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Cake, Culture, and Coalitions: The Political Economy of Income Distribution and Political Instability

presented by Ashley Timmer

candidate for the degree of Doctor of Philosophy and hereby certify that it is worthy of acceptance.

*Signature* ........................................

*Typed name* Jerry R. Green, Chair

*Signature* ........................................

*Typed name* Jeffrey G. Williamson

*Signature* ........................................

*Typed name* Robert H. Bates

*Date* May 1, 1998

# Cake, Culture, and Coalitions:

# The Political Economy of Income Distribution and Political Instability

A thesis presented

by

**Ashley Susan Timmer**

to

**The Department of Economics**

in partial fulfillment of the requirements

for the degree of

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in the subject of

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UMI Number: 9832512



UMI
300 North Zeeb Road
Ann Arbor, MI 48103

# Abstract

This thesis presents three essays examining the interaction between income distribution and political choices. In *Exit Options and Political Stability* and *Distributive Rules as Evolutionary Outcomes*, I examine the impact of collective choices on political stability. In *Using Politics to Keep Up With the Joneses*, workers' concerns for their relative position helps predict the changes in New-World immigration policy in the late 19th and early 20th centuries.

**Exit Options and Political Stability**

In a simple model of a society, individuals care about cake and the color of the houses. The society can exploit gains to economic cooperation in the production of cake, but it faces potential conflicts over choosing colors to paint the houses. Any individual, or group of individuals, will continue to cooperate in the society as long as their expected utility from doing so is at least that of their "exit" option. By allowing individuals to have varying degrees of other-regarding preferences for house color, I am able to assess the conditions under which liberal, democratic political institutions offer a wider range of stable outcomes and where they do not. I am also able to illustrate the circumstances when diversity of preference is a luxury good and when it cannot be sustained at any degree of development.

**Distributive Rules as Evolutionary Outcomes**

In a cooperative-game-theoretic model of a society, distributive choices are made under uncertainty. Societies can choose from a variety of distributive rules, such as the Kalai-Smorodinsky bargaining solution. Individuals must

be made better off, ex post, in order for them to continue to cooperate in the game. Under plausible assumptions about the probability distributions of individuals' and groups' productive abilities, I show that certain societies that use the Shapley Value as their distributive rule have a small, but significant, advantage in sustaining themselves over time. Because the Shapley Value is the only such rule that is based on the marginal product, one imagines that the evolution of capitalism as a dominant economic structure is no accident. The results suggest, however, that such a market-based rule will not be optimal where the distribution of productivity is highly unequal.

**Using Politics to Keep Up With the Joneses: New-World Immigration Policy and Relative Incomes**

The conventional wisdom suggests that restrictive New World immigration policies were a backlash against stagnating wages, especially among unskilled workers. In the United States, the correlation is exactly the opposite: positive changes in real wages correlate with, but precede, restrictive changes in policy. In this paper, I develop a model where political lobbying effort derives from changes in relative well-being, using a habit-formation approach. As wages decline relative to average income, workers expect greater gains from political pressure, and policy becomes more favorable towards laborers. Empirical tests on five new-world economies for the period 1860 to 1930 confirm the basic validity of this model.

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## Cake, Culture, and Coalitions:
## The Political Economy of Income Distribution and Political Instability

Distributional questions have, until recently, been a territory in which economists were reluctant to tread. Linked both with radical perspectives and normative ones, concerns over the distribution of income were dangerous ground for neoclassical economists. But with the surge in interest in positive political economy in the past decade, the distributive choices that societies make have increasingly been a focus of inquiry.

There are two directions from which the issue has been addressed. First, one can take the distribution as given, and investigate the policy consequences. The relative wealth of the median-voter has been used to predict trade policy (Mayer, 1984), immigration policy (Benhabib, 1997), educational transfers (Perotti, 1992), economic growth (Alesina and Rodrik, 1994), and redistributive taxation (Persson and Tabellini, 1994). These investigations offer insights on how income distribution will matter in policy making and therefore predict correlations between initial income distribution and redistributive policies. The results do not offer any predictions on an equilibrium level of inequality, where the policy changes given an initial distribution do not change that distribution, *ex post.*

The alternative is to investigate the equilibrium distribution that results from a given nature of society and political system. Given the economic pie, how is it to be divided? Although early social-choice theorists such as Sen and Arrow were quite taken with the question from both a philosophical and technical point of view, the end result of their inquiries fell short of offering predictions. Recently, Rodrik (forthcoming) and others have offered new insights into the question, by examining the causes of growth of the "welfare state." Evolutionary game-theorists have also addressed the cake-division problem by asking what norms of distribution might evolve from non-cooperative play.

In the three essays that follow, I look at the interaction between income distribution and political outcomes from both directions. The first two essays offer related, but quite different, models that help predict the distributional choices that societies make. The common element is that the constraint on political choices comes through individuals' ability to *exit.* By assessing the exit options that individuals and groups have in a society, it is possible to narrow the feasible range of redistributive outcomes.

In *Exit Options and Political Stability,* I argue for using a cooperative-game-theoretic model of a society. Because political and economic interests align themselves into groups, it is critical to any model of stability that these coalitions are modeled explicitly. The coalitions, whether a single individual or a group of many members, have opportunity costs of cooperating with the political outcome. These exit options define the characteristic function of the game. I offer a new definition of "political stability:" the stable societal outcomes must lie in the core of the economy.

In the essay, individuals care about cake and the color of the houses. Therefore, they must make choices in both economic and cultural dimensions. The society can exploit gains to economic cooperation in the production of cake, but it faces potential conflicts over choosing colors to paint the houses. There are three basic "cultural" types: those who prefer amber houses, those who prefer blue ones, and those who prefer crimson ones. The intuition is that in real societies, social choices generate conflict among different groups. Individuals have varying degrees of other-regarding preferences for house color—that is, they may or may not care about their neighbors' behavior. The degree of heterogeneity, nosiness, and intensity of preference will impact the ability to exploit gains to cooperation in the economic dimension.

The model exploits the divergence of preferences to examine the role of political institutions in political stability. I assess the conditions under which liberal, democratic regimes offer a wider range of stable outcomes than more autocratic regimes, and where they do not. In certain circumstances, illiberal institutions offer better prospects for stability. I am also able to illustrate the circumstances when diversity of preferences is a luxury good and when it cannot be sustained at any degree of development.

In the second essay, *Distributive Rules as Evolutionary Outcomes*, I exploit my definition of political stability to look at the differential success of distributive choices over time. Societies can choose from a variety of distributive rules, such as an egalitarian one, but the cake-division choices are made under uncertainty with respect to exit options. At the time the cake must be sliced, the individual and coalitional exit options are known only in expectation. Individuals must be made better off, *ex post*, in order for them to continue to cooperate in the game.

Cooperation fosters political stability, which is postulated to allow more economic growth than an unstable society. As societies choose differentially advantageous division rules, they come to claim a larger share of the global pie. Over time, the distributive norms that evolve are those used by the more successful societies. Under plausible assumptions about the probability distributions of individuals' and groups' productive abilities, I show that societies using the Shapley Value as their distributive rule have a small, but significant, advantage in sustaining themselves over time. Because the Shapley Value is the only distributive rule that is based on the marginal product, one imagines that the evolution of capitalism as a dominant economic structure is no accident. The market-oriented rule takes more than 10,000 years to become truly dominant, so it is no surprise that other systems have continued to coexist. In particular, the results show that a capitalist distributive rule will not be optimal where the distribution of productivity is highly unequal.

