeddedness lead to lock-in, rather than out of it.

In this article, we seek to provide a coherent account of how actors may seek to adapt to changed environmental circumstances through changing their institutional responses to that environment. Here we adopt a functional account of institutions, but not a functionalist one. We posit that institutions exist in order to fulfil certain purposes, and that actors will seek to adapt institutions in response to changes in their environment, but we make no claim that institutional adaptation is driven by systemic factors, or that institutional change tends towards social efficiency.<sup>4</sup> A fundamental problem with functionalism is of course its neglect of power relations (Knight 1992). While power relations do not figure in path dependence as such, they may create external constraints that affect actors' ability to choose between paths. We show how power may have this effect in the body of our paper (the third extension of our model).

More generally, however, we seek to advance on the current literature, which is rather better at explaining the circumstances under which actors will continue to act as they have always acted, even when their actions are no longer appropriate, than in discussing how they may adapt to new needs. We provide a simple account of the factors likely to affect actors' ability to respond appropriately to change, which we seek to complicate in successive steps, so as to incorporate new factors and possibilities that affect actors' capacities. We acknowledge that we are likely to annoy many people. Strict path dependence theorists are likely to find our arguments mathematically underspecified, while many non-rational choice sociologists, on the other

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actors know that these other institutions would be more efficient (North 1990). Second, sociologists have identified a quite different set of factors which they subsume under the more general rubric of embeddedness (Granovetter 1985). Under these accounts, actors' particular social ties both allow them to mobilize certain resources, but close off certain other possibilities of action. If actors lack the right ties, they may find themselves locked into sub-optimal patterns of behaviour and unable to respond appropriately to change. This is because their particular ties with others provide a repertoire of appropriate responses that they may learn from and apply to changed circumstances (Grabher 1993a).

<sup>4</sup> For reasons of simplicity, however, we do not try to model how actors' behaviour may itself affect their environment in a recursive fashion. We are grateful to Carlo Trigilia for bringing this set of issues to our attention.

hand, will feel that we have conceded too much to the formalists. However, it is undeniable that the causal factors emphasized by both path dependence and sociological approaches are relevant to actors' capacity to respond to environmental change, and furthermore, that these factors may interact in complex ways. Frameworks such as ours, which seek to bridge economic and sociological approaches to the explanation of human behaviour (Di Maggio 1998), represent an important – and arguably necessary – step in the evolution of debate within the social sciences.

Our arguments emphasize the importance of redundancy in providing resources which actors may use to respond to unexpected change. There is a recent tendency in the social sciences, and in political economy in particular, to emphasize how institutional systems tend to crystallize around coherent logics of ordering (Hall and Soskice 2001). However, such approaches may systematically overlook fruitful incoherencies within empirical social systems; institutional systems, far from being coherent, are characterized by redundancies, previously unknown capacities, and incongruities, which very frequently provide the means through which actors – whether firms, policy entrepreneurs or others – may seek to tackle new exigencies. Furthermore, the empirical process of institutional change and adaptation is likely frequently to involve initiatives that seek to build on these redundant capacities, 'breaking' the path rather than continuing along it.

We begin by returning to path dependence theory's roots, in Polya urn processes, reformulating the original arguments of Arthur (1994) and others in a manner that specifically incorporates the important role of redundant resources. We then seek to build out from the path dependence perspective, progressively building in refinements that address how social embeddedness may create resources for actors seeking to respond to change. Next, we examine the significance of our arguments for the methodology of recent approaches to institutional comparison in political economy. We conclude by summarizing our main findings, and demonstrating how they may provide an alternative path towards the understanding of institutional change and adaptation.

### **Current Debates on Path Dependence and Change**

Path dependence had its origins in recent developments in economic theory which seek to take account of how increasing returns may complicate equilibrium analysis. Neo-classical economists have typically worked on the assumption of decreasing returns, which allows more analytically tractable models in which rational economic actors will typically tend to converge towards the efficiency maximizing equilibrium. Path dependence, in contrast, suggests that there is no necessary tendency towards efficiency in situations where increasing returns apply. In a situation where there are a number of possible equilibria, path dependence theorists suggest that early moves will often have a decisive effect in determining which of these equilibria is chosen. Insofar as these early moves may have a self-reinforcing impact on the probability of later moves, the final equilibrium reached will by no means necessarily be the most efficient one. Thus, path dependence theory predicts that sub-optimal paths of development may be taken, which may persist

even over the long term, and even in situations where actors realise with hindsight that a different set of initial moves would have been to everybody's advantage.

The theory of path dependence builds upon mathematical modelling techniques - so-called Polya urn processes - in which early events in a series have a substantial effect on later ones. Path dependence thus seeks to capture the frequently observed phenomenon that performance of an action can in itself make more likely its subsequent performance (Arthur 1994). This is very different from the more familiar case in probability theory, where if one tosses a fair coin repeatedly, or if a blind agent repeatedly draws one of two balls, one red one white, from an urn and simply replaces them after each draw, there is an equal probability of either outcome. In both cases, the aggregated outcomes will tend towards a 50:50 ratio of heads to tails, or red balls to white balls, over repeated iterations. While one of the two possible alternatives might have a temporary dominance in the first few tosses or draws, this dominance will disappear over time.

Path dependence, in contrast, seeks explicitly to model circumstances in which early events increase the possibility of later events of the same sort occurring. Assume that every time a ball of a particular colour is pulled from the urn, it is returned, and a further ball of the same colour is added to it (Arthur, Ermoliev, and Kaniovski 1987). Any random dominance of one colour in the first few rounds now has major consequences. The chances of pulling further balls of that colour rather than the other now increase sharply, and are further reinforced in subsequent rounds. Its dominance continues to increase, and eventually the second colour will be drawn only rarely. Formally, the ensuing pattern takes the form of a random walk on a convex surface (Arthur 1990).

Arthur and others (David 1992a, 1992b, 2000) argue that many economic situations are better modelled using increasing returns assumptions. For example, many scholars working on the economics of geographic location have argued that firm location tends to be dominated by pre-determined factors, such as allocations of basic inputs, so that the location of firms across a given territory reflects an efficient allocation of resources. While these models provide a good explanation of how firms in industries with clear geographical needs locate, they are far poorer at explaining the forces governing the location of firms in industries which have less need for exogenously allocated resources (e.g. knowledge-based ones) (Arthur 1994). Firms in these industries will often want to locate themselves not where basic inputs are to be found, but where other firms in the same industry are to be found. Thus, it is possible that agglomerations will be affected by chance events early in their history, when the first firms to arrive made random choices of where to locate, but whose existence then attracted resources such as skilled labour to the area, creating positive reasons for further firms to go there.

