The Economic Journal, **113** (*January*), 1–20. © Royal Economic Society 2003. Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

MISCONCEPTIONS AND POLITICAL OUTCOMES*

David Romer

A large literature shows that strategic interactions among actors with conflicting objectives can cause the political process to produce outcomes that lower welfare. This paper investigates an alternative explanation of such outcomes: if individuals' errors in assessing the likely effects of proposed policies are correlated, democratic decisionmaking can produce welfare-reducing outcomes even in the absence of conflicting objectives. Under plausible assumptions, choosing candidates from among the best informed individuals does not remedy the problems created by such errors, but subsidising information and exposing representatives to information after their election do. Concentration of power has ambiguous effects.

Political decisions are important to the allocation of resources. If, for example, one wants to understand the extent of international trade, the quantity and composition of resources devoted to pollution abatement, or the division of an economy's output between consumption and investment, it is necessary to understand the determinants of political decisions concerning trade restrictions, environmental regulation, and tax policies and budget deficits. Moreover, political decisions that affect resource allocations often appear to reduce welfare. For example, trade restrictions are common, environmental regulation relies heavily on command and control, and many countries run large, persistent budget deficits.

These facts have motivated a large literature investigating the possibility that strategic interactions among individuals with divergent interests or preferences can give rise to undesirable political outcomes. Persson and Svensson (1989) and Tabellini and Alesina (1990), for example, show that an elected leader's inability to make a binding agreement with his or her successor can cause the leader to accumulate more than the socially optimal amount of debt to restrain the successor's spending. Coate and Morris (1995) and Rogoff (1990) show how the combination of voters' uncertainty about politicians' honesty or competence and their inability to commit to their future voting policies can cause politicians to adopt inefficient policies to try to signal that they have desirable characteristics. Shleifer and Vishny (1994) and others show how the interaction of a small number of individuals with much to gain from a policy with a large number with little to lose, coupled with enforcement problems or social sanctions involving direct transfers, can lead to the adoption of inefficient policies that benefit the few at the expense of the many.

But in their informal discussions, and in their activities as teachers and policy advisers, economists often suggest that political outcomes that appear to reduce welfare stem not from strategic interactions, but from ignorance. In this view, trade barriers, command-and-control approaches to environmental regulation, and high

* I thank Laurence Ball, David de Meza, Roberto Perotti, Thomas Piketty, Christina Romer, and two referees for helpful comments, and the National Science Foundation for financial support.

deficits are so prevalent in part because voters and politicians do not understand the efficiency benefits of free trade, the distortions and rent-seeking created by regulation, and the long-run benefits of government saving.

Such arguments rest on the idea that individuals do not understand the workings of the economy, and thus appear to depend on irrational or biased beliefs. As a result, economists have been reluctant to rely on them in their formal analyses of political decisions. Tabellini and Alesina, for example, dismiss the idea that persistent deficits might arise from voters' misunderstandings on the grounds that 'this notion is difficult to reconcile with standard assumptions of rationality'. Similarly, Rodrik (1996) divides candidate explanations of why governments sometimes embark on unsustainable macroeconomic policies into ones based on 'some kind of coordination problem' among agents who behave 'rationally and non-myopically' and those 'attributing myopia or irrationality to the main political actors'.

Models of strategic interactions of knowledgeable individuals are a natural starting point of efforts to understand apparently undesirable political outcomes. Yet such strategic interactions may not be the only force at work. Given how central political outcomes are to resource allocations and how often they appear to reduce welfare, it is reasonable to explore a wide range of possible explanations of those outcomes. The purpose of this paper is therefore to take a first step in the direction of taking seriously the fact that individuals do not have complete knowledge of how the economy functions, and to see whether this provides any insights about political decisions concerning resource allocations.

The paper's first result is that irrationality is not needed for incomplete knowledge to give rise to welfare-reducing political outcomes. All that is required is imperfect information of a particular form: individuals' errors must be correlated with one another. I refer to such correlated errors as misconceptions.

The idea that there may be misconceptions should be uncontroversial. Since each individual does not know others' errors, misconceptions do not involve irrationality. And most economists' experiences provide direct evidence of misconceptions: economics students and non-economists appear on average to underestimate the importance of incentives and the distortions caused by holding prices below their market-clearing levels, to overestimate the probability that simple mercantilist views of trade are correct, and so on.

Even more clear-cut evidence of misconceptions can be found in basic physics, where there is little doubt about what is correct and where it is often fairly straightforward to determine individuals' beliefs. A large literature documents numerous examples of correlated errors in individuals' understanding of the laws of physics.[1] One standard example involves beliefs about the path that an object on a string that is being spun in a circle will follow if it is released. Individuals are much more likely to predict that it will continue to curve in the same direction as before than to make the opposite error of predicting that it

[1] For examples from mechanics, see McCloskey *et al.* (1980), Halloun and Hestenes (1985) and Hestenes *et al.* (1992). For examples from optics and electricity, see Goldberg and McDermott (1987) and Cohen *et al.* (1983).

will curve in the other direction. Another common example concerns views about the relative speed of a light and a heavy object dropped in a vacuum: individuals often incorrectly predict that the heavy object will fall faster, but they rarely predict that it will fall more slowly. The fact that there is clear evidence of misconceptions concerning elementary questions of physics suggests that we should be open to the possibility that there are misconceptions concerning more complicated questions.

Furthermore, misconceptions may be particularly important to political decisions. Since each individual has little impact on political outcomes, individuals' incentives to gather and evaluate information about alternative policies or candidates are small. Similarly, individuals have only small incentives to determine what types of institutions produce desirable outcomes in the face of the possibility of misconceptions, and to support the adoption of such institutions. Thus it is plausible that in the political arena, individuals take existing institutions as given and support the candidates or policies that a superficial examination of the evidence suggests will produce the more desirable outcomes. As a result, their errors may be especially large, and it is particularly likely that they will not take corrective action even if misconceptions have large effects.

This paper therefore analyses the effects of correlated errors in individuals' beliefs on political decisions under different institutional arrangements. To keep matters simple, I neglect issues of distributional conflicts and heterogeneous preferences that are the usual focus of political analysis. Rather, following the tradition of Condorcet (1785), I simplify the analysis by considering decisions concerning policies that affect each individual's utility identically. I assume that individuals do not have full information about what those effects will be. The errors in their beliefs may have a common component, and the amount of information they have may be heterogeneous.

After Section 1 lays out my assumptions about individuals' information, Section 2 analyses the baseline case where the decision of whether to adopt a policy is made by referendum. This analysis demonstrates the straightforward points that misconceptions can lead to the adoption of undesirable policies and that voting can be a poor way of aggregating information.