In the third essay, *Using Politics to Keep Up With the Joneses*, I turn the causality around to assess how current income distribution will affect policy outcomes. I examine the impact of income distribution on immigration policy, using a model in which individuals care about their relative position in society. The conventional wisdom suggests that restrictive New World immigration policies—especially those of the 1910s and 20s—were a backlash against stagnating unskilled wages. In the United States, the correlation is exactly the opposite: positive changes in real wages correlate with, but precede, restrictive changes in policy. In the period from 1860 to 1930, there was reasonably consistent real-wage growth in the U.S., as there was in Canada and Australia. Although Brazil and Argentina suffered significant wage declines in the 1910s, wages had rebounded by the 1920s.

The puzzle is why so many economies would turn against immigration, when unskilled workers seemed, in absolute terms, to have been doing better and better? The hypothesis, supported by much experimental evidence, is that *absolute* living standards are not how individuals judge their well-being. Rather, they care about how they are doing relative to others. The evidence for all five New-World economies during this time period is that while real wages were growing, wages relative to average income were declining. I develop a model where political lobbying effort derives from changes in relative well-being, using a habit-formation approach. As wages decline relative to average income, workers expect greater gains from political lobbying (which is costly to them), and policy becomes more favorable towards laborers.

The model is tested on these five economies during the period from 1860 to 1930, using a newly created index of immigration policy as the dependent variable. The empirical results cleanly reject the conventional wisdom of real-wage stagnation pushing the doors shut. Surprisingly, there is no evidence to support an alternative theory that racism or xenophobia was at play in the policy choices. The results do offer support for the relative-income hypothesis. Although the model is tested only on immigration policy, its success suggests that income distribution may impact policy in ways more complicated than we had previously assumed.

In combination, the essays offer a new approach to understanding the fundamental choices that all societies must make if they are to build on the potential gains from cooperation among their citizens. The modeling results demonstrate the critical role of exit options in sustaining stable coalitions of the whole. The empirical results demonstrate how productive classes judge their own well-being—and hence assess the value of their exit options—in choosing to exercise political voice over policies that directly affect their relative incomes. The overall result of the three essays is to place issues of income distribution squarely back in the neoclassical perspective.

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# Exit Options and Political Stability

## 1 Introduction

Political instability has a long history. Not surprisingly, so too does speculation about its nature and causes. The question is critical because of the increasingly persuasive evidence that instability hinders growth and economic performance (Londegran and Poole, 1990; Alesina *et al.*, 1996). The theoretical literature offers at least two avenues of exploration: economic conditions and group conflict. Along the economic route, the speculation is mostly common sense: growth is good; economic crisis is bad (Alesina *et al.*, 1996; Gupta 1990, *inter alia*). The literature on group conflict takes as fundamental that differing interests of both economic and social groups can lead to instability. The question of interest is what makes certain conflicts erupt into instability and others not (Rabushka and Shepsle, 1972; Gupta, 1990; Hardin, 1995; Fearon and Laitin, 1996).

In general, neither the economic nor the political theories have received strong empirical support. In particular, several puzzles have arisen. Alesina and Perotti (1996) find that more-equal land distribution matters more for stability than does more-equal income distribution, but they do not offer a reason why. Despite the stylized fact that ethno-linguistic fractionalization leads to conflict, the empirical trials offer only mixed support (Gupta, 1990). Such statements as "poor democracies are more unstable than poor nondemocracies" (Esty *et al.*, 1995) suggest that the political structure might behave differently under different economic conditions (and vice versa), but the theoretical arguments offer only fixed correlations between the variables and instability.

This paper develops a formal, if simple and intuitive, model of stability which offers more nuanced predictive variables than does the conventional wisdom. The model broadens the definition of instability to include all forms of rejection of social choices. I postulate that individuals have an opportunity cost of cooperating in society, which implies that variables such as income and educational achievement must be considered in relation to these opportunity costs. Thus the model suggests that every variable that matters does so in relative, not absolute, terms. An important innovation in this model is the inclusion of both cultural preferences and political structure, in order to demonstrate how these dimensions interact to foster stability or the lack thereof.

In *Democracy and the Market*, Adam Przeworski made the argument that for democratic systems to survive, not just the winning groups but also the losing groups had to be better off than they would be by subverting the system (Przeworski, 1991). Subversion, however, may have many forms other than political violence. One should be concerned with actions that individuals might take—short of political violence—whose impact could nonetheless be consequential for the society as a whole. Political instability occurs not just when individuals choose to take up arms against the government, but also when they choose to *exit*, a point first made by Hirschman (1970). Individuals may choose to emigrate; groups may choose to secede. Groups or individuals may take their economic activity underground—forgoing government support but also ceasing to provide any revenues to the government. These activities have not usually been thought of as elements of political instability, but the stability of a polity depends as much on continued economic cooperation and physical presence as on political cooperation. A mass exodus of individuals, even in a fully functioning democracy, would likely suggest a nation falling apart. Likewise, where black market activity (or organized crime) becomes prevalent, some group is vetoing the economic outcomes of the state, even though the mechanism may not be political in the narrower view. Thus political stability can be considered a multi-dimensional phenomenon, and this paper models political instability in this more general sense.

On the one hand, these non-political symptoms of underlying complaint will weaken a polity by eroding the tax base. On the other, they offer avenues of exit that substitute for political violence and political voice. Emigration might be stabilizing where those who leave feel they did not receive enough net transfers; it might be destabilizing where those who leave believe they paid too much in transfers. It is not the goal here to formalize the *method* of exit. Instead, I seek to illustrate that there are many places one might search for signs of instability. In broadening the range of conditions considered unstable, there is the potential for improved empirical results. If we know more exactly the characteristics of the dependent variable, it will be possible to be much more precise about the causal variables.

The existing literature is heavily dependent on the idea that individuals dissent when they are angry enough, or ideological enough, to overcome the risks of retaliation and costs of collective action (Gurr 1970; Gupta, 1990). Other models focus on ethnic or religious groups who battle each other over resources (Rabushka and Shepsle, 1972). Gupta (1990) surveys the older behavioralist literature on political violence as well as the more recent attempts to offer rational models. The most common link through all the literature is a focus on relative deprivation or disruptive change. From this perspective, individuals judge their well-being relative to the position of others, or relative to where they themselves used to be. There is increasingly strong experimental evidence that individuals derive utility in such ways (Frank, 1985). But changes in the income distribution from economic change might create groups of individuals who no longer receive a share of the pie sufficiently large to sustain their cooperation. They may appear to be "relatively deprived" or unhappy with massive economic upheaval, when in fact they simply have better options in exit because the system is not positively responsive to their own outside opportunities.

The focus on income distribution as a causal force in political instability has been taken up by a more recent branch of the literature, rooted in models of economic growth, that is trying to assess the joint impact of political instability and growth. The emphasis has been on the growth side of the story. Most authors do not offer their own explanation for the causes of political instability and have leaned on the common sense ones: economic growth is stabilizing, but inequality is destabilizing. Perotti (1996) offers a brief survey of the arguments, summarizing that "a highly unequal, polarized distribution of resources creates strong incentives for organized individuals to pursue their interests outside normal market activities or the usual channels of political representation" (p.151). Gupta (1990), Alesina and Perotti (1996), and Perotti (1996) all find strong evidence that the share of income of the middle 40% of the population is positively correlated with stability. They offer this fact as support for the theory. But as Gupta shows, the share of income among the bottom 20% is negatively correlated with stability—a correlation that would seem to be evidence against the polarization argument, since presumably the bottom 20% is worse off than the middle 40%.

Because the literature is trying to identify forces that cannot be observed, the measurable variables are often interpreted to mean what the authors want them to mean. For example, Londegran and Poole (1990) offer empirical support for the idea that once countries become politically unstable, they are much more likely to continue to be unstable. Specifically, once there has been one coup, more are likely to follow. Furthermore, the longer a country remains stable, the less likely it is to become unstable. Many have taken this empirical tendency as support for the joint causality between growth and stability (Alesina *et al.*, 1996). However, Gupta (1990) uses this result to confirm that "mobilization" is empirically important, because he uses instability in previous years to proxy for increased gains to participation in violence. Some of the literature offers no rationalization for its findings. A report by the U.S. Central Intelligence Agency on state failure found that the best predictive model included measures of infant mortality and openness to trade. The explanation was that each must proxy for other variables that might matter, leaving open what those underlying variables might be (Esty, *et al.*, 1995).