Path dependence further predicts that stable equilibria may be reached given increasing returns to scale, but that in many important instances one cannot predict *ex ante* which equilibrium will be reached, because of the importance of initial perturbations to the final outcome. In more technical terms:

Fluctuations dominate motions at the outset; hence, they make limit points reachable from any initial conditions. But they die away, leaving the process directed by the equivalent deterministic system and hence convergent to identifiable attractors. (Arthur 1994: 123)

The lessons of path dependence extend considerably beyond industrial location theory. They are of direct relevance to social scientists insofar as they touch on questions of institutional development. Douglass North (1990a) argues that institutions too are subject to the forces of increasing returns. In what is perhaps the most influential application of path dependence theory, he seeks to explain a near-inexplicable puzzle for efficiency based approaches to economics; why it is that countries in the developing world have not converged on the more efficient set of institutions offered by the developed world. He argues that the divergences in the economic histories of North and South America may in large part be explained by the differing initial institutional matrices they inherited from Spain and Britain respectively.<sup>5</sup> Most recently, Paul Pierson (2000a, 2000b) has sought to build upon this by offering a more general set of insights into institution-building as a path dependent process. In Pierson's argument, initial institutional steps may have a strong conditioning effect on later ones. Insofar as institutions generate learning effects, coordination effects and adaptive expectations, they may substantially affect trajectories of institutional development, so that later institutions reflect these earlier steps. Positive feedback may in turn lead to a single equilibrium that is likely to be resistant to change. As Pierson further points out (see especially Pierson 2000b), this provides an alternative to functionalist variants of rational choice institutionalism.<sup>6</sup>

Thus, path dependence gains much of its explanatory interest from its demonstration that persistently inefficient equilibria may result from initial choices. Even in situations where paths of institutional development are clearly inappropriate to the current environment, they may persist; the costs of moving from one path to another may be extremely high, and much too high for any individual actor to take on her own. However, major change does occasionally occur, and path dependence theory offers little guidance as to how changes of path may be modelled. For example, Karl (1997) makes good use of the theory to explain why nearly all petroleum-dependent economies have found it impossible to diversify, even when it was fully recognized by policy-makers that diversification was essential. But she cannot

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<sup>5</sup> We note that North's account of institutional development in South America may be criticized for its lack of attention to the role of power relations; see Knight (1992), Solokoff and Engerman (2000); also Karl (forthcoming).

<sup>6</sup> As Miller (2000) points out in response to Pierson, by no means all rational choice theories of institutions are functionalist, and basic results of rational choice theory suggest that inefficient outcomes are likely to be the norm in common social dilemmas. See, more generally, Knight (1992, 1995).

use the theory to help explain why the one major exception - Norway - failed to follow this path.

While Arthur (1994, pp.118-119) offers some preliminary contentions about the likely costs of changes, these do not serve (nor are intended to serve) as a theory. Two responses to this may be seen in the literature. Sophisticated applications of the theory (North, 1990a; Pierson 2000a) acknowledge the difficulty. They seek to avoid determinism, arguing that short periods of wide-ranging change are likely to be succeeded by much longer periods in which change continues, but is relatively closely bounded (Pierson 2000a);<sup>7</sup> but they fail to advance arguments about what such wide-ranging change involves, and how actors will respond to it.<sup>8</sup> Less sophisticated versions misunderstand path dependence, arguing that paths are set at a given point in time, so that actors are ineluctably condemned to follow out a specific trajectory without possibility of change or exit.<sup>9</sup> Under such accounts, paths of development exercise an influence so compelling that outcomes are more or less completely determined.

### **Introducing a Bayesian actor: Why redundant capacities are important**

As we have discussed, path dependence theory seeks to apply results derived from Polya urn processes to the understanding of causal processes in which earlier events in a sequence have a positive effect on the probability of similar events occurring later in the sequence. In the following discussion we wish to build from the same set of assumptions, but with a single, highly important difference. Most conventional accounts of path dependence (e.g. Arthur 1994) fold the individual agent and her reaction to the action of others into the sequence itself (though some formulations (e.g. North 1990a) seek, as we do, to take account of the cognitive effects of institutions). A firm makes a location decision which may reflect the previous location decisions of other firms, and may in turn affect the future decisions of other firms still. Path dependence theory thus models the action of the agent as itself a single step in the mathematical process.

In this paper we wish to suggest some fruitful complications (Hirschman 1970) to this model. Specifically, we wish to examine the actions, and more precisely the decision to act, of the individual agent in greater

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<sup>7</sup> This conception of closely bounded change may be nicely captured using Levi's (1996) analogy of path dependence with a tree, where larger boughs or branches exfoliate into smaller branches, which in turn exfoliate into twigs.

<sup>8</sup> Pierson (2000a, p.265) limits himself to observing that change is bounded 'until something erodes or swamps the mechanisms of reproduction that generate continuity'.

<sup>9</sup> See, for example, the account of Italian regional development in Putnam (1993). While Putnam suggests in his conclusions that change is possible, he does not seek to integrate this suggestion with the main body of his argument, which emphasises how the dead hand of path dependence weighs on current political outcomes. On Putnam's misuse of path dependence theory, see Levi (1996).

detail. In order to do so, we treat the agent's own action sequence in isolation from its effects on the environment, although we allow the agent to update her behaviour in order to respond to environmental path dependences. Path dependence assumes a process in which balls are taken from an urn, and replaced according to a specific logic. Our model differs in that it posits an agent that seeks to match developments in her environment by drawing from a separate urn. Assume an agent ( $A$ ), and an environment ( $E$ ). Each round,  $A$  incurs some small fixed cost,  $K$ , regardless of her action. Further, assume that both the agent and the environment draw balls from separate urns. Balls in each urn may be either red or white. As in Arthur's (1984) original example, when a ball of either colour is drawn from either urn, it is replaced, and a new ball of the same colour is added to that urn. Both  $A$  and  $E$  draw balls unsighted from the urn; however,  $A$ , unlike  $E$ , may ascertain her ball's colour after it has been drawn, but before she has seen  $E$ 's ball. For a cost,  $C$ , which is additional to  $K$ , she may replace it and draw a new one, and may repeat this procedure until she has drawn a ball with which she is satisfied.  $E$  then draws its ball. Only  $A$ 's final choice of ball will be returned to the urn along with another one of the same colour. If the final choice matches the colour then drawn by  $E$ ,  $A$  receives a reward,  $R$ . The exercise is repeated infinitely. Under these circumstances  $A$  will seek to maximize the sum of rewards, subject to some discount factor,  $\delta$ , so that future rounds of the game are not valued as much as the current round.

Assume further that  $A$  is a risk-neutral Bayesian decision-maker with knowledge of the basic parameters of the game (in particular that both her urn and that of the environment  $E$  are subject to increasing returns).<sup>10</sup> If  $A$  wishes to maximize the sum of her rewards, she will need to solve a problem: given her information about which balls have been drawn, are the draws from  $E$ 's urn on a path  $Pr$ , in which red balls predominate, or  $Pw$ , in which white balls do? Bayesian calculation allows her to update her beliefs in each round, given the ball that  $E$  has played.

This provides a simple account of how individual actors may seek to respond to an environment with increasing returns, through patterns of behaviour that are themselves subject to increasing returns, as most patterns of behaviour are (repetition allows learning). On the aggregate level it also presents a very basic account of how actors may adapt institutions to a given environment. Like individuals, organizational actors may develop a standardized repertoire of institutional responses as they seek to adapt their behaviour to a given environment. We do not solve the problem for particular parameter values; rather, by setting it out in a general fashion, we seek to come to a better understanding of the sensitivity of the model to changes in these parameters.<sup>11</sup> Through seeking successively to 'match'

<sup>10</sup> For the application of Bayesian principles to social situations, see Breen 2000; Western 2000.

