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The Argument

This paper examines the interaction between economic models and policy advice through a case study of the U.K. government's Panel of Independent Forecasters. The Panel, which met for the first time in February 1993, was part of the government's response to the policy vacuum created by its departure from the European Exchange Rate Mechanism. The paper focuses on the policy recommendations made by the Panel and their foundation in economic models. It is argued that, because of their ambiguity, economic models do not provide an "objective" basis for policy making. Rather, they provide a level epistemological basis for debating the various social, political, and moral theories that can be used to frame economic policy. The paper concludes that although economic models often serve to depoliticize economic issues, they also have the potential to do exactly the opposite — namely, repoliticize them by connecting economics to wider social and moral debates.

1. Introduction

On 16 September 1992, the credibility of economic policy makers in the U.K., and to a lesser extent economic forecasters and analysts, suffered a significant blow at the hands of the international money markets. It was on this day, quickly dubbed "Black Wednesday" by pundits in the media, that the Chancellor of the Exchequer, Norman Lamont, was forced to raise interest rates, first to 12 percent and then to 15 percent, before admitting defeat and suspending U.K. membership of the European Exchange Rate Mechanism. This decision, which cost billions of pounds

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in foreign exchange reserves, also broke an international agreement to maintain sterling's exchange rate at levels agreed with other European countries. In taking it, the government effectively canceled what had previously been the centerpiece of its anti-inflationary strategy and reinforced doubts about its commitment to wider issues of economic integration within Europe (e.g., the Single European Market and European Monetary Union). Truly a bad day!

In response to this policy crisis, and to bolster the credibility of any new economic policy, the government introduced the "Seven Wise Men" — a panel of independent economic forecasters appointed to provide economic analysis, advice and policy recommendations to the Chancellor of the Exchequer.[1] This innovation, which brought together a diverse group of economists, represented a significant change from the system of civil service briefings and committees that had preceded it, in that the Panel's advice was made available to the public as well as to the government. One of the most obvious consequences of this change, and the one that is the focus of this paper, was the way in which the Panel brought the diversity of economics into the public domain. It represented a very different way of using economic models (and other models) to inform policy decisions to that which had hitherto prevailed.

Traditionally, models are used to depoliticize decision making by creating objective and scientific assessments of the likely consequences of any particular policy choice. As numerous sociological studies have shown, however, these models typically contain, embedded within them, a range of frequently unarticulated values and social assumptions (see e.g. Martin 1979; Irwin and Wynne 1996; Shackley and Wynne 1996). Unfortunately, due to the complexity of most policy models, these issues are accessible only to those who possess a significant degree of technical knowledge. The potential contribution the Panel could make, therefore, to the policy process in the U.K. was to break the monopoly on this information and bring these assumptions into the open. Rather than depoliticizing decision making, therefore, the inauguration of the Panel actually had the potential to repoliticize it.

In practice, however, this effect was mitigated by the tendency of the Panel's reports to emphasize the points on which they agreed, rather than those on which they disagreed. Nevertheless, the reports did go some way to communicating the diversity and excitement of economic (and econometric) models and, to this extent, the openness of the economic future. For example, simply providing an institutional framework within which different economic models and explanations

[1] This designation, the "Seven Wise Men," reflects both the size of the Panel and its composition: all the economists recruited were men. Later, in 1995, as the original members of the Panel were replaced, two women — Kate Barker of the Confederation of British Industry and Bridget Rosewell of Business Strategies Limited — were recruited to the Panel. At the same time, Martin Weale, who succeeded Andrew Britton as the Director of the National Institute of Economic and Social Research, also replaced him on the Panel. Andrew Sentance left in December 1993, following his appointment at the London Business School. From that time the Panel consisted of six rather than seven members.

are applied and defended might have promoted a debate about economic policy in which the underlying values were as much a part of the discussion as the expected outcomes (cf. Jasanoff 1995). Alternatively, it is possible that different interest groups could use specific disagreements or arguments to bolster their own attempts to mobilize support for particular policy proposals. The main point is, however, that through their economic models, the Panel showed that a whole range of policies had the potential to make sense as economics. As a result the Panel created the opportunity, never fully realized by the wider society, to encourage a more reflexive policy-making process — one that allowed for "debate of what values and social-cultural identities the possible [economic] options and commitments signify, reflect and reproduce" (Wynne 1995, 33).[2]

To support this argument I use the meetings of the Panel of the Independent Forecasters as a window on the relationships between economic models, economic policy, and wider social and political concerns. Clearly economic models do not exhaust the range of possible influences on economic policy makers, who will be attempting to meet several other, often noneconomic, criteria as well. However, it is also the case that economic policies must usually make sense as economics. In this way, economic models can form the link between scientific knowledge and the interests of particular social groups and thus form an important case study in the sociology of scientific knowledge (SSK). In this paper I draw on in-depth interviews with the Panel members, as well as their published reports, to illustrate both the range of theories and models that lie behind their policy advice and also the range of economic policies and futures that their models could legitimate.[3]

In doing this I draw on the idea of the experimenters' regress (Collins 1992). The experimenters' regress is an important concept, as it highlights the way in which the development of the "correct" theory and the "appropriate" interpretation of empirical evidence are coextensive with each other. In controversial sciences, therefore, deciding which are the good experiments or models and which are the good theories are two sides of the same coin. As a result, as long as there are theoretical disputes within a science empirical evidence will be ambiguous, and vice versa. The insight of the experimenters' regress, and its relevance for such policy sciences as economics, is that extra data or theoretical elaboration will be insufficient to resolve the controversy, since they are themselves open to further challenge. Instead, scientific controversies close, and the correct model, theory, and interpretation are simultaneously identified through the influence of social factors traditionally held to be "outside" formal scientific practice.

In this paper I use the idea of the experimenters' regress to show that when econometric evidence is ambiguous and the definition of a "correct" model unclear, social and political concerns can effect (a temporary) closure of the debate. My

[2] The replaced word was originally "technical."

[3] These interviews were conducted as part of a Ph.D. in the sociology of scientific knowledge that was subsequently published as Evans 1999.

aim in so doing is to demonstrate how economists, when using economic models to provide policy analysis and advice, move seamlessly between matters of economic theory, economic policy prescriptions, and normative social theorizing. I am not saying there is anything wrong with this per se — indeed the uncertainty that surrounds the interpretation of econometric evidence would suggest that there is little alternative at present. Instead, my aim is to argue that this phenomenon needs to be more widely recognized if economic models are to be used wisely within policy-making processes (see also Evans 1997a).

The paper is structured as follows. In the next section, I provide some background information on the economic events that led to the inauguration of the Panel and set the policy agenda for 1993. Next I briefly describe the theoretical and interpretative models the Panel members used to analyze and understand the economy. The focus here is on the "big picture," the broad trends within the economy, and two main "storylines" are identified. Section 3 looks at a particular application of these models and theories — understanding unemployment and producing policy advice in October 1993. The focus here is on how the general (conceptual, but also empirical) models are applied to a particular historical moment and emphasizes the "interpretative flexibility" of economic data. I then show that choices about economic theory and models are also choices about economic policy and moral theories of society. The conclusion I draw is not that economic models (or modelers) are irrational, but rather that their potential is in providing a more open epistemological arena for debating the range of social, political, and moral theories that can be used to frame economic policy. In this way, and perhaps paradoxically, the paper concludes by arguing that the potential contribution of macroeconomic modeling to the policy-making processes lies in the way it repoliticizes economics rather than depoliticizes it.