The difficulty with the existing theoretical literature is that it does not, in general, formalize at the level of individual actors. Although Gupta offers an expected-utility model of individual behavior, it is a model of the choice between private productive activity and revolt; the latter he considers to be a public good. But the more relevant calculus, it would seem, is expected utility from private consumption (or more generally, private utility) with and without agreement with the government. That is, if a group is being heavily taxed, and has an opportunity to continue its economic activity in a tax-free way, I suggest that it will do so.[1] The model builds on the insight of Aumann and Kurz (1977), who argued that individuals with large endowments in a society have more influence in the taxation structure, because those individuals have the right to destroy their endowments, thus causing societal losses. In this spirit, the model is one of private gain through socio-politico-economic

[1]Obviously, one could add to the calculus the risk of being caught if such behavior is illegal, or the lost resources from government support, or both.

exit. Although the literature on collective action in the political arena has a long history (*cf.* Olson, 1965), it is not this aspect of the problem that is addressed here. By ignoring how difficult it is for groups to come together to improve their situation, I might be overestimating their exit options. The model thus understates the inertia that impedes collective exit, and therefore is likely to overstate the fragility of societies.

The paper proceeds as follows: Section 2 lays out the basic structure of the society. Section 3 develops the formal assumptions of the model. Section 4 develops the model with self-regarding preferences and explores several elaborations. Section 5 examines instability in a world with other-regarding behavior. Some concluding thoughts are expressed in Section 6.

## 2 The Framework

The social set-up has three principal aspects: an economic dimension, a cultural dimension, and a question of liberalism. They are developed in turn.

### 2.1 The Economic Dimension

The "society" is defined as a group of individual citizens who cooperate economically. Collectively, they produce *cake*, a classic economic good of social-choice theory. Societies exist to exploit gains to economic cooperation. At present, the size of the society is exogenous, and I am ignoring any interaction between polities.[2] Individuals receive some share of the cake. The amount of cake produced is taken as fixed for any given number of productive citizens, and thus its supply is not subject to

[2]In future work, I hope to exploit this model to predict the size of nations and political unions, but those questions must be put off for now.

problems of work incentives. However, this fixed quantity of cake can be produced only if it is individually rational for each citizen to continue to cooperate. The feasible social-choice set is thus constrained. It is not possible to divide the cake in just *any* old way, because the citizens will cooperate in production only if they receive as their distribution at least as much as they could produce for themselves. More generally, the citizens must expect the same level of utility from the combination of all the collective choices as they would expect from their outside options.

The amount of the economic good that the entire society can produce will be defined as $C$ (the whole cake), denoted as $V(N) = C$. There is an allocation vector, $\{c_1, ...c_N\}$, such that $\sum_{i \in N} c_i = C$. Each individual will also be able to produce some amount of cake, as will groups of individuals. The collection of citizens, $N$, can be partitioned into smaller groups, $S_k$, of any size. The amount of cake that can be produced by these coalitions is denoted as $V(S)$, which represents the opportunity cost of cooperation for that coalition. I postulate that $V(S)$s are such that the game is *balanced*, which guarantees that a core exists.[3] It is possible to divide the cake in such a way that everyone is better off than they could otherwise be. I make this assumption to rule out ongoing cooperation where there could be a Pareto-improvement if the society were to break up.[4] Of course, there are a number of historical examples where cooperation continued under enforced togetherness, only to shatter as soon as the central authority collapsed. One would suspect, for

[3]Balancedness is defined as $\sum_{S \subset N} \delta_S \cdot V(S) \leq V(N)$ ,$\forall$ sets $\delta$, where $\delta$ is a mapping from $2^N \backslash \{N\}$ into $[0,1]$, such that $\sum_{S:i \in S} \delta_S = 1$, for all agents $i$. Balancedness is necessary and sufficient for the core to exist in a transferable-utility game. The condition rules out any proper coalition having too much productivity relative to the grand coalition. For proof, see Moulin (1988).

[4]Such continued cooperation (where no core exists) might reflect expectations about future gains to cooperation, but the modeling of changes to the game over time goes beyond the scope of this paper.

example, that Yugoslavia was a society with no core.

We therefore have a cooperative game in which each individual, and group of individuals, has some productive value outside of the society. (This value may be zero, or even negative in the case of a coercive state.) In a stable society, no one can make himself better off through a form of exit. The set of feasible allocations is the core of the game, and if a distribution outside of the core is chosen (or if no core exists), there is a group that can make itself better off by exiting. These exit options are discussed below. By characterizing the nature of the core under a variety of political and social scenarios, I develop predictions about the causes of instability. In some cases, the predictions have already been confirmed by earlier empirical work; others await future research.

Although this individual-rationality approach might seem obvious, it undermines the theoretical validity of many of the usual explanatory variables in predicting political instability. Unequal income distribution, as noted above, is often cited as a cause of socio-political instability. But according to the above, what matters is not the income distribution, but the difference between the distribution of productive ability and the *ex post* distribution of economic goods. In a society in which individual options are highly skewed, a *more* equal distribution would be *less* stable. Although educational achievement is usually cited as a stabilizing factor, human capital development is likely to raise the exit values for citizens, and thus greater education would constrain the feasible choice set.

## 2.2 The Cultural Dimension

Such a simple formulation already goes a long way towards resolving some of the empirical puzzles, but to focus on only economic goods would be to miss the critical difficulty of polities. When individuals come together to cooperate economically, they bring a set of personal preferences that are unlikely to be aligned. Most people's preferences for cake consumption are likely to be consistent: more is better. But organizing a society means social interaction and social choices. We need to organize a government, set up rules, agree to a common language, etc. Predicting stability—the continuing cooperative involvement of all citizens—is a matter of assessing how problematic these other aspects of the social choice problem will be and assessing if the economic gains from continued cooperation are worth the trouble of agreeing to these other things. In this paper, I model preferences in one dimension of *culture,* so-called in keeping with Becker's distinction between social issues—which are mutable and derive from socio-economic conditions—and cultural traits, such as religion and ethnicity—which are more or less fixed (Becker, 1996). The cultural dimension is one on which individuals have preference orderings that are independent of their economic well-being, even if their utility derived from cooperation depends on an interaction of the two dimensions.

The cultural dimension is captured here by a stylized aspect of societies: house color. The example is useful because it is a discrete choice.[5] As with real-world cultural dimensions, it makes little sense to think that one would pick a midpoint as a compromise. The solution to Northern Ireland will not be to have everyone convert to a religion that is a cross between Protestantism and Catholicism. Rather, the

[5]True, we do mix paint colors, but pink is not a compromise between red and white. I suspect that preferences for colors are neither continuous nor differentiable.

choices are discrete. An individual has preferences over which color to paint his own house. The ordering of those preferences does not change with economic outcomes. An individual may or may not care about what the neighbors are doing. Although one could make the argument that it is legitimate to be concerned with the color of your neighbor's house, since you have to look at it, I will take the approach that it is *other-regarding behavior*, of the sort that we usually consider illegitimate because it is more nosiness than externality that drives your feelings. Alternatively, these preferences could be interpreted more charitably. For example, in the case of language, there might be disutility in having neighbors speaking a language you cannot understand.[6]

## 2.3 Liberalism

The final complication, but one that adds real interest to this model, is the question of who does the choosing. Although the model has two private goods, it is not necessarily the case that individuals will always be able to choose their own preferred bundle of goods. In general, societies often constrain choices in private goods, either because of externalities or because of beliefs. Indeed, many localities have rules constraining the color that houses may be painted.