<sup>11</sup> We note that our use of quasi-mathematical notation may give an impression of greater precision and formality than is in fact the case. As should become apparent, we do not seek to use sophisticated formal theory, and we accept that some of our conclusions may be difficult to prove in mathematical terms at the level of generality that our arguments involve. However, we contend that our manner of explication is appropriate to our purpose, in that it allows us (a) to specify better the linkages between our arguments and the basic

behaviour or institutions to the demands of the environment, an actor may seek rewards. Most particularly, while the actor has no control over the environment, *E*, she does have some control over her own urn, and through deliberately selecting balls, may seek to take advantage of the increasing returns from a specific course of institutional adaptation. We note that this account bears a strong resemblance to strategic games, most notably the Matching Pennies game, which has no equilibrium in pure strategies. However, what we seek to model here is not strategic action; rather it is an exercise in parametric decision-making, where a player seeks to respond to an environment which is not itself a strategic player.

In the first round of the game, *A* will know that there is a 50:50 chance of either red or white being drawn by *E*, and will not wish to incur the cost *C*, so she will simply present the ball that she has drawn at random. Let us assume that *E* establishes a path *Pr* soon thereafter, in which red balls predominate, in a random walk across a convex surface. *A* will conclude at some point that *E* has begun to establish this path,<sup>12</sup> and, if her expected rewards for so doing outweigh her expected costs, will begin to invest in search costs in order to present red balls.<sup>13</sup> The speed of *A*'s adaptation to red path dominance will be a function of the variables: *C*, *R*,  $\partial$  plus a random element dependent on the 'luck of the draw'. In most circumstances, one may expect the dominant colour to become more quickly established thereafter for *A* than for *E* - insofar as *A* is capable of forming beliefs about the environment and its future course of development, and guiding her own institutional path so as to match that of the environment. It must be remembered that red does not achieve 100% dominance; white balls remain in both urns and, until the number of red balls approaches infinity, stand a small but finite chance of occasionally being drawn.

This provides a simple model of how behavioural routines or institutions may become matched to their environment. But what happens if the environment changes? Let us assume that for some exogenous reason *E*'s urn is switched for a new one, containing again a single red and a single white ball, under the same conditions as for the original urn.<sup>14</sup> In this

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contentions of path dependence theory, and (b) to express our arguments with a higher degree of clarity than would be possible in everyday language.

<sup>12</sup>For the sake of simple presentation we ignore the possibility that *A* reaches a confounded learning equilibrium (Breen 2000). However, we note one interesting implication of such equilibria; they involve players converging on a set of beliefs in which they attach positive probabilities to each of the possible states of the world. This may lead to lower returns on any particular path, but may also make it easier for players to adapt to exogenous changes of the rules of the game, which involve switching from one path to another.

<sup>13</sup> We note that for some parameter values expected benefits will be less than expected costs, so that *A* will be unwilling to incur such costs. However, these are theoretically uninteresting for our purposes.

<sup>14</sup> We note that such change is not incorporated into the initial parameters of the game. It would be possible to do so by having some probability *p* at each stage of the game that *E*'s urn would change. In this case, *A*'s expected payoffs would take *p* into account. However, what we wish to examine is the possibility of entirely exogenous change, which belongs to

instance, however, draws from the urn become dominated by  $P_w$ , so that white becomes established as the dominant colour.

In Breen's (2000) terms, the agent perceives the change from the perspective of her existing beliefs, but cannot immediately move to new, more appropriate ones. Depending on her precise beliefs, it is likely that  $A$  will at first consider the sudden appearance of white balls as examples of the occasional appearance of this colour which she has always experienced and has learned to disregard. Guided by this belief,  $A$  will persist with her path-dependent behaviour, and will continue to present red balls. After a time however it will become clear to her that there has been a true change of probabilities, and that her earnings are seriously declining. The length of this time period will depend on the strength of her beliefs, as well as a random factor. There will come a point where  $A$  realizes that she needs to locate white balls and may deem it rational to incur considerable search costs if necessary.  $A$ 's willingness to switch to the new white path when she realizes this is appropriate will depend on three factors: (i) the relationship between costs ( $C$ ,  $K$ ) and rewards ( $R$ ); (ii) the ratio of red to white balls in  $A$ 's urn; and (iii)  $\delta$ , the extent to which  $A$  discounts the future.

Clearly these parameters permit a wide range of variation; for purposes of illustration we examine two extreme cases. First, take the case where costs are high relative to rewards, where  $A$ 's urn has a strong preponderance of red to white (so that it is difficult to switch over), and where  $\delta$  is high, so that  $A$  discounts future rewards heavily. Under such parameter values,  $A$  is unlikely to incur the costs necessary to change the path in her own urn, so that she may consistently find white balls to match those of  $E$ . Given the cost  $K$  incurred each round,  $A$  will expect to incur losses if she seeks to remain in the game for the rare occasions when  $E$  presents a red ball given white ball dominance.  $A$ 's expected future earnings from the game will very likely be outweighed by her costs, so she may be expected to leave the game if she can.

Alternatively, if rewards are high relative to costs, there is a relatively low preponderance of red to white balls in  $A$ 's urn, and  $\delta$  is low so that  $A$  places a relatively high value on future rewards, one may expect  $A$  to seek to respond to the change in the environment by changing the path dependence of her own urn. She will accept search costs in order to find white balls, and may thus come to establish white ball dominance. Search costs will then decline and earnings rise. Clearly this may involve a lengthy transition period.

At the level of generality which our arguments involve, it is impossible to specify more precisely the relationship between the parameter values and the extent to which mid-range outcomes (in which some parameters point in one direction and others in another) will tend to involve  $A$  leaving the game,

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the category of uncertainty rather than risk, and thus cannot be anticipated by the actor involved. Thus we assume that  $A$  is aware that there is some possibility of path change occurring, but cannot assess that possibility *ex ante*; she is in a situation of uncertainty. *Ex post*, however, she may realize what has happened after she updates her beliefs due to disconfirming evidence. This is rather difficult to describe using formal Bayesian analysis, but provides a reasonably good account of how real actors will behave in conditions where unpredictable changes may occur.

or incurring the necessary costs to remain in it. However, by specifically incorporating learning and adaptation costs, our model provides important insights into how actors will respond to 'crises' in situations of path dependence. Both in situations where actors respond to the situation by abdicating, and those where they seek to adapt directly to changed environmental circumstances, they are likely to take some time to understand and respond to the changed situation. Indeed, they will be likely to perceive initial difficulties as conjunctural - random and temporary aberrations from a long-run trend - rather than secular changes in the trend itself.

More particularly, the model provides some basic insights into what change is likely to involve. *A* is capable of drawing both red and white balls from her urn in order to respond to a given environment. These may serve as a simple proxy in our argument for different possible patterns of behaviour, or even more generally different paths of institutional development, which respond to different varieties of increasing returns in the environment, and themselves involve increasing returns (Pierson 2000a). Insofar as a path becomes established in the environment (so that, say, red balls predominate in *E*'s urn), a given set of responses which are well matched to that environment (red balls in *A*'s urn) may also come to predominate. Other institutional possibilities exist (white balls in *A*'s urn), and indeed may continue occasionally to affect actors' responses to the environment. Even when *A* has established red-ball dominance in her urn, she will occasionally draw white balls, which, insofar as they do not match the red balls typically produced by *E*, will be viewed as examples of institutional misfit and inefficiency. However, in situations where the environment has changed (*E*'s red-ball dominance switches to white), such apparent examples of maladaptation change their significance, so that they become dominant resources, which actors will seek to draw upon, in order to respond better to changed circumstances. (White balls had, in fact, been cases of potentially useful redundancy during the period of red domination.) *A*, if she is not driven out of the game, will search out the occasional white balls that have always presented themselves, in order to establish a new pattern of behaviour, or institutional path of development, which has always been implicit, but has previously been submerged by a dominant alternative logic. In contrast to prevailing arguments which see change as either involving adjustments along a specific path of institutional development, or perhaps a cascading system collapse, this model tells us that agents can resolve their crises by adaptation to new paths rather than either recourse to completely exogenous solutions or collapse. This will be so provided that they have access to 'dormant resources', different from their existing path dependence but available within their overall repertoire of responses.