2. U.K. Economic Performance, 1982–92

In the mid 1980s, following the recession of 1979–81, the U.K. economy began to experience something of a boom — particularly in consumer expenditure — but also a rising rate of inflation. According to common explanations, a range of factors, including the deregulation of credit, rising house prices, lower direct taxation and relatively high interest and exchange rates, were to blame. From the perspective of this paper, however, the causes of the boom are less important than the observation that, at the time, it was not forecast by either the government or the majority of forecasting organizations (see e.g. Burrell and Hall 1994). As the boom continued to strengthen and it became clear that both growth and inflation rates were going to remain strong, the government began to pursue more deflationary policies. Initially their strategy was to "shadow" the German exchange rate (i.e., informally "fix" the rate). Later, and with the support of a large part of the

U.K. economics profession, this policy was formalized by joining the European Exchange Rate Mechanism (ERM), a Europe-wide agreement to fix exchange rates within certain bands.[4]

Eventually the economic cycle did begin to turn, and by the early 1990s boom had become bust. Its options now constrained by the policy of maintaining the exchange rate within its agreed ERM band, the U.K. government could do little to stimulate recovery, and the recession that followed the boom lasted for two and a half years. Again, neither the government nor other economic forecasters in the U.K. predicted the severity of this phase of the economic cycle particularly well. Eventually, in the summer of 1992 — ironically, just after the National Accounts would later show that GDP was increasing — the perceived inconsistencies between the economic slump in the U.K. and the government's restrictive policies came to a head. Speculators gambled that the U.K. government would leave the ERM, thereby lowering the exchange rate, and began selling sterling. Initially, the government responded by buying sterling and raising interest rates in an attempt to prop up the pound. This strategy did not work, however, and on 16 September 1992 the U.K. government abandoned its international commitments and cut interest rates, thus allowing the exchange rate to fall below its ERM band and stimulating some sort of recovery.[5]

Although popular with some of the government's supporters and some economists (not to mention speculators like George Soros, whose Quantum Fund reportedly made $1 billion on the devaluation), there was a cost associated with this decision: the government no longer had an economic policy. Moreover, the majority of the economics community had backed the policy it had just abandoned. One explanation for the formation and role of the Panel of the Independent Forecasters, therefore, is that it was introduced to fill this political vacuum and bolster the credibility of economic policy and of the government. As Alan Budd, the Chief Secretary to the Treasury, explained:

> Associated with [leaving the ERM] was the feeling that the Treasury, in particular, had produced appallingly bad forecasts and that this was one of the reasons why we had made this ERM mistake.... So what the Chancellor did, to appease the wrath of the people who said he and the Treasury forecasters ought to be sacked ... [was to say] "Well, actually we never paid

[4] An important part of the economic rationale for joining the ERM was that the high cost of reneging on such a public and formal agreement would enhance the credibility of the government's policy.

[5] Coincidentally, the autumn of 1992 was also the time at which I began a Ph.D. in the sociology of scientific knowledge (SSK) at the University of Bath. The formation of the Panel of the Independent Forecasters presented an ideal case study for analyzing the way in which knowledge claims by economists are negotiated and the role of econometrics within this process. The research itself involved estimating a simple macroeconometric model and conducting in-depth interviews with the Panel members after each of their meetings, in 1993 and early 1994. The aim was to track the Panel's forecasts throughout 1993 and see how it responded to and incorporated new data and evidence (see Evans 1997b).

> that much attention to our forecasts, and it isn't the only thing we do. But, to demonstrate that we do take account of outside views, I shall have this Panel of Independent Forecasters to supplement what my own guides are saying." (Alan Budd, interview, 22 March 1994, p. 8)

From this perspective, the idea was that the Panel of the Independent Forecasters would act as a public check on the Treasury by providing a yardstick against which government policies could be measured.[6] The Panel, which met for the first time in February 1993, was composed of seven economists, and its members, who were all regular economic forecasters, were deliberately chosen to reflect a broad spectrum of views, backgrounds, and analyses. Of course, the requirement that Panel members had to be engaged in some form of quantitative economic modeling and forecasting, even when interpreted broadly, nevertheless excluded a whole range of economic and other perspectives. The Panel and its role are summarized in figure 1.

In practice, the Panel's meetings and reports covered the usual elements of economic forecasting — assumptions, domestic demand, net trade, prices, unemployment, monetary conditions, and so on. The published reports (initially three per year, but later reduced to two per year) included a discussion of the main factors affecting the economy, and forecasts covering the main economic indicators for up to two years ahead. Medium-term projections, covering a five-year horizon, were discussed in a separate section, and the reports generally concluded with recommendations for fiscal and monetary policy. The format adopted was that each report would consist of two main parts. First, there was a common front section, which summarized the discussion and indicated where various Panel members agreed, where they disagreed, and what they recommended; second, each report included a set of appendices, being the seven individual submissions in which the Panel members outlined their own views and concerns in greater detail.

3. Understanding the Economy

As a result of its constitution, the Panel was as diverse as any group of economic modelers and forecasters are likely to be.[7] For example, they ranged theoretically from traditional Keynesianism through (mainstream) neo-Keynesianism to new classical economics and Friedman-style monetarism. Institutionally, the Panel members worked in organizations ranging from universities to merchant banks, although most had previously been involved in giving policy advice. Although

[6] In contrast, more cynical observers suggested that the Panel was simply a ruse to deflect future attention and blame from government economists.

[7] As noted above, this is not to say that they exhaust the possible perspectives. As I argue in Evans 1999, the Panel is more appropriately viewed as the starting point for exploring economic policy options than as the last word on the matter.