The degree of freedom in making private-good choices is a measure of liberty. Certainly the social-choice literature, beginning with Sen (1970), has argued for modeling liberty in this way. Sen suggests that liberty can be thought of as giving an individual the right to make a certain social choice. If an individual prefers state $x$ to state $y$, (where, for example, the only difference between $x$ and $y$ is the color

[6]There is a flip side to other-regarding behavior, which is concern for how others regard *you*. Such "keeping up with the Joneses" issues are not dealt with here. But see Timmer (1998) for a model of political outcomes based on such preferences.

of his house), then liberty grants the individual decisiveness over that pair (Sen 1970). However, Nozick (1974) argues that a better way to model liberty is in the removal of those dimensions from the social choice set. A liberal solution would be to redefine both $x$ and $y$ minus the house-color dimension, before the social choice is made. Those choices for which we want to grant individual liberty are not made collectively in any way. The only problem with Nozick's formulation of liberty is that not all dimensions *can* be removed from the social choice vector. Some decisions must be made collectively.

House color could be left up to the individual. Alternatively, the society could add N dimensions to the cake division problem by deciding what color to paint each individual's house. However, this is not typically how such decisions are made collectively. Rather, when the state chooses, it chooses *one* color for everyone. When individuals choose, they can make separate choices. Obviously, there is no *theoretical* reason why a state could not make separate choices, but there is no point in modeling a state that has the power to make such decisions if it is going to choose on a case-by-case basis. In fact, the "power of the state" is usually interpreted to be the power to choose one color for everyone, or at least to constrain the choice set.[7] Furthermore, for many of those cultural dimensions that cannot be delegated to individual choice (for example, a national language), only *one* choice can be made. The analysis has broader interpretation when formalized in this way.[8]

The model is flexible enough to carry out comparative statics not only on how

[7] An interesting question, but one that is left for future research, is to determine whether there might be an optimal size of the choice set. Would a state do better to offer citizens a list a possible house colors, perhaps including only those that did not evoke strong negative reactions of neighbors? Such an approach might give new interpretation to Sen's "minimal liberty."

[8] Formulating the problem in such a way, although intuitively sound, does not allow for direct interpretation in a social-choice theoretic framework. The problems of "liberty" in this context will be different from those developed in the work following from Sen (1970).

much you care about your neighbors' paint choices, but also on how those preferences interact with the economic dimension. Different real-world aspects of culture may interact differently with cake. In some cases, we might think that cultural outcomes are additively separable—raising or lowering utility but having no effect on marginal changes. One imagines that the choice of landscaping shrubbery matters little to the utility of economic goods. In other circumstances, the ability to derive utility from cake may be affected. (I cannot eat with your house that ugly color—it ruins my appetite!). Not surprisingly, it makes a huge difference to the nature of stable outcomes.

## 3 The Model

Individual utility is derived from at least two, and possibly three, variables—the cake consumed, one's own house color, and possibly a measure of the colors chosen by one's neighbors—that is, $U_i = f(c_i, h_i, h_{-i})$. Define $c_i$ as the quantity of cake consumed by individual $i$. Define $h_i$ as the utility for house color, where there are only three colors from which to choose: amber, blue, or crimson. For an individual whose preferences are *amber* $\succ_i$ *blue* $\succ_i$ *crimson*, $h_i$ is defined in the following way:

$$h_i = \begin{cases} 1 & : \ amber \\ 1/2 & : \ blue \\ 0 & : \ crimson \end{cases} \tag{1}$$

This is not the most general way to characterize the utility derived from such a choice, but it simplifies the analysis without losing too much generality. The key is to assign a zero value to the least preferred choice. Then the parameterization of the utility function will generate the comparative statics, rather than this arbitrary cardinal utility scale.

Define $h_{-i}$ as the utility indicator for houses other than that of person $i$, which takes on the value: $h_{-i} = min\{h_1, h_2, ...h_{i-1}, h_{i+1}, ...h_N\}$, where (abusing notation) the $h_i$s are evaluated relative to the preference rankings of person $i$. By choosing to measure one's utility for one's neighbors' house colors by the worst of their choices, I am trying to capture an existence problem, not a pervasiveness problem. It is not necessary for individuals to be affected *at all* by their neighbors' houses, but if they are, I will measure it using the worst-case scenario.

The utility function allows the elasticity of substitution between cake and house color and between one's own house and others to be parameterized separately:

$$U_i = \left\{[\alpha_1 h_i^\rho + \alpha_2 h_{-i}^\rho]^{\frac{\gamma}{\rho}} + c_i^\gamma\right\}^{\frac{1}{\gamma}} \tag{2}$$

The function is composed of two constant-elasticity-of-substitution (CES) functions. By varying $\rho$, the CES function replicates other useful forms. When $\rho \to 0$, the function approaches a Cobb-Douglas form. When $\rho \to 1$, the function becomes additively separable (i.e., linear). As $\rho \to -\infty$, the function approaches a Leontief function. Although it is unnecessary to make such a restriction, we have all the flexibility we need by constraining $\gamma$ and $\rho$ to be between 0 and 1 (inclusive), because of the way $h_i$ and $h_{-i}$ are defined.

Here, $\gamma$ measures the elasticity of substitution between cultural and economic goods. Likewise, as $\rho$ varies, the elasticity of substitution between my house color and yours varies. The $\alpha$'s are weights put on the various house colors (your own and everyone else's.) I constrain $\alpha_1 + \alpha_2 = 1$. By increasing $\alpha_2$, you increase the weight that you place on what other people are doing. When $\alpha_2 = 0$, you place no weight on your neighbors' houses, and thus you do not have other-regarding preferences.

On the other hand, if $\alpha_1$ is low, you care more about your neighbors' houses than your own—what Blau (1975) would call "meddlesome" preferences, an extreme form of other-regarding preferences.

Parameterizing the model in this way allows me to illustrate situations in which cultural conflict is politically problematic and those in which it is not. In the terminology of Rabushka and Shepsle (1972), the model can capture the difference between a plural and pluralistic society. The task is to formalize how other people's choices, as well as our own, affect our utility. A subsequent task, then, is to think about how to measure these parameters, to see if they contribute empirically to our understanding of political stability.[9]

The collective decision to be made (in addition to the cultural choice in the case of an illiberal state) is the allocation vector $\{c_1, c_2, ...c_N\}$. But there may be several feasible vectors which would foster continued stability. I establish a simplified notion of "power," which is the authority of a subset of the population to choose from among the feasible vectors. If one person chooses, there is a dictatorship. If half the population is needed to decide, we have majority rule. If everyone has to agree to the division, it is consensualism. Define $\beta$ as the proportion needed to enact a division of the cake, where $\frac{1}{N} \leq \beta \leq 1$. Those "in power," a group of size $\beta N$, choose the vector $\{c_1, c_2, ...c_N\}$. By assumption, those in power pay only the minimum possible to the others and divide the rest of the cake among themselves. If the vector satisfies all the individual rationality constraints, everyone will accept. If not, then those that have higher exit options (as individuals or as groups) will

[9]It should be pointed out that the literature on political instability suggests that many authors believe the relationship may be closer to one where $\gamma = -\infty$. That is, they seem to suggest that economic and cultural goods are perfect complements and are not in any way substitutable. However, by allowing $h_i$ to take a value of zero, I accomplish the same basic result without Leontief preferences.

exercise them, resulting in "political instability."

This interpretation of political power has a history in the literature, although it has not usually been formalized in this way. The best examples are in Olson (1993) and Levi (1988). Olson offers a stylized model of the evolution of government as the most efficient means of skimming the surplus value out of a society. Likewise, Levi offers the following straightforward assessment of her model: "Rulers maximize revenue to the state, but not as they please. They maximize subject to the constraints of their relative bargaining power vis-à-vis agents and constituents...." (p.10). Thus, those in power are given a first-mover advantage. If they are rational and have full information, they understand the limits of how much cake they can take without inducing exit.