There are limitations to this simple model, some of which we shall seek to address in more fully specified versions below. It does not address institutional change which results from wholesale borrowing or imposition of institutional practices from 'outside'. It thus limits itself to endogenous change, as fundamental to it is the claim that agents can change to new ways of behaving if they have some endogenous access to appropriate new behaviour. It cannot deal with totally exogenous, bolt-on institutional

borrowing. One may take the efforts of car manufacturers in Britain and Germany to introduce Japanese work practices in the 1980s. To the extent that such change involved the introduction from outside of completely novel institutions, our arguments have little contribution to make. However, insofar as efforts to adapt to these new challenges made use of older, pre-existing institutional repertoires (Morris and Imrie 1992; Braczyk and Schienstock 1996),<sup>15</sup> our model may contribute to the understanding of such change.

Second, we note that our model presents a stylized picture of reality. *A*'s need to find the matching ball for the environment may implicitly suggest, at least in this simple version, that there is 'one best way' to respond to a given set of environmental pressures, and that *A* has (at least potentially) the necessary capacities to respond in this fashion. In reality, *A* will often be more likely to try to use certain forgotten capacities to provide a response to the new challenge which is functionally equivalent to the proffered one best way and more amenable to her. This response will not necessarily be the most efficient possible. We shall address this possibility more fully below; for the present we merely reaffirm that our arguments have the simple aim of using results from probability theory to model social outcomes, incorporating actors' limited abilities to try, at a cost, to adjust to those probabilities.

Our arguments highlight a relatively under-appreciated implication of path dependence theory: that more than one path of institutional development is possible, even if only one becomes established.<sup>16</sup> This means that the theory is only applicable to cases where alternatives exist somewhere within agents' repertoires, but have become forgotten or hidden through disuse or failure to appreciate their possible relevance.<sup>17</sup> However, they remain in existence (occasional white balls on a red dominant path), and may provide the seeds for new paths of development. If such possibilities do not exist, then in principle the path dependence frame of reference is not applicable. Many current uses of path dependence theory by social scientists do not include the idea of hidden alternatives. They make the assumption that a path is irrevocably set, so that agency has no scope to change it. Strictly speaking these writers do not need path dependence theory; merely the simple argument that agents' possibilities to create change are entirely

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<sup>15</sup> See also Herrigel (1993) on the conditions under which internationally oriented large firms have sought to make use of, or alternatively displace local paths of development, in their efforts to respond to a changed environment.

<sup>16</sup> In our simple example, we assume there are two such ways; as we illustrate below, a number of paths of institutional development may be possible in a given set of social circumstances.

<sup>17</sup> Something of this is embodied in Douglas's (1987: 66-7) adaptation of Lévi-Strauss's idea of *bricolage*. For Lévi-Strauss this idea of rummaging around in disused practices for ways of solving problems was specific to 'primitive' societies; Douglas sees that it might happen equally in 'advanced' ones. But both see it as essentially conservative practice, rather than as a potential springboard for true innovation. Our formulation of the possibility of change within the initial model is a case of *bricolage*, but once we consider the transfer of practices from one field to another in which they have not previously been applied (as in the extensions), there is a possibility of true innovation.

circumscribed by social structure. While our model predicts that paths under given sets of parameter values will be very difficult or costly to change, it does not predict that path change is impossible, and indeed sets out a set of conditions under which change will be more or less difficult to accomplish.

Many empirical cases approximate to our arguments. First, there are those where what innovating agents do is to discover a new application or adaptation of a routine which they already practise. The German vocational training system embodies a wide and complex set of formal and informal institutions. From time to time it has undergone crisis as economic and technological changes create an environment that no longer matches its assumptions. However, in each case those responsible for implementing the system - a large number of agents in fact - have found ways of adapting it, within the framework of the apprenticeship concept, to the new challenges. Initially designed for the *Handwerk* sector, it was successfully adapted to large-scale industry (Streeck 1992); designed for manufacturing, it had to adapt to services sectors; designed for the lower levels of educational qualifications, it was adapted to the rise in educational achievements (Crouch, Finegold and Sako 1999: ch 5); designed for specific skills, it adapted to polyvalence; most recently it has been adapting to the new highly flexible occupations in mass media industries (Baumann forthcoming). There was often a time-lag while this adjustment was made, while those concerned either persisted with the old version or failed to find a means of adaptation. However, the fact that change was possible without either a total collapse of the model or exogenous borrowing means that the problem was solved by considering hitherto unrealized potentialities of the system. Furthermore, the adaptations made involved substantial changes in the path of the system's overall development; they were not simple returns to an existing path after temporary shocks. The fact that this kind of system contains, as it were, seeds of potential adaptation within itself means that it is not an instance of actors being trapped in a social structure, or knowing one thing and one thing only. Rather, there is a bundle of possible paths hidden like the white balls in the urn, some of which are concealed by lack of use.

Strictly speaking, the German vocational training case is an example of retracing past steps in an exfoliation process. Once a new branch has been selected, actors proceed along its path and become dependent on it. When they recognize that the path is no longer bringing them returns, they may be able to return to where they selected that branch from a more generic starting point and begin to forge a new path from there. To regard this as a mere case of rediscovering the white balls therefore over-simplifies a complex process of change. However, our model offers a simple way of comprehending these sorts of change, and how it may be possible to return from a specialized application of a path to the more generic choice situation from which the path originated.

Ebbinghaus and Manow (2001) refer to a very similar concept in their idea of 'layered' institutions within welfare states, which they use to show how various European welfare states have defied the predictions of some path dependence analysts and have reformed themselves. As institutions develop over long periods of time, argue Ebbinghaus and Manow, they cease

to embody a simple logic, but a complex bundle, dormant elements of which may open up possibilities for change at difficult moments.

This logic may also apply to unintended consequences. Imagine a policy that contains components  $L$ ,  $M$  and  $N$ .  $M$  and  $N$  are the main targets of the policy;  $L$  is included by chance or for some unimportant reason. It is therefore not often the focus of debate, policy renewal, training of staff administering the policy, etc. But it remains in existence, like the white balls in the urn. At a certain date actors realize that this existing but neglected policy might help solve certain apparently intractable emerging problems. There are some important examples of this in the recent history of Dutch social policy reform (Visser and Hemerijck 1997).

### **A First Extension: Alternative policy challenges as resources for responses to large-scale change**

The above discussion has shown how, while remaining within the parameters of path dependence theory, it may nevertheless be possible to model how an agent may, under certain limited circumstances, be able to effect change and innovation. But many social situations present actors with more complications: consistent action may not be consistently rewarded, and actors may find that they are occasionally called upon to act differently from the normal case. If the situation is so confused that there is no normal case, path dependence theory ceases to be of use, so we confine our attention to those cases where diversity in the pattern of rewards takes the form of departures from a norm. A particularly important class of such situations is that involving redundant capacities. By making some additions to the adapted Polya urn base set out above, we can adapt path dependence theory to model this form of complexity. The environment now draws from two urns. After every  $n$  rounds of the red-ball game already described (now called the dominant game) with  $E$  (now  $E1$ )  $A$  plays one round of a subordinate game in a second environment,  $E2$ , in which the path dependence is reversed, white balls being the subject of increasing returns.  $R$  is the same for both urns. The two environments are represented by two separate urns, which refill according to their opposite path dependences, but  $A$  has only one urn. If  $A$  has an understanding of the basic parameters of the game, she will have different Bayesian probability expectations for the two environments.