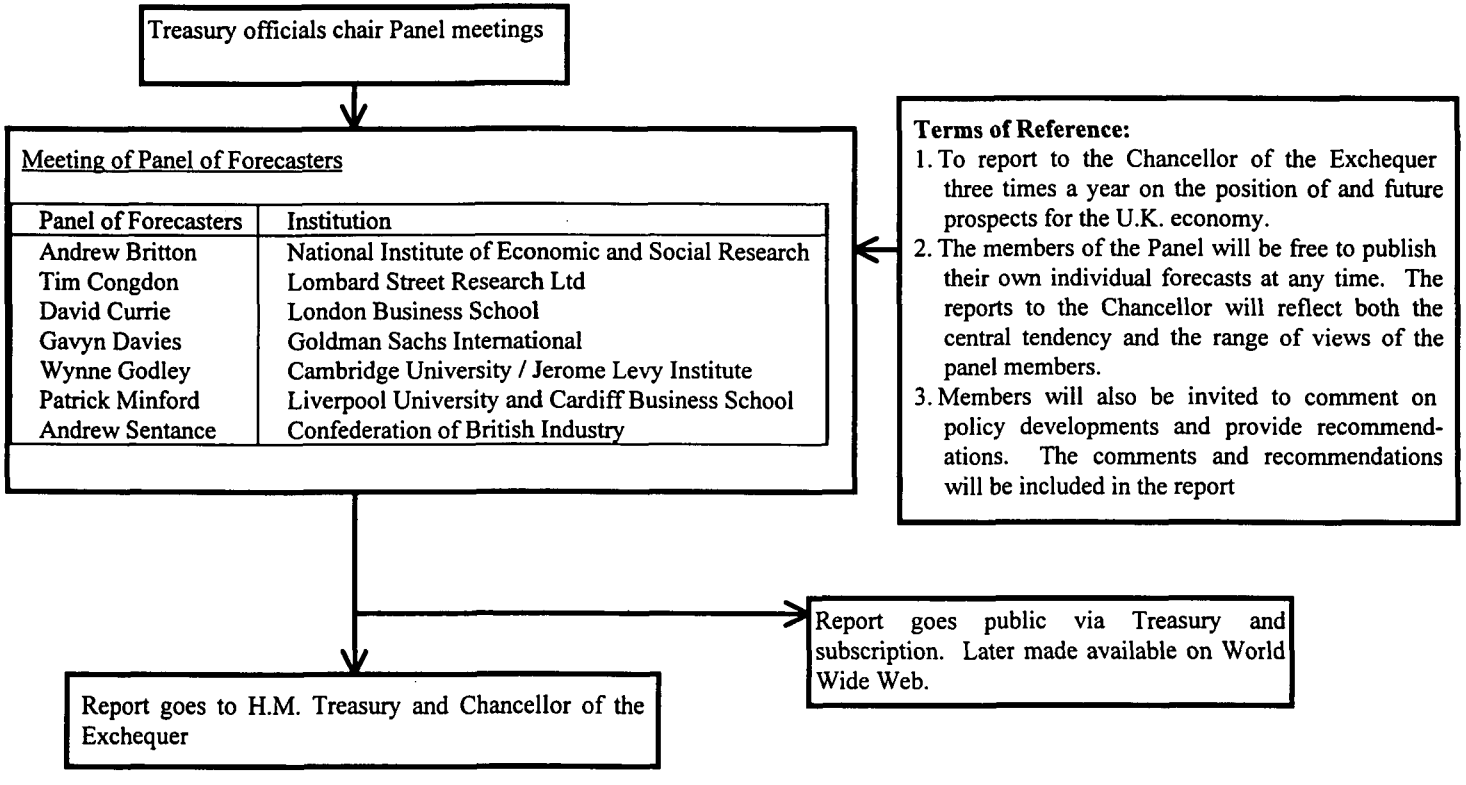

Figure 1: Members of Panel of Forecasters and Their Relationship to Government

they all used quantitative economic models, there were differences in the sorts of models used — for example, some were "large" models (i.e., containing hundreds of equations), others were "small" models; some used rational expectations, others did not. What is more these "methodological" differences often cut across the theoretical divisions. Finally, and in large part because of this diversity, no attempt was made to standardize the forecasts the Panel produced (e.g., by using common starting assumptions about economic policy), and differences between the forecasts and policy recommendations reflected a mixture of different economic models, different assumptions, and different judgments.

It is important not to interpret this diversity in a simplistic or negative way. Articulating the full range of views was very important because, at least in retrospect, part of the problem with the previous system was its being perceived as too committed to the ERM policy. Thus Treasury economists were alleged to have been unwilling or unable to countenance alternatives, thereby putting excessive faith in their own predictions that growth would resume much sooner than it did. Not considering all the alternatives is not a criticism that could be made of the Panel of Forecasters! For instance, at their first meeting in February 1993, the diagnoses and forecasts they produced ranged from reasonably optimistic to extremely bleak (e.g., forecasts for GDP growth in 1993 ranged from 0.2% to 2.0%), and their individual policy recommendations reflected this. Indeed, a close examination of the individual forecasts reveals some quite profound differences about where economic growth was expected to come from. For example, the relative contributions of domestic demand and net trade to overall economic growth varied considerably, and in the case of domestic demand the differences were not just ones of magnitude but of *direction.*

Thus although there was a consensus amongst the Panel that the U.K. economy was likely to resume some sort of economic growth as a result of leaving the ERM, there remained a range of views regarding the character of this recovery. The reasons for these differences lie not in the data but in the theoretical and empirical models the Panel members used to interpret and structure those data. Despite the diversity of models, theories, and assumptions, however, two reasonably clear "stories" about the economy did emerge. First, there were the forecasts and policies in which the decision to leave the ERM was central and which were based on what might be termed a "devaluation" story. Second, there were forecasts and policies based on a more "classical" economic interpretation and which relied on concepts of equilibrium, natural rates, and the adjustment of prices. The main features of these two sets of theories are outlined below and are summarized in table 1.

Table 1: Summary of Theories and Policies

Theoretical Framework	*Proponents*	*Policy Issues*	*Policy Solutions*	*Economic Prospects*
Devaluationists	Andrew Britton David Currie Gavyn Davies Wynne Godley Andrew Sentance	• Net trade and balance of payments • Unemployment and government borrowing • Inflation • Investment	• Fiscal tightening • Training and education • Boost investment • Reduce consumption	Bleak
Classicals	Tim Congdon Patrick Minford	• Weakness of economy • Distance from natural rate • Government borrowing	• Fiscal prudence • Monetary boost	Good

3.1 The Devaluationist Forecasters

The "devaluationist" forecasters represent what may be thought of as the mainstream consensus view in U.K. economics. The group includes the majority (five) of the Panel members and both the traditional and the neo-Keynesian approaches to understanding the economy. According to the devaluationists, the U.K. economy would recover during 1993, with growth resuming as a result of the fall in the sterling exchange rate that had occurred the previous September (i.e., 1992). In addition, the low level of interest rates that the devaluation had permitted was expected to bring about a modest expansion in consumer spending. Over the longer term, however, problems were expected to appear, as economic growth led either to falling unemployment, which would then cause wages (and hence inflation) to rise (thereby forcing deflationary policies), and/or rising consumption, which would increase imports and hence the trade deficit (again forcing deflationary policies). The devaluationists thus forecast a difficult future for the U.K., in which the economy was constrained by either the budget deficit or the trade deficit, or both.

3.2 The Classical Forecasters

The other way in which the economic data could be interpreted was to refer directly to the economic cycle itself. The "classical" forecasters represented a minority view on the Panel (two out of the seven economists) and possibly in U.K. economics in general. Theoretically, they included both the monetarist and new classical approaches to understanding the economy. Although the devaluation was important in this account, it was not the *cause* of the recovery. Rather, because of the effects of the recession, actual output was significantly below its "potential

level" (i.e., what it would have been without the recession), and it was this "disequilibrium" that was the cause of the devaluation (by making the high interest, high exchange rate policy of the ERM unsustainable).

According to this interpretation, the "output gap" (the difference between potential output and actual output) was "exceptionally large," and this meant that the economy could grow at an above trend rate for several years ("filling in" the gap) before the trade-off between growth and inflation became adverse. In fact, so strong were the deflationary forces acting upon the economy, it was even considered possible that the price level would actually fall unless the government acted to ensure economic growth (Congdon 1993, par. 5). Thus, unlike the devaluationists, the classical forecasters were fairly optimistic about the longer-term future and tended to believe that any problems that might arise in the near future would be caused by the government not acting swiftly to reinforce the recovery.