Furthermore, this approach parallels formal models of legislative behavior (Baron and Ferejohn (1989), *inter alia*) where "power" derives from agenda control, which decides the bill to be voted up or down. Legislators must "buy" their majorities and try to do so as cheaply as possible so that they may keep as big a share of the pie as possible. Likewise, a lower bound on the distribution of cake can be defined such that stability is maintained. From there, I can establish comparative statics under various assumptions about who is in power and how often power shifts.

## 4 Self-Regarding Preferences

Take as a starting point the case where $\alpha_1 = 1, \ \forall \ i$. That is, nobody cares what the neighbors are doing. The utility function reduces to a simpler function with cake and one's own house color as the only arguments:

$$U_i = [h_i^\gamma + c_i^\gamma]^{\frac{1}{\gamma}} \tag{3}$$

### 4.1 A "Liberal" Society

Liberty, so-defined in this model, means that each person can choose his own paint color. Because there are no externalities and (by assumption) no difference in cost associated with each color, each individual should choose his own, most preferred color.[10] With this assumption, there is a derived utility function, where the social dimension has already been optimized:

$$U_i(h_i^*, c_i) = [1 + c_i^\gamma]^{\frac{1}{\gamma}} \tag{4}$$

When $\gamma = 1$ or $\gamma = 0$, utility is a linear function:

$$U_i = 1 + c_i \; (\gamma = 1) \tag{5}$$

$$U_i = c_i \; (\gamma = 0) \tag{6}$$

In either case, the marginal utility of cake is constant and equal across individuals, which means that the sum total of utility from cake available to the society is constant regardless of how the cake is distributed. Therefore, we can look at the distributional game using cooperative game theory without further specifying how subcoalitions make their own distributional decisions.[11]

**A Game of Individuals.** In the simplest of simple cases, I can reduce the problem to a bargaining game, by assuming that $V(S) = \sum_{i \in S} v(i)$ , $\forall S \in N$. (That is, the proper coalitions have no additional productive capacity beyond the sum of their individuals.) I focus on the case where $\gamma = 0$ or 1. In a single-play game, the no-exit

[10] As we will see, once one has to worry about what the neighbors think, there may be strategic reasons to forfeit one's own favorite color.

[11] In the case where $0 < \gamma < 1$, only one-person coalitions are well-defined, because the value of the coalition, in terms of utility, depends on how it chooses to divide the cake. Much of the discussion that follows focuses on a bargaining game instead.

condition is $c_i \geq v(i)$, $\forall i$. By assumption, $C > \sum_N v(i)$. There is therefore some surplus to play with. Consider first the case of a dictator ($\beta = \frac{1}{N}$), who can get, at most, $C - \sum_{N \setminus dictator} v(i)$. Over an infinite lifetime, a dictator who remains in power must give all citizens the same lifetime expected utility as they could have by exiting. In this case, there is no uncertainty because of the infinitely-lived dictator. The relevant no-exit condition is for:

$$U_i(stay) = \sum_{t=0}^{\infty} \frac{c_{it}}{(1+\delta)^t} \quad (7)$$

$$\geq \quad (8)$$

$$U_i(go) = \sum_{t=0}^{\infty} \frac{v(i)}{(1+\delta)^t} \quad (9)$$

where $\delta$ is the discount rate.[12] In this particular example, there is no uncertainty. It is straightforward to see that all citizens will receive just their exit value at each point in time, except for the dictator, who takes all the surplus each period.[13]

This formulation is too simple to have much real-world application, except that it helps illustrate how the exit values drive the outcomes. A dictator, an oligarchy, or any form of government has the widest variety of stable outcomes if these exit values are low. True, repressive regimes could reduce these options through force or threat of force. But consider also how land-based wealth offers different exit options than does human capital. Suppose the citizenry is primarily agricultural, with widespread (if small-scale) ownership. These individuals, despite the possession of potentially good productive abilities, have low exit values because their productivity is tied to

[12]The discount rate has little importance in this particular formulation. In later sections where there is uncertainty and the choice vector changes over time, a low $\delta$ might be useful in sustaining cooperative equilibria. See Appendix A.

[13]Because there is risk neutrality in cake, there are no utility-reducing effects of political uncertainty, although such effects might be an interesting direction for future thought. (For example, can a "good" dictatorship be more stable than a rotating—and therefore uncertain—power structure?)

their land, which they cannot take with them.[14] In contrast, an educated population with skills, or more mobile forms of capital, would not have to give up the source of their productivity in exit. This intuition suggests that it will be difficult for an economy to remain stable during the process of industrialization unless the division of cake becomes less extractive, *ceteris paribus.*

The other side of the story is that industrialization tends to increase the divergence of the $v(i)$s. One explanation, perhaps, for the widespread urban bias during the development process might be that urban citizens are more problematic for political stability precisely because their exit values are high relative to those of equal incomes in rural areas. Taxation in a stable regime would need to be biased against the rural population. Moreover, economic development may be thought of as a process of raising the gains to cooperation, relative to these exit values. Highly specialized and integrated economies might be quite wealthy, but individuals and small groups have limited exit values, because of their dependence on other segments of the economy. Such complex, wealthy societies would be more stable than simpler, poorer societies.

**Oligarchies and Proper Coalitions.** In the more general case, not just individuals but also coalitions have outside options. It is impossible to characterize the outcomes without specifying all the values of all the coalitions, except to note that groups with the highest exit values have to get the largest shares. But consider a simplification where $V(S)$ depends only on the size of the coalition, and not on the identity of its members. This is useful because it is a symmetric game, and we know

[14]This would be true even if the form of exit is not emigration. Land ownership ties an individual to a specific area, which may also limit the ability to stage uprisings or even to organize a secessionist movement, if allies are not contiguous.

that for those in power, and out of power, the outcomes must be the same, since the cheapest way to buy people off is to pay them all the same amount. Supposing that $V(S)/|S|$ is increasing in $|S|$ (which implies superadditivity and, because of symmetry, a core), the coalition of size $|N-1|$ would have the largest per-capita exit value. Each person will need to be paid at least $\frac{V(N-1)}{|N-1|}$, which leaves $C - \frac{V(N-1)}{|N-1|} \cdot |N|$ as the surplus to be shared among those in power. How those in power decide to share surplus is, in general, indeterminate, but, with symmetry, it is reasonable to assume that each of those in power end up with the same share of the surplus. Recall that $\beta$ is the fraction of the population in power. It is straightforward algebra to show that those in power receive:

$$c_i = \frac{C}{\beta N} - (\frac{1}{\beta} - 1) \cdot \frac{V(N-1)}{|N-1|} \tag{10}$$

whereas those out of power receive:

$$c_i = \frac{V(N-1)}{|N-1|} \tag{11}$$

As $\beta$ approaches one, the distribution approaches equality. When the same people are in power all the time, this distribution will be the same in cross section as it is over time. It is interesting to see what happens when the power structure shifts every period. Suppose that the $\beta N$ in power are randomly drawn each period. Each individual has a probability $\beta$ of being in power each year (or political cycle, generation, etc.)[15] I suggest that those in power will give those out of power just enough to satisfy their lifetime individual rationality constraints. Suppose the $\beta N$ take *everything* to share among themselves. They take $\frac{C}{\beta N}$, and the rest get nothing.

[15]Because of the risk neutrality, there are actually no gains to a "cooperative" equilibrium, where those in power share equally and expect others to do the same (which would be enforceable in an infinitely played game with a tit-for-tat strategy, for example.)