Let us further assume that at a certain point, as in the first game,  $E1$ 's urn changes to white dominance; there is no change in  $E2$ 's urn. One may assume that for most values of  $n$ , red will again have established a dominance in  $A$ 's urn, as in the simple game. Again,  $A$ 's specific behaviour will depend on parameter values. For higher values of  $n$  (white ball dominant rounds are relatively infrequent), and/or  $C$  (searching for balls is relatively expensive),  $A$  may simply seek to create a red ball dependence, and 'take her lumps' on the occasional rounds where the urn switches to  $E2$ . Here,  $A$  will behave much as she did in the original game, albeit with lower overall

rewards.<sup>18</sup> For lower values of  $n$  and  $C$  - the 'interesting' cases from our point of view -  $A$  may seek rewards from both paths, but again will have lower overall rewards than in the original game. She will not be able to take full advantage of the possibilities of creating path dependence in her own urn, and will have to incur higher search costs in matching both  $E1$ 's and  $E2$ 's draws. While  $A$  knows which game she is playing at any one time, the chances of finding a red ball at first attempt in the game with  $E1$  are less than in the original game, while the game with  $E2$  usually requires search costs to locate a white ball. However, by the same token, when  $E1$ 's urn changes,  $A$  is able to adjust to the new path dependence more quickly than in the simple game, because she has a considerably higher proportion of white balls in her urn.  $A$  now finds that playing the two-environment game had greatly eased the transition.

This version of the model represents serendipitous redundancy, in which the need to switch between two different environments prepares actors better for completely unexpected changes in one of them. The independent variable here is the two environments.<sup>19</sup> Bayesian actors will not take account of uncertain events in the future; insofar as they do not involve risk (i.e. expected probabilities), they cannot be translated into beliefs. They will therefore encounter only serendipitous rather than planned redundancy. The latter form may however be inserted into their environment; differing sets of environmental pressures may generate different forms of redundancy (Low et al 2001), or what Goodin (1996) calls institutions which are designed 'around the risk of accidents'. An example of its practical application appears in Hollingsworth and Hollingsworth's (2000) study of the institutional contexts of major scientific discoveries. The researchers found that institutions with particularly large numbers of such discoveries to their credit typically encouraged, even possibly constrained, specialists in one area of science to sustain knowledge and interest in other areas:

..... major discoveries occurred repeatedly because there was a high degree of interdisciplinary and integrated activity across diverse fields of science (thus, scientists with diverse perspectives interacted with intensity and frequency)..... (ibid.: 222)

Sometimes these scientists might have found this irksome, as they could have made more progress with their 'own research' had they not had to 'sustain the subsidiary areas. They may even have fallen behind colleagues in more specialized institutes. However, at points of major new breakthrough, where new combinations of knowledge were needed and therefore where

<sup>18</sup> Given that there is a cost  $K$  for staying in the game each round, lower values of  $n$  may depress expected rewards so much for certain sets of parameter values that  $A$  will wish to withdraw from the game.

<sup>19</sup> Planned redundancy is different; the independent variable here is  $A$ 's urn. This means that one could incorporate some planned redundancy even into the simple, early model where there is only one urn. If  $A$  has some precognition that there is a substantial positive chance that her environment will change in the future, as in the first game, she might simply build in redundancy by every once in a while searching out a white ball. She will do this in the knowledge that this will reduce her own path dependence (and thus her expected payoffs) while the red ball dominance lasts, but that it will also make it easier for her to switch whenever necessary.

continuing an existing line would have been inadequate, they had major advantages over those who were more specialized. The two-environment game enables us to anticipate this outcome - but also to explain why the majority of academic institutions are structured in the opposite way and avoid redundancy by encouraging specialization. They do not take the risk of losing predictable routine returns by gambling on the chance of major discoveries.

Garud and Karnøe (2001b) present several similar examples of such unplanned synergies in their accounts of technological innovations, and develop an argument concerning redundancy when they say of entrepreneurs that they:

..... may intentionally deviate from existing artefacts and relevance structures, fully aware that they may be creating inefficiencies for the present, but also aware that such steps are required to create new futures. (ibid.: 6).

North (1990a: 74-81) anticipates the problem of incentives to acquire pure knowledge - which has no immediate pay-off, but might have some in the future - and sees the particular structures chosen by firms as putting them into better or worse positions for dealing with it. Within the constraints of pure path dependence theory he has however no way of modelling different potential solutions.

More generally, as many economists acknowledge, their models have extreme difficulty in dealing with how actors confront uncertainty, as opposed to risk. Insofar as actors are willing to incur costs in order to take advantage of future uncertainty, they are acting within a Schumpeterian rather than marginalist framework. Hollingsworth and Hollingsworth's (2000) research organizations were Schumpeterians, willing to take risks avoided by those engaged in marginal adjustments in order to reap large rewards when they suddenly arose.<sup>20</sup> Individual scientists within the institutes may occasionally have preferred to be marginalists, but they were constrained by the rules of their game. In a Schumpeterian framework, entrepreneurs are agents who either sustain redundant capacities, or engage in temporarily less profitable activities, so that at certain moments they may boldly grasp new opportunities. Schumpeter himself insisted on the importance of monopoly for entrepreneurs, arguing that continual strong competition undermined the risk-taking that they required. This insight has been developed by evolutionary economists in their arguments about the need to protect research and development departments from erosion by competitive pressure (Nelson and Winter 1982), which is often more easily accomplished by monopolies (Lazonick 1991). We are here able to go beyond these accounts and identify as fundamental, not monopoly as such, but the capacity to retain redundant capacities in order to be able to cope with new or changing environments. Monopoly and limited competition are particular

<sup>20</sup> Within the economy as such, the chances for super-profits occur because the entrepreneurial agent is willing to take a risk which others refuse, making possible temporary rents. (The super-profits of the Hollingsworths' (2000) scientists are rewards like Nobel Prizes, which can be seen as a kind of permanent rent.)

examples of how redundancy might be maintained. Other examples might be external constraint or simultaneous participation in different fields of activity, between which cross-over is encouraged. For Hage and Hollingsworth (2000) the essential point is a number of separate specialized areas which are connected to each other through an innovation network.

Such arguments about redundancy in scientific and economic entrepreneurship have clear relevance to paths of institutional development too. Insofar as agents or their institutions are regularly exposed to different sets of environmental pressures, they will be likely to develop substantial redundancies. These redundancies will often make it easier for agents to adapt these institutions to new and unexpected sets of environmental circumstances.