4. From Theory Choices to Moral Choices

Having thus set the scene and described the economic events that led up to the inauguration of the Panel of the Independent Forecasters, I now want to examine how these general theoretical frameworks were applied at a particular point in time. The case study I have chosen is the third meeting of the Panel that took place in October 1993. This meeting is particularly important because it preceded the U.K.'s first "Unified Budget" in which taxation and expenditure decisions would be presented simultaneously. As a result, the Panel's October meeting was highly focused around the policy recommendations that followed from their individual models and forecasts.

In addition to its importance for U.K. economic policy, this meeting of the Panel of the Independent Forecasters is also an important case study for sociological analysis. In particular, because the meeting was concerned with turning economic forecasts into economic policy advice, it necessarily addressed the links between economic ideas and policy actions. What is more, to the extent that the theories, forecasts, and models differed from one another, the negotiations that occurred at these meetings offer a crucial insight into the ideas, values, and assumptions underpinning these models. Analysis of this one meeting, then, provides insights into many other cases where economists are appointed to advise the government and use macroeconomic models to do so. In this sense, the strength of the case study is that both the methods used by the forecasters (i.e., macroeconomic models) and the issues addressed (i.e., GDP growth, unemployment, inflation, government debt, net trade, and so on) are the everyday concerns of economic policy.

My argument proceeds in three main steps. First, I examine how the same data can be interpreted in ways that, despite all being correct as economic models, are nevertheless very different as economic theories. To illustrate this point, I survey

the different theories of unemployment — a key social and economic policy arena that impacts on a wide range of social, political, and economic issues — that were used by the Panel members. I then outline their foundations in econometrics and examine other evidence. Second, I show how these economic theory choices implied different policy regimes and describe the range of economic policies that the Panel felt their models justified or supported. Finally, I outline the different social and moral visions that these economic policies supported. The analysis thus shows that economic theory choices are simultaneously policy choices and also normative statements about society. Moreover, it is only by reaching consensus on these wider social and political issues that economists will be able to resolve their experimenters' regress and decide what the properties of a "good" model are. The other side of this coin is that in so doing they will also be defining how "model" citizens should behave. It is this function that gives economic models their social and political relevance, and illustrates the Panel's potential importance as an institutional innovation.

4.1 Understanding Unemployment: The Theory Choices

Among the Panel of the Independent Forecasters there were two basic theories about unemployment. One remained true to the equilibrium tradition of classical economics and the related idea of natural rates of output and unemployment. In this account, explanations of the rate of unemployment focused on the economic cycle and the adjustment of wages, which is in turn influenced by such institutional factors as the power of trade unions, labor mobility, and the social security and unemployment benefit systems. The other theory, which is of much more recent origin, supplemented this classical story with an additional factor known as "hysteresis."

Although a relative newcomer, it is the hysteresis model, developed by Richard Layard and Steve Nickell and thus also known as the "Layard-Nickell" model, that is the mainstream representation of the labor market among U.K. economists (see e.g. Layard et al. 1991, 1994). The Layard-Nickell model is based on the observation that after there has been a recession, unemployment does not fall back to the level it was before (as a more classical interpretation would suggest) but appears to remain "stuck" at the new higher level. The simpler versions of the hysteresis idea explain this observation by suggesting that unemployed workers become deskilled and are thereby prevented from regaining employment. More sophisticated interpretations of the data also include the effects of recession on employers and build in ideas of "path dependency" and "missed opportunities." The ideas behind the model can be summed up as follows:

> If you look at the course of unemployment, it goes up in steps, and it never falls back to the extent it did before. This is perhaps due to the problems in

> the labor market or possibly the economy more generally. Hysteresis may not simply be a matter of people losing their ability, or their acceptability, or something, in the labor force. But it may also be to do with the loss of opportunities for innovation, loss of investment, and so on. So you can't simply assume that the capacity is in some sense "there" to make up after the recession. (Andrew Britton, interview, 12 July 1993, pp. 3–4)

4.1.1 The Scientific Controversy

In terms of economic science, the question that exercised the Panel in their deliberations about unemployment was whether or not hysteresis exists. In other words, what does the observation that unemployment appears to get "stuck" reveal about either the economy in general or labor markets in particular? One way of understanding this question — and particularly the problems that economists face when they try to answer it by using economic models to mediate between the theoretical concepts of their science and the empirical data they observe — is the idea of the experimenters' regress.[8]

The problem created by the experimenters' regress can be illustrated as follows. In order to decide whether or not hysteresis exists, economists need to know whether the data series for unemployment is correctly interpreted as "a ratchet-like increase in unemployment occurring over time" or as "fluctuations around an equilibrium rate or level." To know this, economists need to know whether or not hysteresis exists, and to decide this they need to develop a model that explains the data. The problem is that models that include hysteresis as well as those that do not are both compatible with the data. Thus to know whether or not the model explains the data correctly, they need to know which is the appropriate theory. To know this, they need to know whether or not the data series shows "a ratchet-like increase in unemployment occurring over time" or "fluctuations around an equilibrium rate or level." To know this they need to know whether or not hysteresis exists, and to do this they need to develop the correct model. But different models are compatible with the observed data . . . and so on. The important point, which is illustrated in greater detail below, is that this cycle cannot be broken until some way is found of breaking the regress and establishing one model, interpretation, and hence explanation, as correct. Once the correct model is known, so too is the correct interpretation. In the absence of such clear criteria, however, what counts

[8] Note, however, that the situation faced by economists is slightly different from that faced by the physicists in Collins's original account (Collins 1992). In the physics experiments, the controversial data were generated through the experimental activities of the physicists. In the case of economics, processes outside the control of the economists generate the data. As a result, it is the interpretation of the models that simulate the data that becomes the source of controversy rather than the interpretation of the data themselves. It is in this sense that models mediate the economists' understandings of economic activity.

as a good model is much harder to define. One result of this problem is that different interpretations of the economic data will coexist, with the "correct" interpretation of those data remaining the subject of dispute.

In fact, this is exactly what does happen. Economists who accept the idea of hysteresis interpret it as implying that inflationary pressures, particularly those due to wage inflation, will be strong even when unemployment is relatively high. This is because one effect of hysteresis will be to reduce the pool of available workers (as not all the unemployed are able to compete effectively for jobs) and, as a result, inflationary pressures will emerge even at relatively high levels of unemployment. In the U.K. context this means inflationary pressures will begin to build when unemployment is around 2–2.5 million (roughly 7–8 per cent of the labor force).[9] On the other hand, if hysteresis does not exist, then unemployment will be able to fall to relatively low levels (around 1–1.5 million, or approximately 3–5 percent) before inflationary pressure are significant (see figure 2).