But if the probability of being in power is the same for all individuals, then that probability is $\beta$, and lifetime expected utility is:

$$U_i(\cdot) = \sum_{t=0}^{\infty}\left(\beta \cdot \frac{C}{\beta N}\right) \cdot \frac{1}{(1+\delta)^t} \tag{12}$$

$$= \sum_{t=0}^{\infty}\left(\frac{C}{N}\right) \cdot \frac{1}{(1+\delta)^t} \tag{13}$$

which is, by assumption, greater than any individual's best outside option (because of symmetry.) Those in power at any given time will take the whole cake, and each individual's expected lifetime cake consumption averages an equal share. This analysis suggests that in a political system in which power shifts, we would expect that it is stable to have greater *cross-sectional* inequality than in a system in which power remains among a select few. However, there should be lower *lifetime* inequality.[16] The intuition is straightforward: people are willing to accept less cake in a current political situation, if they have reason to believe that they will have a chance in the future to come to power and take a large share. The potential for changes in power might account for systematic differences between time-series and cross-section estimates of models purporting to capture the impact of income distribution on political stability and economic performance. As we will see in the following sections, this rotation of power might also be the only way to handle divergent preferences for house color and maintain stability, because the choice is discrete.

## 4.2 An "Illiberal" Society

A liberal society—without other-regarding preferences—has to worry only about dividing the cake in an acceptable fashion. The situation becomes more complex

[16] Upon hearing my description of this project, a colleague quipped that surely the United States would falsify any theory that said income distribution had anything to do with stability, since the United States is both highly stable and unequal. However, the United States has one of the highest measures of class mobility in the world.

when it is those in power who must choose the house colors. Since, by assumption, they can choose only one color, they must consider the cost to each preference profile of such a choice. Only one preference profile will have its first choice; so choosing collectively is more costly, in utility terms, than allowing individuals to choose for themselves. Thus, in the simplest case, liberal states have a better possibility of stability than others, *ceteris paribus*. However, not all social choices can be delegated to the individual, and it is important to assess the difficulty of maintaining stability under a diversity of preferences.

**Fixed Power Structure.** To simplify matters, I assume that those in power have the same preferences for house color, although the more general case follows from the same logic. We can divide the population into three groups: those who rank amber as their most-preferred color, $\chi_1$, those who rank amber as their second choice, $\chi_2$, and those who rank amber last, $\chi_3$. Then $\chi_1 \cup \chi_2 \cup \chi_3 = N$. Suppose that $\chi_1$ is in power. Return to the bargaining-game formulation—assume that $V(S) = \sum_{i \in S} v(i)$—so that we do not need to constrain $\gamma$ to the extreme cases. Recall that the utility function will be:

$$U_i = [h_i^\gamma + c_i^\gamma]^{\frac{1}{\gamma}} \tag{14}$$

Suppose that those in power choose amber to be the color of the houses. The resulting utility for members of each group will be:

$$U_{i \in \chi_1} = [1 + c_i^\gamma]^{\frac{1}{\gamma}} \tag{15}$$

$$U_{i \in \chi_2} = [\tfrac{1}{2^\gamma} + c_i^\gamma]^{\frac{1}{\gamma}} \tag{16}$$

$$U_{i \in \chi_3} = [0^\gamma + c_i^\gamma]^{\frac{1}{\gamma}} \tag{17}$$

Note that if any members of $\chi_3$ have preferences such that $\gamma = 0$, this color cannot be a stable choice, regardless of the amount of cake given to them, because their marginal utility of cake is constant at zero. As long as they have a non-zero outside option, they will be better off to exercise it. Indeed, if there are members of each group whose preferences behave in this way ($\gamma = 0$), there is *no* stable choice that can be made in a single-play game. Likewise, where there is no shift in the power structure over time, it would be impossible to have a stable choice, provided we assume stationarity of the choice strategy. On the other hand, where there is a possibility to compensate individuals with cake for their utility losses in house color, the question is whether the gains to cooperation are large enough. Consider the case where $\gamma = 1$, $\forall i$. For convenience, define $\bar{v}_{i \in \chi_1}$ as the exit value for members of $\chi_1$. As noted before, a "liberal" society, either in a single-play game or with a fixed power structure, needed only for $C \geq \sum_N v(i)$. An "illiberal" society needs for the following to hold:

$$C \geq \chi_1 \cdot \bar{v}_{i \in \chi_1} + \chi_2 \cdot (\tfrac{1}{2} + \bar{v}_{i \in \chi_2}) + \chi_3 \cdot (1 + \bar{v}_{i \in \chi_3}) \tag{18}$$

More generally, the constraint is:[17]

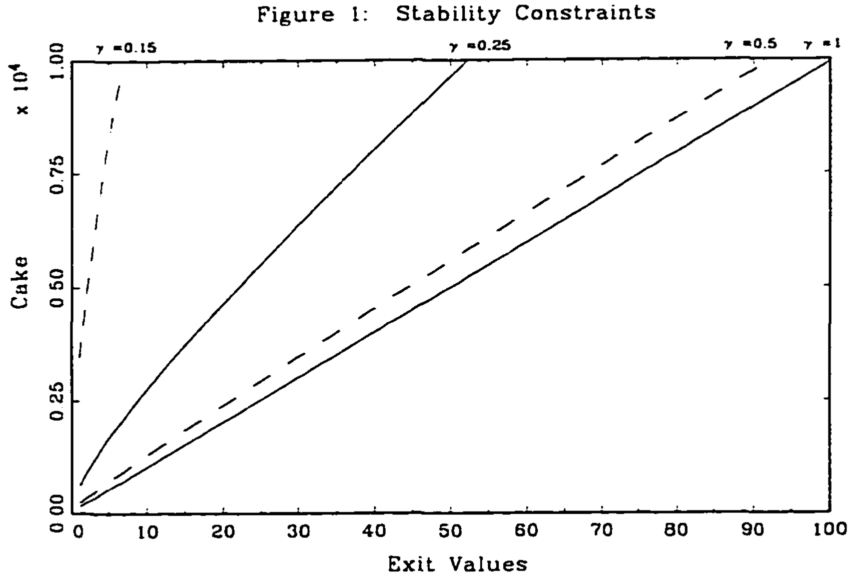
$$C \geq \chi_1 \cdot \bar{v}_{i \in \chi_1} + \chi_2 \cdot (\tfrac{2^\gamma - 1}{2^\gamma} + \bar{v}^\gamma_{i \in \chi_2})^{\frac{1}{\gamma}} + \chi_3 \cdot (1 + \bar{v}^\gamma_{i \in \chi_3})^{\frac{1}{\gamma}} \tag{19}$$

As long as $\gamma \neq 0$, there is some level of economic gain that will ensure the existence of a stable social choice, but the lower $\gamma$, the larger C must be. Figure 1 illustrates the necessary size of cake, relative to exit values, for several values of $\gamma$, assuming that each group is of equal size and all individuals have equal exit values. (Both variables

[17]Those in $\chi_1$ get their favorite color, and need only be paid $c_i \geq \bar{v}_i$ in order not to exit. The no-exit constraint for those who rank amber as a second choice is for $[(\frac{1}{2})^\gamma + c_i{}^\gamma]^{\frac{1}{\gamma}} \geq [1 + \bar{v}_i^\gamma]^{\frac{1}{\gamma}}$. Solving for $c_i$, $c_i \geq [\frac{2^\gamma - 1}{2^\gamma} + \bar{v}_i^\gamma]^{\frac{1}{\gamma}}$. Those who rank amber last can get $[1 + \bar{v}_i^\gamma]^{\frac{1}{\gamma}}$. Multiplying each individual constraint by the numbers of each type yields the stability constraint for the entire population.

are measured in arbitrary units.) The figure demonstrates not only the importance of $\gamma$, but also the importance of exit values. As exit values rise, it becomes more difficult to maintain stability with a collectively-made cultural choice. This difficulty is furthered if $\gamma$ is small. Such a result might help to explain the conventional wisdom that increased education fosters demands for increased liberty. In this model, it is clear that if educational achievement raises exit options, other things being equal, the state would need to become more liberal to maintain stability.