### **A second extension: Meeting major change with solutions already used in adjacent fields**

A different form of complexity concerns situations where the same actors are present in more than one institutional context, with different kinds of action being appropriate in different contexts. In such cases an agent might be able to resolve an impasse reached in one sphere by 'borrowing' or extending actions from another. This will be particularly important in the cases of collective actors, operating over a wide social range. One interesting historical example would be the way in which late-19th century Dutch elites began to apply lessons they had learned about conflict management in the religious field (the *verzuiling* system) to conflicts emerging in industrial relations which could no longer be tackled in traditional ways (Hemerijck 1992). They could do this because of their acquired experience of using these mechanisms, understanding how they operated, and trusting them; *verzuiling* in the religious arena had become a self-reproducing path dependence, involving substantial increasing returns to learning. It would have been far more difficult, say, for French elites suddenly to imitate emerging Dutch industrial relations policy, because they did not have the prior learning experience from a proximate field. Another example would be the case of Norway in Karl's (1997) comparative study of petroleum referred to above. Norwegian policy makers had wide experience of managing change through widely representative discursive processes. They were therefore able to use these techniques to address the problem of dependence on a single sector.<sup>21</sup>

By making some further simple amendments to the situation presented in the first extension, we can model such possibilities. We now give *A* two urns, *A1* and *A2*, provided that she pays each time she chooses to move between them. (It is a basic assumption of the whole model that all changes of action are costly in one way or another.) The original search cost *C* is now *C<sub>x</sub>*; the urn swap cost becomes *C<sub>y</sub>*. The relationship between *C<sub>x</sub>* and *C<sub>y</sub>* is not determined *ex ante*. As in the previous example, we assume that *E1* develops a red ball dominance, and *E2* a white ball dominance. In this extension *A* will swap her urns to match the different path dependences of *E1* and *E2*, if *C<sub>y</sub>* is not set at an unreasonably high level. We assume for simplicity that *A* will

<sup>21</sup> We are grateful to Terry Karl for bringing the relevance of this case to our attention.

use urn  $A1$  to operate in environment  $E1$ , and will switch to urn  $A2$  in  $E2$ .  $A$  will seek to establish a red ball dominance in  $A1$ , and a white ball dominance in  $A2$ .

While net profits are *ceteris paribus* lower than in the first, simplest version of the game, they will be the same or higher as those in the first extension. When  $E1$ 's urn changes to white dominance, the relative values of  $C_x$  and  $C_y$ , as well as  $A$ 's Bayesian beliefs will determine her response. If, as we already assume,  $C_y$  is low enough that  $A$  has been prepared to switch urns on turns when  $E$  played  $E2$ ,  $A$  will switch to urn  $A2$  in order to respond to  $E1$  as well as  $E2$ , and will quickly start to draw white balls. This allows us to model a situation that is somewhat different from the redundancies modelled in the previous extension. Now, an agent who has followed two paths of institution building in two different environments or sets of circumstances may borrow from one in order to escape from an institutional path dependence in the other which is no longer appropriate. At its simplest level, this may involve lateral thinking, or, more broadly, as in the Dutch *verzuijing* case mentioned above, *Wahlverwandschaft* (Hemerijck 1992). This kind of innovation is more than mere *bricolage*, because taking responses originating in one action sphere and applying them in a new one can result in entirely new actions and institutions.

### **A third extension: Embeddedness in networks of policy fields as a resource for responding to change**

By incorporating innovation through learned behaviour from proximate fields, we have already gone some way towards bringing the insights of 'embeddedness' within a framework of path dependence. Such learning allows agents to 'capture' external paths of institutional organization in a limited way; by recognizing this possibility, we open the way to dealing with more obviously exogenous phenomena, like imitations and impositions. In an open world it should not be assumed *a priori* that the walls around national or any other systems are impenetrable. Multinational firms, educational institutions, immigrants and consultants regularly penetrate them. Pure endogeneity and pure exogeneity should therefore be seen as end-points of a continuum and should be relativized.<sup>22</sup> We can incorporate this within the model by developing two ideas already implicit within the second extension: that of different levels of 'proximity' of different urns in the game; and that of costs of switching from one urn to another.

Let us assume that there are  $N$  urns, which are used by  $N$  agents all playing the simple game in  $N$  different environments. Each player has an urn with two of  $B$  different coloured balls. These agents are not in competition with each other - indeed they do not interact directly, although they may copy each other's actions (i.e. draw from one another's urns) - and  $A$  is one among them. Further, they are situated on a plane in which some urns are more distant from  $A$  than others; closer urns are those that are less costly for  $A$  to emulate, and further urns are progressively more costly. Let us assume that  $A$  is playing the simple game in which both she and  $E$  have one urn. At

<sup>22</sup> It should be noted that we are here dealing with the endogenous or exogenous nature of their response made by actors, not of the *shock* which stimulates the need for change.

some point  $E$  begins to draw a new colour, which may be any one of  $B$ .<sup>23</sup> When this occurs,  $A$  may draw (blindly) from other urns in order to find the colour which will bring the reward.  $A$  has no prior knowledge of the colours of the balls in the different urns, but may have some knowledge of the underlying probability distribution, and may remember the colour of balls in urns that she has previously drawn from. To draw from another urn  $A$  must pay cost  $dCy$ , where  $d$  is a positive function of the distance of the urn from  $A$ . This embodies the hypothesis that the difficulty of acquiring access to new practices increases with distance from the initial practice. 'Difficulty' may be constituted in various ways, such as a learning curve, or difficulty of communication with those in a remote location. 'Distance' may similarly have various meanings; it may be literal distance, or, more generally, institutional remoteness. (For a formal demonstration of the importance of proximity for agents solving learning problems by observing others, see Anderlini and Ianni 1993).

$A$ 's willingness to search out new balls as her environment changes will depend on: (i), as always, her Bayesian beliefs; (ii) her acquired stock of knowledge of urns  $N-1$ ; and (iii) the relationship between  $t$ ,  $d^*$ ,  $Cy$  and  $A$ 's expected future earnings from finding the proper ball, where  $t$  is the expected number of searches necessary to find the appropriate ball, and  $d^*$  the expected distance from the urn containing the right ball.

As in all other forms of the model, these parameters may have values under which  $A$  will prefer not to play, and will abdicate from the game after the path changes if she has a choice. Here, condition (iii) in particular may be especially burdensome.  $A$  may be faced with a choice of: (a) trying to find a remote solution at possibly ruinous cost; (b) of searching intensively among more proximate urns, even in situations where she knows from the underlying probability distribution that the solution is unlikely to be found close by; or (c) of abdicating from the game. This models a situation often faced by agents required to adopt exogenous solutions which do not fit with their past experience and institutional structures. Even if new ways can be learned given time, they may be so remote from the agent that success cannot be achieved before a total crisis arrives. There may be several examples of this in the history of Central and Eastern European countries during the 1990s. Firms and political elites were in a position where all available paths of development from the state socialist period seemed to have failed completely. International agencies and western governments advised these actors that they must imitate approaches that were extremely remote in terms of their previous experience. The responses adopted provide examples of all three above possibilities (a, b and c).