Section 3 then considers the effects of various alternative institutions. I find that letting decisions be made by an elected representative rather than by a referendum does not improve outcomes even if candidates for office have been exposed to more information than the average voter has. The reason is that even among those who have been exposed to information, there are some who support the policies that are most popular with the voters, and it is these individuals who are elected. But I find that exposing elected representatives to information after their election improves political outcomes. Thus, the possibility of providing representatives with information gives representative democracy an advantage over government by referendum.

Section 3 also investigates the effects of subsidies to information dissemination and non-democratic institutions that place decisionmaking in the hands of a limited number of individuals. Subsidies to information improve outcomes, but concentration of power has ambiguous effects.

Finally, Section 4 offers concluding remarks and discusses possible areas for further work.

1. Basic Assumptions

Society consists of a continuum of individuals indexed by $i \in [0,1]$. The society must choose between two possible policies. A given policy provides every individual with the same utility. I normalise the utility provided by the first policy to zero, and let U denote the utility provided by the second. I refer to the first policy as the status quo, and to the second as the proposed change.

By assuming that each individual receives the same utility from a given outcome, I eliminate all distributional issues and simplify the political problem to that of choosing the policy that is best for everyone. And by assuming that there are only two possible outcomes, I eliminate the complications that arise in political models with three or more choices.[2]

The central assumption of the model is that individuals do not have perfect information about the utility the proposed change would provide. Instead they receive signals of U. Individual i can receive N_i signals at a utility cost of $C_i(N_i)$. Each individual is endowed with a first signal; thus $C_i(N_i)$ is defined only for $N_i \geq 1$. $C_i(1)$ is normalised to zero for all i. An individual's initial signal can be thought of as the policy's intuitive appeal to the individual. I assume that $C_i'(N_i) > 0$ and $C_i''(N_i) > 0$ for $N_i \geq 1$, and that $\lim_{N_i \to \infty} C_i'(N_i) = \infty$.[3] The assumption that the cost function may vary across individuals, coupled with my later assumptions about how individuals acquire information and decide whether to participate in the political process, allows for the possibilities of heterogeneous information and incomplete participation.

Crucially, the difference between the signals an individual receives and the true benefit of the proposed policy is not independent across individuals. My informational assumptions are easiest to describe by starting with the case where each individual receives just one signal. In this case, individual i's signal of the policy's benefit is given by $S_i^1 = U + e^1 + v_i^1$. e^1 is the common component of individuals' imperfect knowledge of the policy's benefit, and the v_i^1s are the idiosyncratic component. U, e^1, and the v_i^1s all have mean zero, and they are mutually independent. In addition, for simplicity they are assumed to be normally distributed. Individuals know the joint distribution of the policy's benefit and their signal. Thus they begin with unbiased priors concerning U. They also know the correla-

[2] Most of the results in the paper also hold in a model where the choice to be made concerns the level of some continuous variable X, where social welfare is single-peaked in X, and where individuals receive signals of the optimal value of X. These assumptions imply that the value of X that the median voter believes is optimal wins a two-way contest against any other value of X. To ensure that this value is in fact chosen by the political process, it is necessary to add assumptions that imply that voters are presented with only two choices and that one of them is the median voter's preferred value. Since those assumptions would complicate the analysis without adding important insights, I focus on the simpler case where there are only two possible policies.

[3] Since the number of signals an individual receives must be an integer, strictly speaking $C_i(N_i)$ is defined only for integer values of N_i. It simplifies the exposition, however, to treat N_i as continuous. The assumptions and results of the paper can easily be restated to account for the fact that N_i must be an integer.

tion of the signals across individuals, and they construct their posteriors concerning U rationally given the information they observe.

What I refer to as a misconception is simply a non-zero draw of e^1. When e^1 differs from zero, individuals' estimates of the policy's benefit on average differ from the truth. Yet those estimates are optimal given individuals' information. That is, a misconception is not any type of bias, but just a correlation across individuals in their rational errors in assessing the likely consequences of the proposed policy.

My assumptions about additional signals are a natural extension of the assumptions about the first signal. Individual i's jth signal is $S_i^j = U + e^j + v_i^j$. The e and v are i.i.d., normal, and independent of one another and of U. As before, individuals know the joint distribution of the signals and update their beliefs rationally.

If many individuals vote, each one's chance of affecting the outcome is extremely small. It follows that if the reason that people vote is because their votes may affect the outcome, even a very small cost of voting prevents high participation from being an equilibrium. That is, as is well known, explaining why so many people vote requires positing that they get some type of direct utility from voting. This is the approach that I follow.

My modelling of the direct utility from voting has two key features. First, an individual obtains utility only from voting for the outcome he or she thinks is better. That is, I ignore, for example, the possibility of individuals obtaining utility from strategically voting against the outcome they think is better on the grounds that their information suggests that conditional on their votes being pivotal, in fact the other outcome would be preferable. In the model, since there is always a continuum of voters, the probability of being pivotal is zero, and so ignoring this possibility is appropriate. In practice, the probability of being pivotal is extremely small, and so the incentive to engage in sophisticated calculations of conditional probabilities is minuscule. Given this, and given the strong evidence that the possibility of being pivotal is not the primary motive for the act of voting, it seems very likely that the possibility of being pivotal is not the primary motive for how votes are cast.[4]

Second, the direct utility individuals obtain from voting depends on the amount of information they acquire. As Matsusaka (1995) describes, patterns of voting behaviour are inconsistent with the view that it is the mere act of voting that generates utility. Most importantly, several types of evidence show that individuals who are better informed, or who can obtain information more easily, are more

[4] As Feddersen and Pesendorfer (1996) observe, the fact that individuals often vote on some items on a ballot while abstaining on others suggests that strategic motives may play some role in voting. For example, as Feddersen and Pesendorfer suggest, such individuals may be abstaining in order to leave decisions to better informed individuals. But this observation does not imply that individuals' voting is fully strategic. We know that voters must get some utility from participating in the political process, and that they have only trivial incentives to compute the impact of their choices of whether and how to vote on the likelihood that the better outcome is chosen. Indeed, Feddersen and Pesendorfer are able to obtain realistic levels of participation only by assuming that many voters automatically support a particular outcome. Given that voting appears to be far from fully strategic, for simplicity I structure the model so that there is no role at all for strategic voting.

likely to vote. First, one of the strongest findings from studies of voting behaviour is that education has a consistent, clear-cut, and powerful positive association with voting; see, for example, Ashenfelter and Kelley (1975), Wolfinger and Rosenstone (1980), Sigelman *et al.* (1985), and Timpone (1998). Second, this literature also consistently finds that individuals who are exposed to more information, whether as a result of contact by a campaign representative, high levels of political advertising, or following politics themselves, are more likely to vote; see, for example, Sigelman *et al.* (1985), Teixeira (1987) and the studies surveyed by Struthers and Young (1989). Third, there is a positive association between direct measures of how informed individuals are and their likelihood of voting (Palfrey and Poole, 1987; Timpone, 1998).