Figure 1: Stability Constraints




Equation 19 defined the amount of cake necessary to sustain the choice of amber houses. However, in a game with different *sizes* of groups, each color choice will have a different price. Thus, there will always be a "cheapest" choice, depending on the size of the various groups. If $\chi_1$ is small, then amber is not the easiest choice to sustain. In fact, even when $\chi_1$ is the group in power, it might not choose amber as the choice. For mathematical ease, assume $\gamma = 1$, $\forall i$.

The utility of a member of $\chi_1$ for each color choice is as follows:[18]

$$U_{i\in\chi_1}(amber) = 1+\frac{c}{\chi_1} - \frac{\chi_2}{\chi_1}[\tfrac{1}{2} + \bar{v}_{i\in\chi_2}] - \frac{\chi_3}{\chi_1}[1 + \bar{v}_{i\in\chi_3}] \quad (20)$$

$$U_{i\in\chi_1}(blue) = \tfrac{1}{2}+\frac{c}{\chi_1} - \frac{\chi_2}{\chi_1}[1 + \bar{v}_{i\in\chi_2}] - \frac{\chi_3}{\chi_1}[\bar{v}_{i\in\chi_3}] \quad (21)$$

$$U_{i\in\chi_1}(crimson) = \frac{c}{\chi_1} - \frac{\chi_2}{\chi_1}[\bar{v}_{i\in\chi_2}] - \frac{\chi_3}{\chi_1}[\tfrac{1}{2} + \bar{v}_{i\in\chi_3}] \quad (22)$$

It is straightforward to show that if the group in power has less than one-third of the population, it will not choose its own most-preferred color. (In fact, any group with less than one-third of the population will not see its favorite color chosen.) Intuitively, the choice of house color causes disutility for some individuals relative to their personal (liberal) choice, and the cost of the required compensation is linear in the size of the group. One is better off to give a large group its favorite color and then enjoy the savings in cake. This result is sensible only in the linear case, but it is not without anecdotal support. In the 1950s in Indonesia, for example, the Javanese (who controlled the government) chose *Bahasa Indonesia*, not Javanese, as the official language. The most famous example might be Henri IV, leader of the Huguenots, who in defending his conversion to Catholicism to take the throne declared that "Paris is worth a mass."[19]

The above analysis offers some important insights into multi-cultural societies in which one culture wields power. First, in stable societies, cultural groups whose preferred choices are not realized should be wealthier, on average, than those whose first choice was chosen (absent coercion of the groups, which reduces their exit options.) For example, apart from instances of repression, we would expect that the minority group of Chinese in Southeast Asia would be wealthier than the average

[18]These utilities are calculated as in equation 19, using the amount of cake each group would need to be given for each color choice. The group in power splits the surplus.

[19]I thank Robert Bates for the anecdote.

indigenous citizen. (More precisely, we would expect them to have less net taxation.)

Secondly, different types of illiberalism go hand in hand. If a society collectively chooses a single culture (amidst diversity of preference), it has a much greater chance of stability if it restricts emigration and otherwise reduces the exit options of its citizens. A society might have large enough economic gains to maintain such a choice without reducing such exit options, but poor, illiberal countries are likely to have to be illiberal in other ways to maintain stability.

**Changeable Power Structure.** The picture looks somewhat brighter when we consider a collective cultural choice under circumstances in which those in power change over time. By allowing the power structure to change, we create expectations that different choices will be made over time, which turns out to be very helpful in generating a higher expected utility of continued cooperation than from exit.

Expected lifetime utility depends on beliefs about the strategies chosen by those in power. Appendix A works through the conditions under which it would be rational to expect and pursue various strategies. The key question is whether the groups can sustain a strategy where those in power share the cake more equally, as opposed to simply taking all the cake for themselves. Under the assumption that we have three groups of equal size who are equally likely to be in power, it turns out that only under a narrow set of conditions can a more cooperative strategy be sustained in equilibrium.[20] More often, the strategy is one in which whoever is in power takes all the cake and picks its favorite color. Appendix A provides details of where this is true and where it is not. Under a winner-take-all strategy, the expected lifetime

[20]Obviously, if one group has only a minuscule probability of being in power, this statement cannot be true, but having already dealt with the fixed-power scenario, I want to look at the other extreme. Scenarios that are somewhere in between equal power-sharing and fixed oligarchies have results that are likewise somewhere in between.

utility of cooperation/exit is:

$$EU(stay) = \sum_{t=0}^{\infty}\left(P_{\chi_1}\cdot[1+(\frac{C}{\chi_1})^{\gamma}]^{\frac{1}{\gamma}} + P_{\chi_2}\cdot[(\frac{1}{2})^{\gamma}]^{\frac{1}{\gamma}} + P_{\chi_3}\cdot(0)\right)\cdot\frac{1}{(1+\delta)^t} \quad (23)$$

$$EU(go) = \sum_{t=0}^{\infty}\left([1+v(i)^{\gamma}]^{\frac{1}{\gamma}}\right)\cdot\frac{1}{(1+\delta)^t} \quad (24)$$

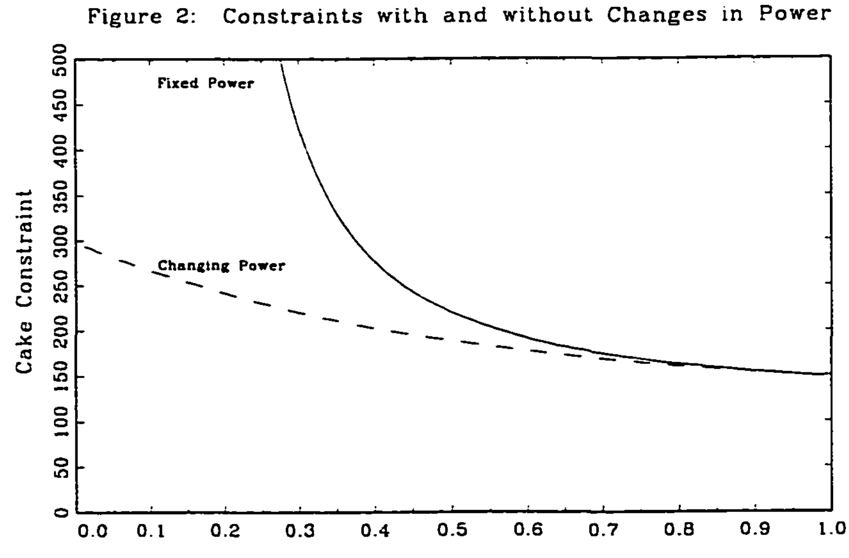
where I assume that each member of the group in power takes an equal share of the cake. If we simplify to assume that $P_{\chi_1} = P_{\chi_2} = P_{\chi_3} = \frac{1}{3}$, then

$$EU(stay) = \sum_{t=0}^{\infty}\left(\frac{1}{3}\cdot[1+(\frac{C}{\chi_1})^{\gamma}]^{\frac{1}{\gamma}} + \frac{1}{6}\right)\cdot\frac{1}{(1+\delta)^t} \quad (25)$$

$$EU(go) = \sum_{t=0}^{\infty}\left([1+v(i)^{\gamma}]^{\frac{1}{\gamma}}\right)\cdot\frac{1}{(1+\delta)^t} \quad (26)$$

Figure 2 illustrates the gains to cooperation needed for stability as $\gamma$ decreases, compared with those in a fixed-power regime. (For both cases, I assume that all the exit values are the same for everybody, and they arbitrarily equal 1.) The important point is that even though there do have to be larger gains to cooperation when $\gamma$ is small, the necessary gains are not infinitely large, the way they are when the power structure is fixed. This result suggests that in those dimensions where

Figure 2: Constraints with and without Changes in Power



$\gamma$ is low, allowing all groups access to power is likely to be the only way to assure stability. This system might not seem to be the best alternative when liberalism is possible, but when the social choice *must* be made collectively, it seems clear that a multi-cultural society has to offer all groups a chance at power.