The idea of a full set of  $N$  possible solutions set at varying degrees of accessibility from  $A$  not only replaces the dichotomy between endogeneity and exogeneity of responses with a continuum, but brings us beyond the logic of path dependence to consider constraints on and possibilities of action caused by relationships between  $A$  and a given social structure of opportunity. She is not endowed with perfect knowledge as in much neo-

<sup>23</sup> This is not to imply that there is an equal probability that each of the  $N$  urns holds the solution, merely that there is a non-zero probability for each of them. For simplicity's sake, however, we do not specify either the distribution function or  $A$ 's search function.

classical theory, but is dependent on her location within that structure for both knowledge of and capacity to use innovations. The lock-in Grabher found in the Ruhr (1993b) during the crisis of the metals sector in the 1980s can be seen to be a case of this extension. All actors within the region were committed to metal manufacture, so that all attempts at solving the crisis involved attempts to reform that sector and no measures for developing new activities. In the terms of our model, all new possibilities were too remote from *A* to be practicable, while all other reasonably accessible players were committed to play the same colour as *A* herself. However, Voelzkow (forthcoming) has shown that some Ruhr cities at least have eventually been able to find new paths, largely through the actions of the Land government of Nord-Rhein Westfalen. This agent, which Grabher (1993b) argued was just as embedded as the Ruhr cities themselves in the metal-industry model, was nevertheless located so that it had access to other games. (To apply the concepts of Anderlini and Ianni's (1993) locality model, agents on the edge of a particular network of embedded relations are likely to have access to other, adjacent networks.) The eventual success of these cities in changing their course of economic development is compatible with our theory, which expects lengthy periods of adjustment and failed attempts to sustain previous paths before actors accept the need for more radical change, but does not rule out possible eventual success as impossible.

By introducing social structure, we may also begin to incorporate a major factor that is often neglected by path dependence theories: power. Jack Knight (1992) defines power as involving the ability to constrain another's choice set. Under this definition, we may see how the 'distance' of particular urns need not be a happenstance feature of social structure; instead, it may reflect the power of external actors to make it more costly for *A* to adopt certain solutions. This again considerably improves the realism of the theory.

In practice it is often difficult to determine whether simple path dependence or a more complex sociological embeddedness lock-in is at work (Thelen 1999); the two may reinforce each other. For example, consider the case of the so-called Bismarckian systems of social insurance established in Germany and a number of other countries, which have become deeply embedded, and which are frequently described in the literature as having produced path dependences. Did these systems originate as the result of the chance prior appearance of some instances of these particular schemes, which fact later led to their being adapted as a national standard? Or were they conceived because they corresponded to a particular balance of power and set of social relationships and compromises? If the former, we have a relatively pure case of path dependence, first-mover advantage and increasing returns as described in the probability theory literature. If the latter, we are instead dealing with something which needs explanation in terms of the balance of social relationships, for which path dependence theory is less suited, and perhaps even unnecessary. However, it may not be easy to disentangle these two phenomena in empirical situations; indeed, social structural reasons for the persistence of institutions may change over time, as for example new groups acquire vested interests in old institutions. For our present purposes disentangling historical origins is not so important as the other end of the chain of events: understanding the character of

practices which have become locked in, so that change and innovation are difficult. However an institution originated, some elements of learning curve and returns to scale may support its persistence against potential alternatives. This is a kind of quasi path dependence, with different origins from those discussed by Arthur (1984), but acquiring some characteristics of that model along the way. There is very likely to be a cluster of supporting and opposing interests, cross-institutional links, etc, creating a structure of embeddedness.

#### **A fourth extension: Functional equivalents and renewed path dependence**

Finally, let us consider how the model might deal with a frequently occurring, difficult question. Given the strong possibility that functionally equivalent alternative solutions exist for many problems, how can agents ensure that, in a situation of widespread availability of alternative institutional models, they have an opportunity to choose among various viable possibilities, hopefully finding one which most 'suits' them? This dilemma also presents itself frequently to many groups in the post-communist societies of central and Eastern Europe. How can they, acting under conditions of difficulty and a need to make rapid changes, ensure that they make those reforms which are best suited to their capacities and needs? We can adapt our model to demonstrate such a context of choice; it strongly suggests the conclusion that such actors may have very little chance of making such optimal choices.

To show this, we modify the third extension (in which  $A$  could search through the urns of her neighbours in order to find a new matching ball when  $E$  changes urns). Now, when  $E$  changes the ball colour which it rewards, it is in principle willing to reward any one of  $m$  different colours, where  $1 < m < B$  and where  $m$  excludes red. Let us further assume that different acceptable balls carry different rewards,  $R_1, \dots, R_m$ .

For the purposes of illustration, let us assume that  $m = 3$ , with three possible colours (white, blue, magenta). If  $A$  has decided to incur the search costs, she searches for a ball until she finds one for which a reward is presented, and finally happens upon a magenta one. She now knows that she will be rewarded if she presents further magenta balls; however, she has no knowledge that blue and white would also be rewarded, and if she finds any of these in the urns of her neighbours she will reject them and continue to look for magenta. While we do not specify any search function, it is reasonable to expect that under many circumstances,  $A$  will start to build up a path dependence in magenta balls. The possibility of offering blue or white balls will never be discovered, even if presenting either of these would be more lucrative, or less costly.

Under these circumstances, Bayesian decision-makers can 'lock in' to inferior choices (Arthur 1994). Arthur also presents an example of a search algorithm that has similar consequences. Under these assumptions, the actual beliefs of agents have many of the characteristics of path dependent phenomena; they tend to lock into repeated patterns that are not necessarily optimal. One might go beyond these arguments, to suggest that in a context where agents observe each other, such effects may be contagious. Another actor, observing  $A$ 's success, might conclude that  $A$  had indeed discovered an

optimal response to a given set of environmental problems, and might copy her. This demonstrates how the idea of 'one best way' can become rapidly established even if in reality a 'world of possibilities' (Sabel and Zeitlin 1997) exists, discovery of some among which would better suit the interests of some agents than the proclaimed one best way.

### Implications for institutional research

In the previous discussion we have constructed an account of how paths may be 'broken' by actors in their efforts to respond to changed circumstances; we now wish to suggest that our account has broader implications for the social sciences. Specifically, we show that it has relevance for current – and important – debates on institutional systems and their economic consequences. Recognition of the possibilities embedded in our model and its extensions, each of which has made the original path dependence model approximate more closely to real-world choice and action situations, has significant implications for research on institutional change. We can observe action of the kind analysed only if we allow for and positively seek element of complexity, even incoherence, in the empirical stories we tell. The 'stylized facts' beloved of social science, which cut away at awkward empirical details to fit simple expectations, do not help in this task. Unfortunately, the main objective of much current research within the institutionalist tradition has been precisely to present national (and very rarely is the ontological priority of the nation state questioned) cases so that they fit neatly into homogeneous, internally isomorphic types. As we have noted, this approach dominates the literature on varieties of capitalism (Hall and Soskice 2001), as well as those on national systems of innovation (Freeman 1995; Lundvall 1992; Nelson 1993), welfare states (Esping-Andersen 1990), and social systems of innovation and production (Amable 2000; Boyer and Didier 1998).

These accounts assume that national systems possess an overall internal congruence, or they will give contradictory signals to agents (Amable 2000: 657). To the extent that such relationships apply, it becomes possible to establish the particular path dependence of a national system and therefore to make strong predictions, not mere *post hoc* empirical accounts, of the behaviour of agents within it and the virtual impossibility of their making major changes. Change is likely to occur only when whole systems change under the weight of exogenous pressure. These assumptions give the literature on economic diversity or comparative capitalism the power to make clear (if often incorrect) predictions, but are by the same token inappropriate for a research programme in which an escape from path dependences and embeddedness can be modelled in entrepreneurial discovery of concealed, unacknowledged or surprising potentialities of the available institutional repertoire. In fact, much recent work in the capitalist diversity literature makes it impossible by definition to carry out such a programme. These authors are virtually bound to consider all evidence of modes of action which do not fit their overall characterization of a given national or super-national system as untheorized, empirical 'noise', which

needs to be disregarded in the interests of an elegant and sharply profiled account. In contrast, our approach depends precisely on incongruities, incoherence, and within-system diversities for its attempt to build - not a series of *ad hoc* empirical objections - but a theory of crisis resolution and Schumpeterian change that does not require either exogeneity or prediction of inevitable failure (see also Hage and Hollingsworth 2000: 983).