In this way, questions about the existence of hysteresis are operationalized as questions about the relationship between unemployment and inflation, and what look like testable hypotheses emerge. For example, if hysteresis exists, then inflationary pressures will be strong at unemployment levels around 1.5 million and only weaken when the number of unemployed exceeds 2.5 million. Consequently, Andrew Sentance describes the experience of the U.K. economy in the 1980s as follows:

> In the 1980s, . . . union membership and influence declined. Unemployment benefits also became less generous in relation to incomes in work. These factors should have pushed down the equilibrium rate of unemployment. But their influence was offset by a rising total of labour market "outsiders" [i.e., the long-term unemployed who are unable to compete for jobs]: long-term unemployment rose steadily, with the number out of work for over a year accounting for almost half the total. *As a result, unemployment of over 3 million exerted little downward pressure on inflation.* (Sentance 1993a, par. 7; emphasis added)

The case made in support of the Layard-Nickell or hysteresis model is that inflation has not been stable at unemployment levels below 2 million for the last ten to fifteen years. This is then taken as evidence that the natural rate of unemployment, which all the economists on the Panel seemed to believe was about 1–1.5 million, is overlaid by additional unemployment due to hysteresis. It is this

[9] Calculating the percentage of the labor force represented by the number recorded as unemployed is fraught with difficulty. In the U.K., the number recorded as unemployed actually refers to those out of work and claiming a specific state benefit. As eligibility criteria for this benefit change, so too does the number of people registered as unemployed. Other measures of unemployment — for example that used in the Labour Force Survey — are rather broader and thus record more people as unemployed than the official statistics, which are arguably more a by-product of the state benefit system than a measure of unemployment.

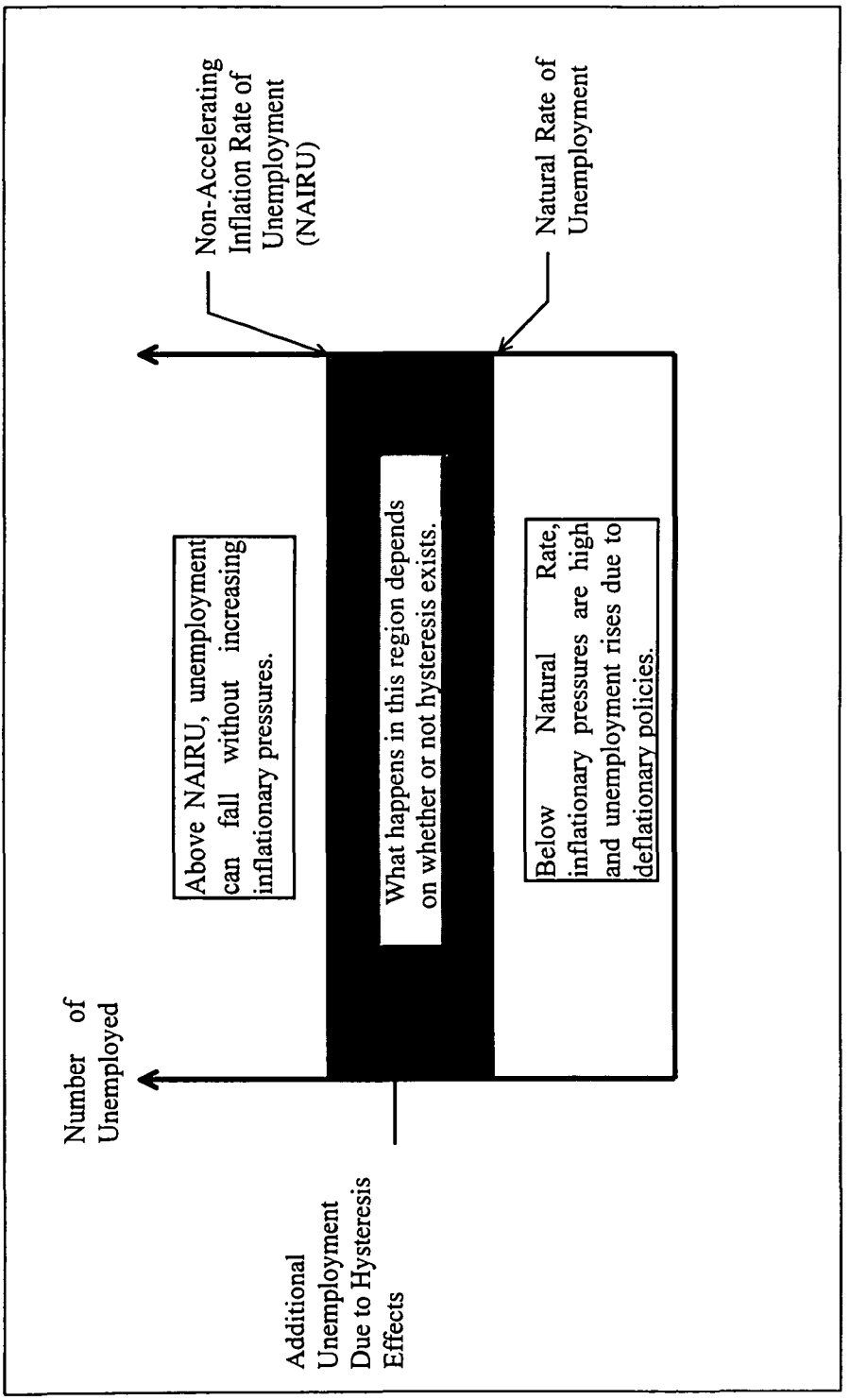

Figure 2: Hysteresis Effects and the Natural Rate of Unemployment

latter effect that makes it seem as if unemployment cannot fall below 2–2.5 million without inflationary pressures increasing.

Although the majority of the Panel favored this interpretation of the data, and hence the Layard-Nickell model as its explanation, it is not beyond reproach. There are economists, most notably Patrick Minford in the context of the Panel, who do not accept that the hysteresis hypothesis has been proven and who therefore challenge both the model and the interpretation. In his submission to the Panel, Minford included a detailed rebuttal and deconstruction of the case for hysteresis. Put simply, Minford's counterargument was that the inflation and unemployment figures should not be interpreted out of context. He argued that wage behavior in the late 1980s was not particularly aggressive, given the headline inflation figures of that time:

> According to our story [the acceleration of average earnings growth from 8 to 10 percent] reflected rising inflationary expectations in the monetary context of 1987–90. It is actually remarkable how little wage settlements reacted to a sharp rise in inflation (from 5 per cent [sic] to 10 per cent on the RPI [Retail Price Index — a common measure of inflation in the U.K.] and around 8 per cent on "underlying" measures); we explain this by our view that *unemployment was above not below the natural rate*. For all this period real wages were growing by substantially less than the 4.7 per cent 1980s average growth in manufacturing (let alone still higher general industrial) productivity. *The behaviour of expected real wages remained moderate even when unemployment had fallen to 1.6 million*; this is inconsistent with a natural rate of 2.5 million and above. (Minford 1993a, par. 7; emphasis added)

However, it remains the case that unemployment and prices both rose in the late 1980s and did so at unemployment levels well in excess of what Minford believes to be the "natural rate." If hysteresis is not the reason, then what is?