My specific assumption is that if individual i votes for the outcome he or she believes is preferable, he or she obtains a utility benefit of $B_i(N_i)$. The benefit function, like the cost function, may be heterogeneous across individuals. For example, for individuals who get no utility from participation and face monetary or time costs of voting, $B_i(N_i)$ is negative for all N_i. Such individuals choose to acquire no information and not to vote. Since everyone is endowed with one unit of information, $B_i(N_i)$ is defined only for $N_i \geq 1$. I assume that $B_i'(N_i) \geq 0$ and $B_i''(N_i) \leq 0$, and that $\lim_{N_i \to \infty} B_i'(N_i) = 0$.

In my basic model (Section 2), individuals vote if the maximum utility they can attain from voting (the maximum value of $B_i(N_i) - C_i(N_i)$) is positive. That is, individuals decide whether to vote by balancing the costs of acquiring information with the direct utility of voting.

My assumptions about how individuals choose to acquire information imply that they may obtain little information even if the stakes are large. The mechanism at work here is one that has been identified by many previous authors: when individuals' chances of affecting outcomes are small, their incentives to acquire information because of the possibility of being pivotal are also small; see, for example, Downs (1957), Buchanan and Wagner (1977) and Magee *et al.* (1989). My formulation differs from previous treatments of rationally ignorant voters by explicitly modelling the possibility of correlated errors across individuals. It is this correlation that gives rise to the possibility of political outcomes that are systematically undesirable but nonetheless the results of rational behaviour.

With heterogeneity in the $C_i(\cdot)$ and $B_i(\cdot)$ functions, the model replicates the stylised fact that more informed individuals are more likely to vote. Individuals who are not planning to vote acquire no information. Thus all nonvoters choose $N_i = 1$. Among voters, in contrast, only those for whom $N_i = 1$ maximises $B_i(N_i) - C_i(N_i)$ choose $N_i = 1$.

Of course, some of the association between information and voting is probably due to factors that both increase the amount of information people have and directly raise their utility from voting. A straightforward variation on the model can accommodate this possibility. In the variation, each B_i is independent of N_i, and the N_i, rather than being the result of optimising calculations, are exogenous. If the N_i are on average larger for individuals with positive B_i, there is a positive association between information and voting. Under this alternative formulation, all the model's main implications (except those hinging on the endogeneity of the N_i) still hold.

2. Decision Making by Referendum

This section considers the baseline case where the proposed policy is put to a direct vote. Each individual decides how much information to acquire and whether to vote. Each voter votes for or against the proposal on the basis of his or her information, and the proposal is adopted if and only if it receives a majority of the votes.

An individual's decision process consists of two steps. The first step is to find the value of N_i that maximises the utility of voting. The resulting value of N_i, denoted N_i^{DEMOC}, is defined by $B_i'(N_i^{DEMOC}) - C_i'(N_i^{DEMOC}) = 0$. The second step is to determine whether the resulting net utility from voting, $B_i(N_i^{DEMOC}) - C_i(N_i^{DEMOC})$, is positive. If it is, the individual acquires N_i^{DEMOC} units of information and votes for the outcome that this information suggests is preferable. If it is negative, the individual acquires no information (beyond the signal he or she is endowed with) and abstains.

Individuals vote on the basis of their beliefs about how the proposed change would affect welfare. Given my distributional assumptions, this means that each individual who votes does so on the basis of the sign of his or her average signal: a voter whose average signal is positive votes for the policy, and one whose average signal is negative votes against it.

The outcome of the referendum need not be the one that is best for social welfare. This point is almost trivial: individuals have imperfect information about the proposed policy's benefits, and this imperfect information may cause them to support the outcome that is in fact less desirable. To see this formally, it is easiest to consider the case where there is no heterogeneity in the benefits of participation or the costs of acquiring information, so that N_i^{DEMOC} is the same for everyone. Recall that the distribution of the idiosyncratic component of voters' signals – the v_i^j – is symmetric around zero. Thus voters' average signals are distributed symmetrically around $U + \bar{e}$, where $\bar{e}$ is the average common component of the error in the first N^{DEMOC} signals. Since there is a continuum of voters, the majority have a signal of the same sign as $U + \bar{e}$. Thus the policy is adopted if $U + \bar{e}$ is positive, and rejected if it is negative. As long as the variance of e is strictly positive, $U + \bar{e}$ may not have the same sign as U – that is, the outcome of the referendum may not be the most desirable one.

This result extends to the case where individuals' $B_i(\cdot)$ and $C_i(\cdot)$ functions, and hence their N_i^{DEMOC}s, are heterogeneous. Let q_N denote the fraction of voters who obtain N units of information, $\bar{e}^N$ the average of e^1 to e^N, $\bar{v}_i^N$ the average of v_i^1 to v_i^N, and $F^N(\cdot)$ the cumulative distribution function of $\bar{v}_i^N$. If voter i has N units of information, he or she votes for the policy if $U + \bar{e}^N + \bar{v}_i^N > 0$. Since there is a continuum of voters, this means that fraction $1 - F^N[-(U + \bar{e}^N)]$ of voters with N units of information vote for the policy; given the assumption of symmetric distributions, this fraction equals $F^N(U + \bar{e}^N)$. Thus the fraction of voters supporting the policy is $\Sigma_N q_N F^N(U + \bar{e}^N)$. $F^N(U)$ is greater than one-half when U is positive and less than one-half when U is negative. Thus in the absence of the common component of individuals' errors (the $\bar{e}^N$s), the policy would be adopted if and only if it raises welfare. But when the e have strictly positive variance,

$\Sigma_N q_N F^N(U + \bar{e}^N)$ can be less than one-half when U is positive, and greater than one-half when U is negative.

More importantly, a referendum is an ineffective way of aggregating information when individuals have heterogeneous amounts of information. Again this is easiest to see in a simple case. Suppose everyone has the same $C(N)$ function but there are two $B(N)$ functions, $B_a(N)$ and $B_b(N)$. Both lead individuals to vote, but $B_a(\cdot)$ leads them to choose N_a^{DEMOC} units of information while $B_b(\cdot)$ leads them to choose N_b^{DEMOC}, with $N_b^{DEMOC} > N_a^{DEMOC}$. Almost all voters have the benefit function $B_a(\cdot)$, but a small (though strictly positive) fraction have the function $B_b(\cdot)$. Let $\bar{e}_a$ and $\bar{e}_b$ denote the average common component of the errors in the first N_a^{DEMOC} and N_b^{DEMOC} signals, respectively.

The more informed voters' information dominates the less informed voters'. But since the vast majority of voters are uninformed, their information determines the outcome of the referendum. That is, the outcome is determined by the average value of $U + \bar{e}_a$, while the best choice given all voters' information would be to decide on the basis of the average value of $U + \bar{e}_b$.