For example, most accounts of the US-American production and innovation system assign it unambiguously to the 'liberal market' (Hall and Soskice 2001) or 'market based' (Boyer and Didier 1998) category, regarding it as virtually a paradigm case. If the vast role of the state-managed defence sector is mentioned it is as an aside (Amable 2000: 670), or is somehow argued around until it is presented as an aspect of the market model (*ibid.*: 677). One of the problems of a vaunted paradigm case is that theorists start reading back from its empirical details into the terms of the theoretical type it is thought to embody. If the role of the US defence sector is regarded instead as *complementary* to the market in the true sense of that word - providing something substantively different from, and compensating for deficiencies in, an existing form - a very different account emerges (Hage and Hollingsworth 2000: 992; Hollingsworth 2000: 605, 613). In the terms of the current argument, the role of the US Defense Department becomes a white-ball game played alongside a red (market) one as in the first or second extensions. Following this path, an account of the US economy would explain its performance in terms of the range of institutional forms at its disposal, rather than see it as the realization of one such form. One might similarly present the high rate of immigration into the USA as evidence of the capacity of firms and other organizations in that country to draw on a diversity of educational experiences, rather than treat relations between the US economy and the US education system as an institutional 'best fit'. The contribution of educational and cultural heterogeneity to innovation is already being strongly noted in certain parts of the Californian software industry.

## Conclusions

In the preceding discussion, we have sought to provide a more nuanced account of change in institutional systems. In order to do so, we have tried to extend and combine path dependence theories in the following ways, resulting in the identification of a number of path-changing possibilities.<sup>24</sup>

1. Through incorporating a Bayesian decision-maker with her 'own' urn, more accurately to model the relationship between actors and their environments;

2. By introducing into the model the possibility of costed searches into other paths concealed within agents' own past experience, to enable them to stand a chance of pursuing possibility one: the use of hidden or dormant alternatives within their own repertoires;

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<sup>24</sup> We use 'possibilities' rather than 'strategies', because, even if agents behave rationally at each stage of the process, they do not choose a path with perfect knowledge of its consequences, so that accident, serendipity and structured opportunity play an important role in the adoption of particular routes.

3. By introducing the possibility of agents playing simultaneous games, to enable them to pursue possibility two: transfer of experience from different action spaces;

4. By introducing the possibility of agents having costed access to additional games, to enable them to pursue possibility three: transfer of experience from other agents through networks of structured relationships – which in turn helps break down the rigid dichotomy between endogeneity and exogeneity as sources of actors' responses;

5. By introducing the possibility of several viable alternatives, only one of which is likely to be discovered, to model how ideas of 'one best way' solutions become established.

This model provides a way of accounting for and studying innovation and entrepreneurship which is endogenous while at the same time being able to encompass extensive change. Our conclusions are similar to those already reached by Garud and Karnøe (2001a: xiii) in their model of entrepreneurs as embedded path creators, as 'neither insiders nor outsiders, but boundary spanners'. They reject the conventional idea of entrepreneurs and innovators as completely original, even exogenous, forces; entrepreneurs develop along the paths provided by history, but attempt mindfully to depart from it. By 'mindfulness' Garud and Karnøe (2001b: 23) mean consciousness of embeddedness and knowledge of when to use it and when to depart from it. They invoke Schumpeter's (1936) stress on the need for entrepreneurs to escape from the strict dictates of rational action. Their entrepreneurs therefore proceed through a path of 'chain linked deviation' (Garud and Karnøe (2001b: 26). This differs from a random walk in that at each step the agent places its next step purposively, though it is acting with only imperfect knowledge.

It must be stressed that we are not contesting the currently dominant approach with a series of anti-theoretical empirical objections along the lines of classic English historiography. Rather, we propose the following approach to the study of path dependences - which shares some characteristics with that advocated by Pierson (2000a: 494-6). (Despite its growing inapplicability, we assume here the simple case of a study of an individual area of activity within an individual nation state.) First, the different modes of governance or institutional approaches at work within the sphere of activity should be discovered following an intensive research process, and specified in terms of theoretical models. Second, an attempt should be made to rank the modes found in terms of their relative dominance. (Here we have a conflict of method with that of the varieties of capitalism school. Having identified a single dominant system, the former excludes all information on subordinate systems from further analysis. The present approach retains them as part of the account.)

Third, a conceptual map must be developed of other institutional spheres within the society, described according to their proximity to the area of activity at the centre of the research and according to their accessibility both to agents relevant to that industry and to those without. Fourth, the different modes of governance or institutional approaches at work within these other institutions must be specified, again in terms of theoretical models. Fifth, an attempt must be made to rank these in terms of their

relative dominance. (Here occurs another conflict with the varieties of capitalism school. Having identified a single dominant system within these institutions, this approach demonstrates its *Wahlverwandschaft* with the main object of study, and excludes all contrary information.)

In practice it is unlikely that such a research programme can be fulfilled in its entirety. However, even without adopting such a wholesale approach, two steps may help adjust research strategy in fruitful ways – neither of which involves resorting to stylized facts and other distortions. First, the range of institutions to be covered by the research needs to be limited to the scope of available knowledge. Thus, if there is well established evidence that particularly forms of parliamentary government are associated with certain kinds of production, it is legitimate to cite such evidence in support of an hypothesized *Wahlverwandschaft*. But if thorough evidence of this kind is lacking, it is not legitimate merely to assume the link because of its theoretical appropriateness; instead it is appropriate to remain silent about it.

Second, researchers into complex macro-social phenomena like the wider institutional structure of an economy may have to accept that, despite their theoretical identity, explanation and prediction are very different activities, and we may often have to limit ourselves to the former. When an event has already taken place it is possible with various methodologies to reconstruct how and why it occurred, and to delve back into the ensemble of wider institutional processes involved. It is not possible to do this for future events, because researcher cannot tell which surprising combinations of institutional resources will in practice be used by creative, entrepreneurial actors – if they can, the changes are not surprising.

We shall continue to be taken by surprise by acts of true Schumpeterian entrepreneurialism as opposed to those of Hayekian or Northian incrementalism. We can however at least conceptualize the likelihood of these occurring in terms of risk-taking. Schumpeterian actions can be conceived as those which make unexpected and daring leaps in innovation. If we retain the basic assumption of the theory, that even such leaps as these have to draw on knowledge which is somehow already available, an innovative leap can be theorized as a decision to start drawing balls from a very remotely located and unlikely urn. The idea of the 'leap' is very apt. In terms of the model, this is always possible; but it is costly. Typical costs will be lack of knowledge whether the innovation will work, because the idea for it has been pulled from such a remote and unfamiliar institutional location. It is therefore reasonable to predict that most such attempts will fail, but a small but finite number will succeed. Further, we can specify the kind of conditions (e.g. redundancy) which will put agents in a position to carry out such innovations.

Such a model can be used in a number of different fields. We have taken examples from economic change, social policy development, and the organization of science; wherever innovation and entrepreneurship are possible, the model is relevant.

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