> Our answer is that owing to our tragic errors in monetary policy we had to hit on the head an economy which otherwise could have remained on a sustained growth path of some 3 per cent. After we had so hit it on the head we joined the ERM proper and continued raining blows on its prostrate body. The resulting deep recession has produced an unemployment "excess" (over the natural rate) of over 2 million. In short it is recession, not the trends of a poorly-performing labour market, that has delivered us this apparent ratchet. (Ibid, par. 19)

In other words, it is Minford's claim that economic policies — particularly the decisions to "shadow" the German deutsche mark and then to keep the U.K. exchange rate fixed relative to European currencies — were to blame for the high levels of unemployment in the U.K. Finally, Minford turned the spotlight back onto the hysteresis hypothesis and offered some criticisms of his own. One issue,

which Minford highlighted in interview, was that there was (at least to him) no convincing econometric evidence:

> There's no evidence for hysteresis.... The sort of equations that people have been [getting are] quite clearly of this form:
>
> $$u_t = \alpha\, u_{t-1} + ...$$
>
> where α is less than 1. It is only if α is equal to one that you get the strong sort of hysteresis. And no one can find it — it is just not there — there are exhaustive studies by Steve Nickell and Co. on this issue and they have said, basically, that there is slow adjustment. Well I've got slow adjustment in my model, it's no big deal. . . . It's just a fairly long drawn out adjustment, so what's new? (Patrick Minford, interview, July 1993, p. 13)

As Minford is prepared to concede, the econometric evidence about hysteresis is not entirely conclusive, and it is possible that a weak form of hysteresis might be one of the reasons that adjustment in the labor market is "slow." However, this is not the way that Minford likes to think about it. For him, the crucial test is to look at what happens to the long-term unemployed. One of the most controversial claims of the hysteresis school is that the very fact of being unemployed can make individuals unemployable. Minford flatly denies that this is the case. According to Minford:

> There is no evidence that once people are out of work they stay out of work forever. Indeed there is positively contradictory evidence. I mean, if you believe in anything remotely Popperian, you cannot sustain the view that long-term unemployed do not get jobs, because it is flatly contradicted by one important event — they did get jobs and they stopped being long-term unemployed. End of story, it seems to me. (Ibid., 13–14)

Of course, as Minford himself has just shown, empirical data are rarely so conclusive, with the result that this is not at all the end of the story. For example, economists who support the idea of hysteresis might focus on those among the long-term unemployed that did not get jobs. As Minford would be quick to point out, this is a retreat from the strong form of hysteresis, in which all the long-term unemployed remain out of work. Of course, given that the econometric evidence produced by Nickell and his colleagues suggests only slow adjustment, they might respond that the strong form of hysteresis is a straw man erected for Minford's rhetorical convenience. In any case, the problem still remains — what causes the adjustment to be slow? Is it hysteresis effects, as the mainstream economists allege, or bad policy choices, as Minford claims? Once again the experimenters' regress begins to bite.

At the time of the Panel's meeting in October 1993, both explanations were available, and models that assumed both the existence and nonexistence of hysteresis were advanced as compatible with the data. In more sociological terms, we can see that what looks like an empirical question to economists is also a question

about enculturation and interpretation. When economists look at the data series for unemployment in the U.K. what do they see? In October 1993, some saw a "ratchet-like increase" (and hence also hysteresis as an economic phenomenon), and some saw "fluctuations around a natural rate" (and hence no hysteresis).

4.2 Controlling the Budget: The Policy Choices

Of course these debates about economic theories and economic models are also debates about economic policies. For example, by focusing attention on the group that do not get work, the hysteresis economists maintained a conceptual and political space within which special measures to combat long-term unemployment were needed. In contrast, Minford's more classical interpretation not only flatly denied that such policies are needed, it also suggested that they would be harmful (e.g., as excessive or unwarranted state intervention in economic markets). In this way, choices about economic theory matter not just to economists but also to economic policy makers.

According to the mainstream economists on the Panel, the existence of hysteresis meant that any growth in economic output that would take place in 1993 and 1994 would quickly be constrained by the increase in inflation that would occur as the level of unemployment dropped below 2 million. As a result, the potential for sustained economic growth would be severely reduced, and unemployment would be likely to remain relatively high (e.g., at or above 2 million). It is a corollary of this slow growth and high unemployment that government social security spending and government borrowing would also be high. This is important, because in 1993 the recession that had preceded the U.K.'s exit from the ERM had already increased government borrowing to very high levels. As a result, policy makers were under pressure to raises taxes or cut expenditure as the economy recovered in order to reduce borrowing. The extent to which they could do this, however, was a key concern and uncertainty. As Andrew Britton remarked:

> The question about how far [the public sector finances] will improve is of course entirely bound up with how far you think the recovery can go.... The optimists on the natural rate of unemployment are also optimists on public borrowing; the pessimists on sustainable growth are pessimists on public borrowing. (Andrew Britton, interview, 12 July 1993, p. 5)

4.2.1 The Classical Policies

What I have characterized as the "classical" economic analysis among the Panel was the basis of the forecasting models favored by Minford and Congdon. According to this view, hysteresis did not exist and the high levels of unemployment seen

in the U.K. were the result of policy mistakes in other areas, particularly monetary policy. From this perspective, then, the sort of government policies needed to promote growth and reduce government borrowing focused on two main areas (see table 1). First, monetary policy needed to be used to ensure that growth would continue; second, fiscal policy needed to remain prudent to ensure that government debts were reduced over the medium term (3–5 years).[10] Given that in this account hysteresis did not exist, there was no reason to think that the long-term unemployed would be excluded from the labor market or that government-run training programs were necessary. Indeed Minford, who was well known for his support of the Conservative government's laissez-faire economic polices, believed that provided interest rates were cut quickly enough, unemployment could fall to such an extent that

> the public borrowing we see would melt away [without additional policies and] there would be no need for the public spending programmes allegedly needed to boost competitiveness. (Minford 1993b, par. 17)

4.2.2 The Devaluationists' Policies

In contrast to this rosy scenario, the economists who believed that the economic data supported the hysteresis hypothesis painted a much bleaker picture of the U.K.'s economic future. Even though the idea of hysteresis was used slightly differently by the different members of the Panel, the majority (Britton, Currie, Davies, and Sentance) all subscribed to something like the following ideas:

> Basically, my line of argument is that the genuine natural rate is probably 1 to 1.5 million, . . . but overlaid on that you have this hysteresis effect which makes it appear that you can't get unemployment down below 2 to 2.5 million without inflation picking up. (Andrew Sentance, interview, 13 July 1993, p.15)

In this scenario, the idea of hysteresis was important for macroeconomic policy because it implied that being *unemployed*, particularly long-term unemployed, effectively rendered people *unemployable* unless special training programs were created. As a result:

> [You would need] things like better training programs for the long-term unemployed. . . . My notion is that *you have to break into this cycle* where people apparently appear to drop out of the labour market and come to exist on benefits for a long period of time. (Ibid., 15–16; emphasis added)

[10] The exact way in which monetary policy could be used varied. Minford favored cuts in interest rates, whereas Congdon advocated measures to increase the supply of "broad money."