Again, the result extends to more complicated distributions of information. Since there is a continuum of individuals, any strictly positive fraction of the population has infinitely many members, and thus an average idiosyncratic error of zero. As a result, using the average signal of a very small fraction of the population consisting of the most informed individuals produces a better outcome on average than does using the average signal of all voters.[5]

3. Outcomes under Different Institutions

This section analyses how various arrangements other than direct referendum affect the outcome of the political process.

3.1. *Representative Democracy*

Political decisions are typically made not directly by voters, but by representatives they elect. Thus it is natural to ask how the earlier results are affected if the decision of whether to adopt the proposed policy is made by an elected representative.

Two issues complicate any model of representative democracy. First, such models tend to have many equilibria; see, for example, Besley and Coate (1997). For example, if many potential candidates support the policy the majority prefer, under plausible assumptions it is an equilibrium for any one of them to be elected. Second, there is an incentive for candidates to lie. Someone who supports the proposed policy can run for office claiming to support the status quo. This may

[5] Further, recall that the assumptions of the model rule out the possibility that the less informed will respond to this problem by abstaining, thereby leaving the decision to the well informed. The model assumes that individuals vote for the utility of supporting the outcome they think is better, not for the possibility of increasing the chance that the better outcome is chosen. Although the assumption that this is the only motive for voting is surely too strong, the idea that it is an important motive is almost undeniable.

divide the votes of the status quo's supporters and thereby increase the chances that a supporter of the proposed policy is elected. If the individual wins, then under the realistic assumption that representatives are not committed to carrying out their platforms, he or she can implement the proposed policy.

There is another complication concerning representative democracy that is specific to the issues of this paper: there may be subtle channels through which voters and potential candidates can draw inferences about others' information that are not present in a referendum system. For example, the timing of candidates' decisions to run for office may provide some information about the distribution of average signals among the more informed members of the population.

To avoid this complication, I focus on a somewhat artificial model of representative democracy. I then briefly discuss how other processes might allow sophisticated voters and potential candidates to obtain information beyond their own signals. Throughout, I structure the model to eliminate multiple equilibria and the possibility of candidates strategically claiming to support the position opposite the one they favour.

Specifically, I assume that in addition to the other components of their utility, individuals get utility (which may be either positive or negative) from holding office. In the terminology of Rogoff (1990), they obtain ego rents. For some strictly positive fraction of the population, these ego rents are large and positive. Everyone, however, obtains large negative ego rents from running and receiving no votes at all; thus no one runs just to send some type of signal. Further, a strictly positive fraction of the individuals who obtain large ego rents from holding office are unsophisticated. Specifically, they do not alter their estimates of the proposed policy's expected benefit on the basis of other potential candidates' decisions about whether to run. Finally, upon election the winner acts to maximise social welfare. That is, representatives are not committed to following the policies they supported during the campaign, and reelection (and the further ego rents it would entail) is not a possibility.

Individuals are asked sequentially (starting at $i = 0$ and proceeding to $i = 1$, for example) whether they want to run for office. An individual who chooses to run expresses an opinion about whether the proposed policy is desirable. Following such authors as Akerlof (1983) and Frank (1987), I assume that individuals cannot lie believably; that is, I directly rule out lying (and thus the possibility of a candidate advocating one position with the plan to adopt the other if elected). I also assume that voters only vote for the first candidate supporting each position. This ensures that at most only one candidate runs in support of each position, and thus rules out multiple equilibria. Finally, I assume that voters get utility from voting for a candidate who supports a particular position in the same way that they get utility from voting for that position in a referendum. That is, they obtain direct utility from participating, but only if they vote for a candidate who supports the position they believe is preferable.

The equilibrium of this process is straightforward. One individual runs in support of the proposed policy and one runs in support of the status quo. The assumption that some fraction of the population obtain large ego rents and are unsophisticated, together with the assumption of a continuum of individuals, ensures that there is always a candidate on each side. No additional candidates

enter. Since there is always one candidate on each side, voters learn nothing beyond their own signals about the value of the proposed policy.[6] Thus, unsophisticated or not, voters judge the policy on the basis of their own signals. They therefore vote for the candidate who supports the position their signals suggest is preferable, and the winning candidate implements his or her preferred policy. That is, the switch to representative democracy has no effect on whether the policy is adopted.

The amount of information the candidates have is irrelevant to the outcome. It may be that individuals who obtain large ego rents from holding office generally have $B_i(\cdot)$ and $C_i(\cdot)$ functions that cause them to obtain large amounts of information (that is, that they have functions with high values of $B_i'(\cdot)$ and low values of $C_i'(\cdot)$). After all, these are individuals who enjoy politics, and who may have the opportunity to decide whether the proposed policy is adopted. In this case, potential candidates are more informed than the general population. But given the realistic assumption that there are many potential candidates, there are always some who support each position.

As noted above, the specific way I have structured the model of representative democracy is designed to shut down all channels through which potential candidates and voters can acquire additional information about the proposed policy's merits. Under alternative assumptions, there would be some scope for such information acquisition. To take a simple example, suppose more than one candidate sometimes runs in support of the same position. Then it may be possible for voters to update their estimates of the policy's benefit based on how many candidates support each position. In this way, the outcome could depend not just on voters' signals, but on potential candidates'. Thus representative democracy has the potential to improve outcomes. But what is driving the result that representative democracy does not improve outcomes at all in the particular model I have described is the simple fact that there are always some potential candidates who support the policies that are most popular with the voters. The presence of this straightforward reason for representative democracy not to improve outcomes is likely to mitigate any potential benefits of representative democracy.[7]

[6] I assume that the voters only observe which positions the two candidates support, not their actual signals. I also assume that they do not observe how many individuals decline to become candidates before the actual candidates choose to run, or the order in which the two candidates announce their candidacies.

[7] Further, even if representative democracy provides channels through which sophisticated voters and potential candidates can make better choices, it does not follow that they will make those choices. In particular, the idea that voters and relatively uninformed potential candidates optimally discount their direct signals in favour of inferences drawn from the behaviour of the well informed requires a level of hyperrationality that seems implausible. In many cases, individuals' different signals are best thought of not as different numerical draws from a known common distribution, but as differences in beliefs resulting from different abilities to process information (Rubinstein, 1993) or from different world views stemming from a lifetime of different experiences (Kandel and Pearson, 1995). Realistically, as Kandel and Pearson emphasise, in such cases many individuals are likely to maintain their beliefs even in the face of the knowledge that there are others with different views.

3.2. *Dictatorship*

When each individual has only a small influence on political decisions, individuals have only small incentives to acquire information about proposed policies. If individuals had more influence, their incentives to acquire information would be greater. But it is not possible to increase some individuals' influence without reducing others'. That is, the only way to make some individuals more influential is to make the distribution of political power unequal.