Given the implications of perpetual unemployment for the public finances and the economy as a whole (not to mention those consigned to life on benefits), the Panel members who accepted the idea of hysteresis also tended to favor government policies and interventions in a range of different areas. As a result, the diagnosis of the problems faced by the U.K. economy was much more complex for these economists. In particular, they saw two related sets of issues. First, like their more classical colleagues, they recognized that the large government debts that had built up (quite appropriately) during the recession had to be reduced as the economy began to grow. Thus, for example, David Currie recommended:

> Budget measures to curb [government] borrowing amounting to some £3–4bn over and above [those] announced by the previous Chancellor. (Currie 1993, par. 10)

In this sense, the classical and devaluationist economists might seem to be in agreement; and to a certain extent some were.[11] On the other hand, unlike the classical economists, the devaluationists' analysis suggested that any gain to competitiveness due to the depreciation of the exchange rate would quickly disappear as a result of higher inflation. Thus what united the devaluationist economists, and differentiated them from the classical economists, was the way in which economic growth and falling unemployment interacted with a second set of economic policy issues. In particular, they were concerned that economic growth in the U.K. has been historically associated with a tendency for imports to increase. Projecting these trends into the future, they forecast that any future economic growth would be accompanied by an increasing trade deficit. Their fear, therefore, was that economic growth could be halted, and unemployment kept unnecessarily high, if previous patterns of economic growth were allowed to repeat themselves. As a result, they argued that policies were needed not just to reduce government borrowing, as the classical economists said, but also to address long-run problems in the British economy. These long-run problems included long-term unemployment but also low levels of investment and poor export performance. On the basis of these considerations Andrew Sentance argued:

> A further fiscal tightening is [needed] to change the balance of fiscal and monetary policy in a way which is favourable to sustaining a higher level of investment and net exports. (Sentance 1993b, par. 14)

This point was also important for Gavyn Davies, who argued that "a further shift in the fiscal/monetary [mix] looks desirable in order to control consumption, boost investment and maintain a competitive real exchange rate" (Davies 1993, par. 4). In terms of practical action, Davies suggested (as he had done at the Panel's previous meeting in July 1993) that the Chancellor should introduce

[11] Not all the economists in this group thought that further measures were needed to reduce the government's debt.

"consumption-reducing measures [which] should probably build up to at least 2–3 percent of GDP over the next 4 years" (ibid., par. 35). Of this revenue, one half would be used to reduce borrowing and the other half to fund special employment training and infrastructure programs.

In other words, the models and forecasts that included hysteresis effects fed into recommendations that differed quite significantly from the laissez-faire approach of the classical Panel members, particularly in terms of the amount of state involvement considered necessary and the problems to which that intervention was to be addressed. As a result of the interconnections between the different sectors of the economy, concern about the effect of hysteresis on the labor market was linked to concerns about the U.K.'s export performance and the balance within the economy between consumption and investment. Understanding unemployment, then, was part of understanding the larger set of budget constraints faced by the government. Perhaps more significantly, five of the seven Panel members recommended that:

- policies were needed to retrain the long-term unemployed, reduce long-term unemployment (and hence hysteresis), and restrain wages;
- training and skill levels in the rest of the economy needed to be improved to increase productivity in the economy as a whole;
- spending and taxation priorities needed to be changed so that the first two points could be achieved.

4.3 Changing Society: Moral Choices

To summarize what has been said so far, hysteresis is not only a controversial topic among economists, it is also something of considerable interest to economic policy makers. The majority of the Panel believed that hysteresis existed and that simply being long-term unemployed would render some people (though not all) unemployable. As evidence for this, the economists pointed to the behavior of unemployment and inflation over the past ten to fifteen years, arguing that this supported their conclusion that unemployment could not fall much below 2 million without wage pressure leading to an increase in inflation. As a result, this group recommended that policy makers introduce measures to increase the "turnover" in the labor market and minimize the number of long-term unemployed. In this way the supply of employable labor would increase and the level of unemployment at which inflation would be stable would fall. Thus, for example, David Currie explicitly argued against reducing expenditure as a way of reducing government borrowing. Instead, he argued:

> A preferable alternative would be to . . . re-deploy resources . . . from public consumption to public investment. This would allow support of those areas of public spending that help strengthen the longer run supply side perfor-

> mance of the UK economy, including education, training and R&D. (Currie 1993, par. 10)

Without such measures the future would be bleak. However, and this is where an SSK analysis can begin to make some links between the (non-) closure of debates in economics and the wider sociopolitical context, if such measures are to be implemented then a change in the political culture of the U.K. would be needed. As noted at the end of the previous section, in order for the training and investment needs identified by the majority of the Panel to be met, changes in the political priorities would be needed so as to reorient policies toward the new goals. Thus:

> The issue is not whether full employment is desirable, but whether it is feasible. . . . What is required however is a change in the structure of both spending and taxation to encourage growth of output and especially employment. Other objectives may have to be sacrificed if that aim is given priority. (Britton 1993, pars. 12, 25)

What is more, for at least some of this group, these policy choices were linked to clear moral commitments about the kind of society they wanted to see. Andrew Britton explained his motives as follows:

> My interest [in unemployment] has been involved by wider social considerations. What is wrong with the state of the nation seems to me to have a lot to do with a sustained period of high unemployment. So my interest in trying to think how full employment could be restored is not just a question of trying to make the economy grow faster and have more real wealth to distribute, but also a feeling that socially it is divisive to have so many people unemployed. That they ought to be able to have a role to contribute to society beyond simply claiming their dole — not just so many mouths to feed, but actually somebody with a useful contribution to make. (Andrew Britton, interview, 12 July 1993, p. 7)

In opposition to this emphasis on special training for the long-term unemployed, the classical economists, and Minford in particular, argued that there was no such thing as hysteresis. The apparent ratchet-like rise in unemployment was the product of policy mistakes that had destroyed growth and created recession. Indeed, in Minford's model, the long-term unemployed were not unemployable at all, as evidenced by the fact they did get jobs. Minford believed that the labor market policies already enacted had made most of the necessary changes and that in 1993 the natural rate of unemployment was below 1 million.

Finally, it is worth noting that Minford is not opposed to governments taking policy decisions that will reduce unemployment. Instead, the dispute is over what sorts of social relationships are compatible with low unemployment. For the devaluationists, it requires fairly active and interventionist policies, particularly in the area of training and investment. In contrast, Minford's position is that training

and investment are best left to market forces and that the role of government is to create the conditions within which these markets can operate effectively. In terms of unemployment, then, his key insight is that the benefit system actually acts to reduce employment, and hence increase unemployment, by keeping wages higher than they need be.

> My whole theory of the labour market, which I published in the middle of the 80s in my *Unemployment: Cause and Cure* book, focuses on the idea that people get caught in the unemployment trap. They don't get back to work and stay long-term unemployed because their potential real wage is less than their reservation wage, influenced by benefits. (Patrick Minford, interview, July 1993, pp. 14–15)

For policy makers living in Minford's world, therefore, the solution is to reduce benefits (or, more accurately, the marginal tax rates faced by those coming off benefits) so that working becomes economically viable. In this scenario, the moral vision offered to society is essentially that of the status quo. There is a continued belief in the ability of the market to provide; and so long as right polices are followed, the future is, potentially, very promising.

Looked at in this way, debates about economic theory and economic policy are also linked to wider social and political concerns. Economic theory choice is thus also a social and political choice about the kind of society the U.K. is (or should be). We can see that what is at stake in these views is much more than an economic analysis. They are also moral and political views about how the country should be run: should the long-term unemployed be offered training? should governments intervene in industry and markets? how should economic agents behave? what is a "fair" wage? In other words, these theory choices are not just choices about the significance of econometric coefficients — and it is worth noting that these are not something on which econometrics has (so far) been able to adjudicate — but also about social relations and responsibilities within society. What is more, by thinking about the links between economic models and theories on the one hand and social and political cultures on the other, we can begin to see how the problems created by the experimenters' regress are (temporarily) resolved. In particular, given the differing degrees of political and social change associated with the choices offered by the Panel, is it not surprising that the government's response was to accept their views on the importance of reducing government debt but not the more radical reforms proposed for the labor market?[12]

[12] Counterfactually, we can note that in different circumstances, or with different interest groups lobbying the Chancellor, a different decision might have been reached.

5. Economic Models and Economic Policy

The previous sections have shown that forecasting economic growth and giving policy advice during 1993 was in essence a controversy over how best to understand the economy. Everyone accepted that the U.K. had been through a severe recession in the previous two or three years; what was not so clear was what would happen next. One view was that the U.K. economy would begin a period of sustained growth with unemployment falling and inflation remaining low. The other was that the recovery would be little more than a brief flurry of activity followed by a much longer period of slow and difficult growth against a background of high unemployment and the reemergence of inflation.

Consequently, one of the key features to emerge from the Panel's meetings was that because of their diversity, economic models, when taken together, have remarkably few implications for policy — at least until there is some agreement about what the correct model of the economy actually is. However, in 1993 the economic forecasters on the Panel had yet to break out of the experimenters' regress and estimate an economic model that commanded respect amongst their colleagues; they had thus to convince themselves and their own community of their theories. For example, even at the end of 1993, when all the economic data had been collected, none on the Panel of the Independent Forecasters felt that they needed either to change their views about the future growth prospects for the economy or to revise their models in any major way. Consequently, although using economic models undoubtedly helps economists organize their thoughts and produce consistent forecasts, a chronic need remains for some way of assigning "weight" or "credibility" to the competing explanations, forecasts, and futures.

As a result, policy makers, who cannot afford to wait for the scientific controversy to resolve itself, effectively took these decisions outside the economics community. Economic policy decisions therefore blend articles of faith with econometrically supported knowledge, economic theories, and information from other sources. In this way, economic models become the sociologically fascinating nexus of an activity that brings together, legitimates, and quantifies political and moral theories about the world. In such a context it is clear that other social interests will also have a powerful influence on the shaping of economic policy and might even achieve a (temporary) closure of the economic debate as well. Indeed, from a sociological perspective the economy can be conceptualized as the institutionalization of particular practices and power relations that, as they become increasingly "sedimented" in society, form the basis of the statistical regularities that economic models estimate and extrapolate (cf. Barnes 1988, Giddens 1979). What the Panel brought to policy making was thus not the beguiling certainty of a "simple" or "single" truth but rather the deconstruction of expert authority and, potentially, the basis for a debate about the kind of economic theory/policy/society that should exist.

The Panel of Forecasters, then, had the potential to improve the way in which U.K. economic policy was made. In particular, finding ways to deal with the uncertainty created by the lack of a definitive economic model lies not in asking whether we need fewer economists or more economists, but in achieving a better understanding of what they do. If the Panel of Economic Forecasters had helped to foster an appreciation of the uncertainty that surrounds economic policy and the opportunities that exist for creating a different society, then this would have been an important legacy. The insight of the sociologist is that although the future is unknown (and unknowable) it is nevertheless a future that society, through its policies, institutions, and choices, can influence and shape. By showing that the economic future is still to be decided, the Panel of Economic Forecasters showed that values as well as facts have an important part to play in economic policy. The Panel thus offered policy makers (and potentially citizens) a moral choice instead of a narrowly (mis)represented economic orthodoxy, and in so doing had the potential to repoliticize economic policy by connecting it to wider social and political concerns.

6. Epilogue

Unfortunately, following their election to office in May 1997 the New Labour government didn't see things in quite the same way. On 6 May 1997 the Chancellor, Gordon Brown, announced plans to abandon the Panel and devolve interest rate decisions to the Monetary Policy Committee of the Bank of England. Rather than creating a link between politics and economics this decision would seem, perhaps regrettably, to have the opposite effect. In particular, by taking economic models out of the public domain and back into the privileged expertocracy of economic advisers, it threatens to undo much of what (in my opinion) had been achieved by the Panel.

7. Bibliography

Barnes, B. 1988. *The Nature of Power*. Cambridge: Polity.

Britton, A. 1993. "Submission to the Report of Panel of the Independent Forecasters, July 1993." In *Report of Panel of the Independent Forecasters, July 1993*, 21–28. London: H.M. Treasury.

Burrell, A., and S. Hall. 1994. "A Comparison of Economic Forecasts," *Economic Outlook* 18(2):29–35.

Collins, H. M. 1992. *Changing Order: Replication and Induction in Scientific Practice*. 2nd ed. Chicago: University of Chicago Press.

Congdon, T. 1993. "Submission to the Report of Panel of the Independent Forecasters, February 1993." In *Report of Panel of the Independent Forecasters, February 1993*, 25–32. London: H.M. Treasury.

Currie, D. 1993. "Submission to the Report of Panel of the Independent Forecasters, October 1993." In *Report of Panel of the Independent Forecasters, October 1993*, 39–46. London: H.M. Treasury.

Davies, G. 1993. "Submission to the Report of Panel of the Independent Forecasters, October 1993." In *Report of Panel of the Independent Forecasters, October 1993*, 47–60. London: H.M. Treasury.

Evans, R. J. 1997a. "Soothsaying or Science? Falsification, Uncertainty and Social Change in Macroeconomic Modelling." *Social Studies of Science* 23(3):395–438.

——. 1997b. "What Happens Next? Can Economic Forecasters Foretell the Future?" Ph.D. diss., University of Bath.

——. 1999. *Macroeconomic Forecasting: A Sociological Appraisal*. London: Routledge.

Giddens, A. 1979. *Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis*. London: Macmillan.

Irwin, A., and B. Wynne, eds. 1996. *Misunderstanding Science? The Public Reconstruction of Science and Technology*. Cambridge: Cambridge University Press.

Jasanoff, S. 1995. *Science at the Bar: Law, Science, and Technology in America*. Cambridge, Mass.: Harvard University Press.

Layard, R., S. Nickell, and R. Jackman. 1991. *Unemployment: Macroeconomic Performance and the Labour Market*. Oxford: Oxford University Press.

——. 1994. *The Unemployment Crisis*. Oxford: Oxford University Press.

Martin, B. 1979. *The Bias of Science*. Canberra: Society for Social Responsibility in Science.

Minford, P. 1993a. "Submission to the Report of Panel of the Independent Forecasters, July 1993." In *Report of Panel of the Independent Forecasters, July 1993*, 73–82. London: H.M. Treasury.

——. 1993b. "Submission to the Report of Panel of the Independent Forecasters,

October 1993." In *Report of Panel of the Independent Forecasters, October 1993*, 71–78. London: H.M. Treasury.

Sentance, A. 1993a. "Submission to the Report of Panel of the Independent Forecasters, July 1993." In *Report of Panel of the Independent Forecasters, July 1993*, 83–90. London: H.M. Treasury.

——. 1993b. "Submission to the Report of Panel of the Independent Forecasters, October 1993." In *Report of Panel of the Independent Forecasters, October 1993*, 79–85. London: H.M. Treasury.

Shackley, S., and B. Wynne. 1996. "Representing Uncertainty in Global Climate Change Science: Boundary-Ordering Devices and Uncertainty." *Science, Technology and Human Values* 21(3):275–302.

Wynne, B. 1995. "Technology Assessment and Reflexive Social Learning: Observations from the Risk Field." In *Managing Technology in Society: The Approach of Constructive Technology Assessment*, edited by A. Rip, T. J. Misa, and J. Schot. London: Pinter.

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