To see how concentration of power affects political decisions in the model, I begin by considering the extreme case where decisions are made by a single exogenously chosen individual. Such an arrangement could correspond to dictatorship, hereditary monarchy, or decision making by an individual chosen by lot.

Of course, the model does not provide a basis for a complete analysis of concentration of power and dictatorship. For example, since the proposed policy is assumed to have the same effect on everyone's utility, there are no possibilities for a dictator to adopt a policy that benefits himself or herself at others' expense. Thus the analysis will tend to understate the disadvantages of dictatorship. On the other hand, I focus on the baseline case where decision makers act to maximise their narrowly defined self-interest and put no weight on the fact that the policy affects all individuals. By making this assumption, I potentially understate decision makers' incentives to acquire information, and thus tend to understate the benefits of concentration of power.

To analyse the effects of dictatorship, it is useful to define $W(N,M)$ to be the expected utility from the policy when the decision of whether to adopt it is made by majority vote among M individuals with N pieces of information. Specifically, let $\mathrm{Med}(N,M)$ denote the median value of individuals' estimates of U when there are M individuals each with N signals. $W(N,M)$ is then given by

$$W(N,M) = \mathrm{Prob}[\mathrm{Med}(N,M) > 0]\mathrm{E}[U \mid \mathrm{Med}(N,M) > 0]. \tag{1}$$

It is straightforward to show that $W(N,M)$ is increasing in N and non-decreasing in M. In addition, I let W^* denote the expected benefit from the policy under perfect information:

$$W^* = \mathrm{Prob}(U > 0)\mathrm{E}(U \mid U > 0). \tag{2}$$

The decision-maker's choice determines whether the policy is adopted. His or her expected utility as a function of the number of signals is therefore $[B_i(N_i) - C_i(N_i)] + W(N_i, 1)$. Thus the decision-maker's choice of the number of signals to obtain, N_i^{DICT}, is defined by $[B_i'(N_i^{DICT}) - C_i'(N_i^{DICT})] + W_N(N_i^{DICT}, 1) = 0$; the resulting level of expected social welfare is $W(N_i^{DICT}, 1)$. For comparison, recall that the number of signals voter i obtains with a referendum system, N_i^{DEMOC}, is defined by $B_i'(N_i^{DEMOC}) - C_i'(N_i^{DEMOC}) = 0$. In the baseline case where the $B_i(\cdot)$ and $C_i(\cdot)$ functions do not vary across individuals, expected welfare under a referendum is $[B(N^{DEMOC}) - C(N^{DEMOC})] + W(N^{DEMOC}, \infty)$.[8]

[8] Throughout, I measure expected welfare *ex ante* – that is, before individuals' signals are realised. This seems appropriate for evaluating political institutions.

This analysis identifies one advantage and two disadvantages of dictatorship. For simplicity, I focus on the case without heterogeneity in the $B_i(\cdot)$ and $C_i(\cdot)$ functions; the discussion applies more generally, however. The advantage is that a sole decision-maker has a greater incentive to acquire information than individuals in a democracy do. That is, because $W(N,M)$ is increasing in N, N^{DICT} exceeds N^{DEMOC}. The fact that $W(N,M)$ is increasing in N implies that this increase in information tends to improve political decisions.

The first disadvantage of dictatorship is that when a single individual decides whether a policy is to be adopted, his or her idiosyncratic views of the policy's merits – the v – affect the decision. In terms of the model, the fact that $W(N,M)$ is non-decreasing in M means that the reduction in the number of decision makers tends to worsen political decisions.

The second disadvantage of dictatorship is that it eliminates the utility benefits of political participation. Recall that high voter participation is understandable only if individuals' participation affects their utility not just through its impact on outcomes, but also directly. The switch to dictatorship eliminates this source of utility. That is, the switch changes expected welfare not just by $W(N^{DICT},1) - W(N^{DEMOC}, \infty)$, but also by $-[B(N^{DEMOC}) - C(N^{DEMOC})]$.

It is not possible to determine whether the overall effect of dictatorship is positive or negative in the model. If the idiosyncratic component of the signals (the v) and the direct benefits of participation ($B(N^{DEMOC}) - C(N^{DEMOC})$) are sufficiently small, dictatorship is preferable to democracy. As the variance of the v approaches zero, the number of decision makers becomes irrelevant to the decision of whether to adopt the policy. Thus dictatorship's effect on the expected utility from the policy approaches $W(N^{DICT},1) - W(N^{DEMOC},1)$, which is necessarily positive. And as the direct utility of participation approaches zero, expected welfare approaches expected utility from the policy.

If $C''(\cdot)$ is sufficiently large, on the other hand, democracy is preferable to dictatorship. As $C''(\cdot)$ approaches infinity, N^{DICT} approaches N^{DEMOC}. Thus the only benefit of dictatorship vanishes.

One possibility is that dictatorship raises expected utility from the policy, but nonetheless lowers expected welfare. That is, it could be that $W(N^{DICT},1) - W(N^{DEMOC}, \infty)$ is positive but less than $B(N^{DEMOC}) - C(N^{DEMOC})$. In this case, the argument for democracy is not that it produces better political decisions, but that broad political participation is desirable in its own right.[9]

[9] Reintroducing heterogeneity in the $B_i(\cdot)$ and $C_i(\cdot)$ functions creates another effect of dictatorship: the dictator's $B_i(\cdot)$ and $C_i(\cdot)$ may differ from the average individual's. Depending on the distributions of the functions in the population, this can either increase or decrease information. Suppose, for example, that as in the discussion in Section 2, almost all individuals have the function $B_a(\cdot)$ but a few have the function $B_b(\cdot)$, and that $B'_a(N) < B'_b(N)$, so individuals with the function $B_b(\cdot)$ obtain more information. Under democracy, it is the average signal of the individuals with $B_a(\cdot)$ that determines the outcome. Under dictatorship, however, there is some chance that the dictator has the function $B_b(\cdot)$. Thus with this distribution, heterogeneity in the $B_i(\cdot)$ functions creates an advantage of dictatorship. But the effect can go the other way. If almost all of the population has the function $B_b(\cdot)$, for example, the heterogeneity makes dictatorship less desirable.

3.3. *Oligarchy*

The consequences of a system where the number of decision makers is finite but not necessarily equal to one are similar to those of dictatorship. To keep the analysis manageable, I again consider only the case where everyone has the same $B_i(\cdot)$ and $C_i(\cdot)$ functions. In this case, with M decision makers expected social welfare is $W[N(M),M]$, where $N(M)$ is the number of signals each decision-maker obtains when there are M of them. $N(M)$ is decreasing in M.[10] The impact of a change in M on expected welfare from the policy is therefore $W_N[N(M),M]N'(M)+W_M[N(M),M]$. The first term of this expression is negative and the second positive. As with the switch from democracy to dictatorship, the sign of the sum of the two terms is ambiguous.

Although one cannot reach any general conclusions about the optimal number of decision makers in this model, three points are worth noting. First, there are cranks in the world: some individuals advocate policies that the best available evidence suggests would be disastrous and that the vast majority of voters oppose. This suggests that the variance of the v is extremely large, and thus that the optimal number of decision makers is almost certainly greater than one.

Second, because majority voting gives no more weight to an individual with a strong preference for a policy than to one with a weak preference, it does not take many individuals to dilute greatly the influence of a handful of cranks. With M decision makers, the decision of whether to adopt the policy is determined by the sign not of $U+\bar{e}$, but of $U+\bar{e}$ plus the median value of $\bar{v}$. Suppose that M is large enough that the central limit theorem can be used to approximate where in the overall distribution of $\bar{v}$ the median individual's $\bar{v}$ falls. Under this assumption, the percentile of the overall distribution of $\bar{v}$ where the median voter's value lies is approximately normally distributed with a mean of 50 and a standard deviation of $50/\sqrt{M}$. With 100 decision makers, for example, the median $\bar{v}$ has a 95% chance of being between the 40th and 60th percentiles of $\bar{v}$'s distribution, and is virtually certain ($p \cong 0.9999$) to be between the 30th and 70th percentiles. With 10,000 decision makers, the median $\bar{v}$ is virtually certain to lie between the 48th and 52nd percentiles of $\bar{v}$'s distribution.

Thus, unless the density of $\bar{v}$ in the vicinity of zero is small, a moderate number of decision makers is enough to make it almost certain that the median value of the decision makers' signals (their $U+\bar{e}+\bar{v}$s) is very close to the common value of $U+\bar{e}$. Thus in cases where $U+\bar{e}$ is large in absolute value, it is very unlikely that the $\bar{v}$s will affect the majority's preference. It follows that just a moderate number of decision makers is enough to almost eliminate the negative effect of concentrated power on political decisions in this analysis. And with only a moderate number of decision makers, each one has a non-zero (though small) probability of affecting the outcome. Thus the decision makers acquire more information than they would under pure democracy.

[10] Formally, $N(M)$ is the Nash equilibrium value of N for the game where each of M decision makers chooses his or her N to maximise $B(N)-C(N)$ plus expected utility from the policy, taking others' Ns as given. As M rises, each individual's impact on expected utility from the policy falls. As a result, N falls.

In sum, in terms of the considerations analysed in this paper, the number of decision makers that maximises the expected benefit of the policy is likely to be more than one but much less than the population of a typical country. An actual arrangement that would come close to this idea would be to choose the desired number of individuals for a particular decision or election at random from the full population.

The third point to make about the optimal number of decision makers is that the direct utility of participation is again relevant. Since there is a continuum of individuals, the average direct utility from participation with any finite number of decision makers is zero. As a result, it may be that having a small number of decision makers is preferable in terms of the average quality of political decisions, but that having full participation is preferable in terms of social welfare.

3.4. *Subsidies to Information Acquisition and Dissemination*

The next institutional characteristic I consider is straightforward. Better information about proposed policies improves political decisions. Thus institutions that make information more easily available and that encourage individuals to acquire information produce better outcomes.

An increase in the amount of information an individual possesses raises the likelihood that the policy chosen is the one that yields higher welfare; this benefits all individuals. Thus information acquisition has a positive externality. We can therefore say not just that subsidies to information on average improve political decisions, but that over some range they raise expected welfare.

In the case where all individuals have the same $B(\cdot)$ and $C(\cdot)$ functions, the optimal subsidy for acquiring N units of information takes the form $W(N, \infty) - K$, where K is any constant. With this subsidy, each individual chooses N so that

$$[B'(N) - C'(N)] + W_N(N, \infty) = 0.$$

Thus, this policy leads to the welfare-maximising choice of N.[11]

Examples of policies that support information acquisition and dissemination include subsidies to non-partisan political organisations, to the broadcast of political speeches and debates, and to the news media. More subtle examples of policies that have similar effects are ones that give well informed individuals a greater voice in elections. Consider, for example, systems where the endorsements of news organisations, interest groups, and other political figures are important to the funding that candidates receive, or are widely publicised and influence voters' decisions. Individuals making endorsements, like potential candidates for office, may be better informed than the average voter. Thus their actions may help candidates supporting policies that yield higher welfare, and thus may improve political outcomes.

[11] When the $B_i(\cdot)$ and $C_i(\cdot)$ functions are heterogeneous, under natural assumptions a small subsidy is Pareto-improving. But beyond some point increases in the subsidy make some individuals better off and some worse off. Thus it is not possible to characterise an optimal subsidy without specifying weights on different individuals' utilities.

3.5. *Educating Elected Representatives*

In the baseline model of representative democracy, there are always some potential candidates whose information leads them to support the position that the majority prefer, and it is always such individuals who are elected. But this barrier to beneficial effects of representatives' information is absent when the representatives acquire their information after they are elected. Additional information on average improves elected representatives' understanding of which policy is better for social welfare. Because representatives want to raise welfare and have the ability to do so (that is, because they are assumed not to be committed to carrying out their campaign platforms), they will act on the basis of this information. Thus devices that increase the amount of information representatives obtain after their election – such as formal training programmes, legislative hearings, official roles for panels of expert advisers, and a professional civil service – improve political decisions.

Indeed, under the assumptions of the model, *ex post* education provides a way of ensuring that the preferable decision concerning the policy is always reached. Specifically, consider any system where one individual – whether chosen by an election or by some other means – is provided with N pieces of information and granted the authority to decide whether the policy is adopted. The expected utility from the policy is thus $W(N,1)$.[12] Since the decision-maker is just one individual out of a continuum, the costs of the information to him or her, $C_i(N)$, have a negligible impact on average welfare. Average welfare is therefore maximised by making N arbitrarily large, which means that the decision-maker knows U with certainty. The expected benefit from the policy therefore reaches W^*, the maximum possible value.

A system of this type is unambiguously preferable to dictatorship. Under a dictatorship, just as under a referendum, there are positive externalities to information acquisition. Forcing the sole decision-maker to have the welfare-maximising value of N therefore produces higher welfare than letting him or her choose N.

Whether a system of this type is necessarily preferable to a referendum system, on the other hand, depends on the nature of the direct utility from political participation. If it is the act of participating that provides direct utility, then a system of *ex post* education, with N arbitrarily large, is the global optimum. Each individual chooses N_i so that $B_i(N_i)-C_i(N_i)$ is at its highest possible level (or, if this quantity is negative, chooses $N_i = 1$ and non-participation). The elected representative's amount of information is chosen so that the expected benefits of the policy are at their highest possible level. But in this system, voters' actions have no impact on the decision of whether to adopt the policy: the decision is determined by the information the elected representative learns after the election, and is utterly unaffected by the election itself. Individuals might get no utility from this type of political participation. In this case, each individual's expected welfare is just W^*. This can be either more or less than their expected utility under a referendum, which involves lower expected utility from the policy but, for individuals who participate, a positive contribution from $B_i(N_i^{DEMOC}) - C_i(N_i^{DEMOC})$.

[12] This neglects the fact that if the decision-maker is elected, he or she also knows what fraction of the population has an average signal that is positive. This complication is unimportant.

When representatives switch their positions in response to new information, they are switching to positions that the majority of voters oppose. Thus they may face conflicts between doing what the majority prefer and doing what they believe is best for society. In such situations, institutions that lower the benefits of pleasing voters may improve political outcomes. Two examples of such mechanisms are term limits (so that re-election is not a possibility) and long terms of office (so that re-election, or running for another office, is less important).

In practice, of course, there are limits to individuals' ability to absorb information and costs to delaying decisions. This has two implications. First, it means that the expected benefit from the policy under *ex post* education cannot in fact reach W^*: realistically N will not be arbitrarily large, and so the representative will sometimes adopt the policy when U is negative and fail to adopt it when U is positive. But this does not change the result that, because of the externality from information acquisition, it is sub-optimal to let representatives choose how much information to acquire.

The second implication is more interesting. As the model recognises, individuals have heterogeneous costs of obtaining information, and heterogeneous benefits from acquiring information. As a result, different decision makers will obtain different amounts of information after their election. Since individuals with more information on average make better decisions, voters will want to elect candidates who are better at absorbing information. That is, candidates' expertise – not in the sense of their knowledge of the issues, but in the sense of their ability to acquire information – will affect voters' choices. Indeed, we observe that voters' perceptions of such characteristics of candidates as their leadership ability, intelligence, character, and decisionmaking capacity are important in elections.

4. Conclusion

Governments often adopt policies that at least appear to reduce welfare. Examples include price controls, protection and persistent budget deficits. In trying to understand the sources of these policies, economists have devoted a great deal of attention to the possibility that strategic interactions among individuals who know the policies' effects but who have divergent interests or preferences can produce undesirable outcomes.

Yet the fact that political decisions so often have seemingly undesirable consequences suggests that we should not focus our search for explanations of such decisions narrowly. This paper identifies another reason that undesirable policies may be adopted: it may be that the policies reduce welfare, but that enough of the participants in the political process have incorrect beliefs about the policies' likely effects that they are adopted anyway. This paper develops a simple model that illustrates this possibility, and investigates how such correlated errors in belief affect political decisions under different institutions.

The view that seemingly undesirable political outcomes arise from misconceptions has very different implications from the view that they arise from strategic interactions of knowledgeable individuals. If misconceptions are important, then efforts to improve officials' and voters' understanding of how the economy

functions can systematically change political outcomes. But if these outcomes arise only from strategic interactions, such efforts are irrelevant, since the participants in the process already know how the economy functions. Indeed, one piece of evidence that misconceptions are important to political decisions is that economists devote considerable effort not just to educating public officials, but to correcting what they perceive to be consistent errors in their views about such matters as the importance of incentives, the effects of price controls, and the efficacy of government regulation.

This paper has considered only a bare-bones model of misconceptions and their effects. There are therefore many directions in which the analysis can be extended. Here I mention three.

First, I have considered only primitive assumptions about information: individuals choose how much information to acquire, and additional information on average improves individuals' estimates of the proposed policy's effects. But a central feature of politics is that supporters of each side of a given issue or election disseminate information intended to sway voters toward the position they support.

Analysing such behaviour would require extending the model of information. For example, one could investigate models where there are different types of information with different effects, where policies vary not only in their effects but in how quickly voters' estimates of those effects converge to the truth as a function of the amount of information they have, and so on. With such extensions, it would be possible to investigate various additional issues. For example, one could examine the possibility that there are policies whose social value is low but for which a superficially appealing case can be made relatively easily. In such a situation, the accuracy of voters' assessments need not be a monotonic function of the amount of information they receive, and so allowing some information dissemination can worsen the outcome. In addition, with more sophisticated models of information, one could extend the analysis to consider such issues as campaign spending, contribution limits, disclosure requirements, and regulations on the form or content of political advertising.

Second, I have abandoned the usual assumption in economic models of politics that officeholders may adopt policies that further their own interests at the expense of social welfare. But there may be important insights to be gained from asking how these possibilities interact with the possibility of misconceptions. For example, the knowledge that individuals may be motivated by self-interest may be an important reason for voters' reluctance to defer to self-proclaimed experts.[13] More importantly, there may be a tradeoff in designing political institutions

[13] A natural question is why voters appear more willing to delegate choices to experts in some areas (such as weapons design or the selection of scientific projects for funding) than others (such as tariff policy, divorce laws, or policies to address global warming). There are at least three possibilities. First, it may be easier to identify experts in some areas than others. For example, the qualifications needed to address questions of basic physics are clearer than the qualifications needed to determine the effects of tariffs. Second, the scope for self-interest may be smaller in some areas, making claims of expertise more plausible. But it does not seem especially difficult to identify individuals with little stake in, say, tariff policy or divorce laws. Third, there may be misconceptions not just in point estimates, but in uncertainty. That is, in some cases individuals may on average overestimate the value of their own information, and thus underestimate the value of delegation.

between addressing the harms caused by leaders pursuing their self-interest and addressing the harms caused by misconceptions. For example, in deciding how much discretion to grant to leaders, there is likely to be a tradeoff between allowing them to act on the basis of new information they obtain about how to further social welfare and allowing them to pursue their own interests at the expense of social welfare.

Finally, there may be patterns to misconceptions. That is, errors in assessing the benefits of alternative policies are likely to be correlated not just across individuals, but across policies. In physics, individuals' errors appear to stem not only from the details of each particular problem, but also from loosely held views of how the physical world operates that are incorrect in systematic ways. As a result, it is often possible to predict the errors individuals will make when confronted with new questions; see, for example, Halloun and Hestenes (1985), Hestenes *et al.* (1992) and Cohen *et al.* (1983). The same may be true with regard to public policy issues. For example, there may be a general tendency to neglect policies' long-term consequences, or to underweight their general-equilibrium effects relative to their direct effects, or to overemphasise their ability to deal with a problem that has arisen recently relative to other likely problems.

If one could say more about the likely nature of misconceptions in evaluating public policies, it would be possible to extend this paper's analysis further. For example, it would be possible to go beyond the general observation that misconceptions can cause the political process to produce welfare-reducing outcomes to specific predictions about the kinds of policies that are likely to arise.[14] Similarly, it would be possible to evaluate the consequences of various institutional arrangements that the framework of this paper cannot be used to analyse. Possible examples include arrangements that prevent certain types of policies from being adopted quickly and ones that allow policymakers to pursue new policies for an extended period before being subject to electoral review.

More generally, the research programme suggested by this paper is that of bringing ideology back into the analysis of politics. In most economic analyses of politics, voters' and politicians' ideologies – that is, their beliefs about the functioning of the economy, the political system, and so on – are irrelevant to political outcomes. Individuals are endowed with perfect knowledge of these matters, or at least have independent errors. They then maximise their utilities given these beliefs and the constraints they face. To take an extreme example, Shleifer and Vishny (1992) propose an explanation of the role of prices in allocating resources under communism based purely on government officials' self-interest, on the assumption that the officials' understanding of the functioning of markets was no different from those of modern Western economists. Although their explanation is plausibly part of the story, it seems unlikely that Marxist beliefs about markets were irrelevant. Ideological debate and rhetoric are prominent features of politics. There may be a great deal to be learned if we do not presume that such rhetoric is

[14] Various authors attribute specific policy outcomes to misconceptions. For example, Buchanan and Wagner (1977) argue that budget deficits arise from misunderstandings of deficits' effects, and Romer and Romer (1997) argue that misunderstandings of the effects of monetary policy are an important source of inflation.

just a mask for individuals' well informed pursuit of their self-interest, but instead consider the possibility that it often reflects individuals' beliefs, and that these beliefs often influence their actions.

University of California, Berkeley

Date of receipt of first submission: April 1999
Date of receipt of final typescript: March 2002

References

Akerlof, G. A. (1983). 'Loyalty filters', *American Economic Review,* vol. 73 (March), pp. 54–63.
Ashenfelter, O. and Kelley, S., Jr. (1975). 'Determinants of participation in presidential elections', *Journal of Law and Economics*, vol. 18 (December), pp. 695–733.
Besley, T. and Coate, S. (1997). 'An economic model of representative democracy', *Quarterly Journal of Economics,* vol. 112 (February), pp. 85–114.
Buchanan, J. M. and Wagner, R. E. (1977). *Democracy in Deficit: The Political Legacy of Lord Keynes*, New York: Academic Press.
Coate, S. and Morris, S. (1995). 'On the form of transfers to special interests', *Journal of Political Economy,* vol. 103 (December), pp. 1210–35.
Cohen, R., Eylon, B. and Ganiel, U. (1983). 'Potential difference and current in simple electric circuits: a study of students' concepts', *American Journal of Physics,* vol. 51 (May), pp. 407–12.
Condorcet, Jean-Antoine-Nicolas de Caritat, Marquis de (1785). *Essai sur l'application de l'analyse à la probabilité des décisions rendues à la pluralité des voix*, Paris: Impremerie Royale.
Downs, A. (1957). *An Economic Theory of Democracy*, New York: Harper and Row.
Feddersen, T. J. and Pesendorfer, W. (1996). 'The swing voter's curse', *American Economic Review*, vol. 86 (June), pp. 408–24.
Frank, R. H. (1987). 'If homo economicus could choose his own utility function, would he want one with a conscience?', *American Economic Review*, vol. 77 (September), pp. 593–604.
Goldberg, F. M. and McDermott, L. C. (1987). 'An investigation of student understanding of the real image formed by a converging lens or concave mirror', *American Journal of Physics*, vol. 55 (February), pp. 108–19.
Halloun, I. A. and Hestenes, D. (1985). 'Common sense concepts about motion', *American Journal of Physics*, vol. 53 (November), pp. 1056–65.
Hestenes, D., Wells, M. and Swackhamer, G. (1992). 'Force inventory concept', *Physics Teacher*, vol. 30 (March), pp. 141–58.
Kandel, E. and Pearson, N. D. (1995). 'Differential interpretation of public signals and trade in speculative markets', *Journal of Political Economy*, vol. 103 (August), pp. 831–72.
McCloskey, M., Caramazza, A. and Green, B. (1980). 'Curvilinear motion in the absence of external forces: naive beliefs about the motion of objects', *Science*, vol. 210 (December 5), pp. 1139–41.
Magee, S. P., Brock, W. A. and Young, L. (1989). *Black Hole Tariffs and Endogenous Policy Theory: Political Economy in General Equilibrium*, Cambridge: Cambridge University Press.
Matsusaka, J. G. (1995). 'Explaining voter turnout patterns: an information theory', *Public Choice*, vol. 84 (July), pp. 91–117.
Palfrey, T. R. and Poole, K. T. (1987). 'The relationship between information, ideology, and voting behavior', *American Journal of Political Science*, vol. 31 (August), pp. 511–30.
Persson, T. and Svensson, L. E. O. (1989). 'Why a stubborn conservative would run a deficit: policy with time-inconsistent preferences', *Quarterly Journal of Economics*, vol. 104 (May), pp. 325–45.
Rodrik, D. (1996). 'Understanding economic policy reform', *Journal of Economic Literature*, vol. 34 (March), pp. 9–41.
Rogoff, K. (1990). 'Equilibrium political budget cycles', *American Economic Review*, vol. 80 (March), pp. 21–36.
Romer, C. D. and Romer, D. H. (1997). 'Institutions for monetary stability', in (C. D. Romer and D. H. Romer, eds), *Reducing Inflation: Motivation and Strategy*, Chicago: University of Chicago Press, pp. 307–29.
Rubinstein, A. (1993). 'On price recognition and computational complexity in a monopolistic model', *Journal of Political Economy*, vol. 101 (June), pp. 473–84.
Shleifer, A. and Vishny, R. W. (1992). 'Pervasive shortages under socialism', *Rand Journal of Economics*, vol. 23 (Summer), pp. 237–46.

Shleifer, A. and Vishny, R. W. (1994). 'Politicians and firms', *Quarterly Journal of Economics*, vol. 109 (November), pp. 995–1025.
Sigelman, L., Roeder, P. W., Jewell, M. E. and Baer, M. A. (1985). 'Voting and nonvoting: a multi-election perspective', *American Journal of Political Science*, vol. 29 (November), pp. 749–65.
Struthers, J. and Young, A. (1989). 'Economics of voting: theories and evidence', *Journal of Economic Studies*, vol. 16, no. 5, pp. 2–42.
Tabellini, G. and Alesina, A. (1990). 'Voting on the budget deficit', *American Economic Review*, vol. 80 (March), pp. 37–49.
Teixeira, R. A. (1987). *Why Americans Don't Vote: Turnout Decline in the United States, 1960–1984*, New York: Greenwood Press.
Timpone, R. J. (1998). 'Structure, behavior, and voter turnout in the United States', *American Political Science Review*, vol. 92 (March), pp. 145–58.
Wolfinger, R. E. and Rosenstone, S. J. (1980). *Who Votes?*, New Haven: Yale University Press.