**Strong Coalitions.** These analyses are best-case scenarios, in that I have assumed away any gains to cooperation from proper coalitions. Although the value to such coalitions is not well defined in a game-theoretic sense, in the real world they are likely to be even more constraining than individual exit values. Coalitions with aligned preferences in the cultural dimension are most problematic, because they do not have to compromise on such matters as house color. In exit, the coalition could exploit gains to economic cooperation without any members losing utility from a less-preferred color choice.

By making a few assumptions about how such coalitions behave, I can offer some examples which illustrate the difficulty. Consider a cake-production technology that depends only on the number of individuals. Suppose that $C = |S|^2$. Figure 3 illustrates the lifetime expected utility for cooperation under this technology and for exit of three different coalitions. Because of the anonymous production function, only two sizes of coalitions could have binding exit values: the coalition of all members of one preference type, and the coalition of all members of two preference types. (Smaller coalitions lose productivity without any gains in homogeneity of culture.)

The problem in assessing the values of coalitions of more than one preference type is in assigning a rule for making the cultural choice. In this case, the coalition of $\chi_1 \cup \chi_2$ does best to choose that color which is ranked first by one group and second by the other. In order to make both types better off, the cake must be divided unequally, giving more to the group that receives its second choice. But it is possible under this technology that a coalition of two types can, for small values of $\gamma$, do better to exit than to continue to cooperate (see Figure 3). Because this cooperation is feasible for *any* coalition of two types, it is not possible for all three groups to continue to maintain cooperation under these circumstances. Recall that the circumstances are illiberal ones. This outcome would not occur in a liberal state.[21]

Figure 3: $S^2$ Technology

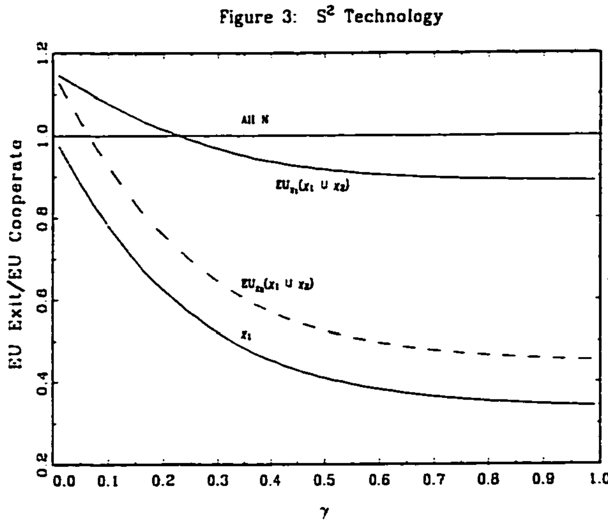
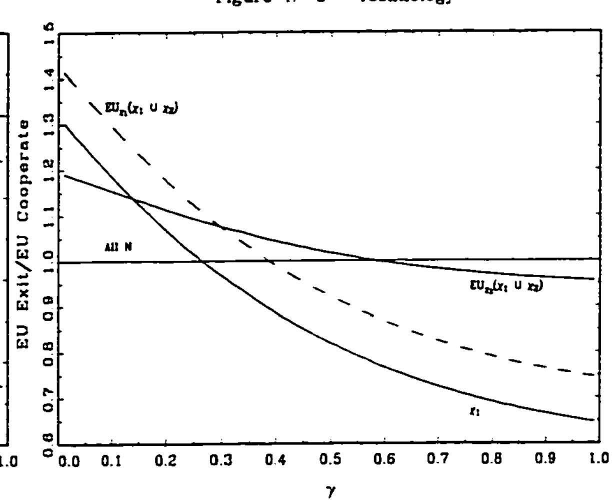



Figure 4: $S^{3/2}$ Technology




If the technology is a little less convex, for example, where $C = |S|^{3/2}$, the situation is even more difficult. Here, even a coalition of a single preference type can do better by exiting, when $\gamma$ is very small. But for a middle range of $\gamma$, the coalition of two types can be better off in exit. Figure 4 illustrates. These coalitional exit values are best-case scenarios, in that the coalitions can costlessly agree to a particular division of their productive output and the cultural choice. One could

[21] Any large coalition that could somehow change the decision rules and exit to liberal conditions will do better, but I assume that the degree of liberalism does not change in exit.

imagine a world in which the distributive battles would preclude such viable exit options. Furthermore, the coalition of the third preference type has every incentive to try to make a deal with one of the other two types to lure it away. There is actually no stable partition of $N$ under these circumstances.

This result suggests that for societies with diverse cultural preferences where there is a low degree of substitutability between culture and cake, these cultural groups have to have an unusually high level of economic interdependence to foster continued cooperation. More positively, societies suffering from instability due to cultural differences might eventually be able to outgrow their instability.

## 5 Other-Regarding Preferences

The above analysis confirms much of the conventional wisdom about political systems and political stability. Giving all groups access to political power is helpful in maintaining stability, as is granting liberty in as many dimensions as possible. It is not surprising that much of the literature has pointed to the absence of political access and liberty in explaining unstable regimes. Liberalism generates stability because it allows all citizens to choose simultaneously their most-preferred house color, even with diverse preferences. But what happens when my favorite house color makes you unhappy? From a philosophical point of view, we can argue that you have no say in the matter, and should not care anyway. But if your neighbors' houses generate disutility for you—even if they "should" not—stability will be more difficult. Indeed, "other-regarding behavior" presents situations where liberalism only makes matters worse. Taking the language example to an extreme, a failure to specify any official language(s) could result in Babel-like chaos.

### 5.1 Liberalism and Other-Regarding Preferences

Consider a society where all citizens may choose their own house color, but where $\alpha_2 \neq 0$, so that individuals place some weight on what their neighbors' houses look like:

$$U_i = \left\{ [\alpha_1 h_i^\rho + \alpha_2 h_{-i}^\rho]^{\frac{\gamma}{\rho}} + c_i^\gamma \right\}^{\frac{1}{\gamma}} \tag{27}$$

If there exist individuals who rank each color first, second, and third, then $h_{-i} = 0\,,\ \forall i$.[22] The most difficult (in fact, impossible) situation is where there is no substitutability of cake for culture—that is, where $\gamma = 0$ and $\rho = 0$. In general, as $\alpha_1$, $\rho$, and $\gamma$ decrease, the society must have larger and larger gains to cooperation for stability to be possible. Figures 5–8 illustrate the amount of cake needed to ensure stability for four different values of $\gamma$, assuming that all individuals have the same exit value of 1.

How problematic other-regarding preferences will be depends on $\gamma$. Where $\gamma$ is close to one, cooperation seems possible even when $\alpha_1$ and $\rho$ are low. When $\gamma$ is closer to zero, the results are much more sensitive to the other parameters. In all of the figures, the cake constraint is graphed on the same logarithmic scale, so that the constraints are directly comparable across figures. Figure 5, where $\gamma = 0.1$, illustrates how quickly the necessary gains to cooperation escalate as $\alpha_1$ and $\rho$ decrease, when $\gamma$ is low. On the other hand, as Figure 8 illustrates, when $\gamma$ is high, stability is not that much more problematic for low $\alpha_1$ and $\rho$, than where $\alpha_1$ and $\rho$

[22]This statement assumes a non-sophisticated decision mechanism—that is, all individuals paint their houses their favorite color. It is not clear that sophisticated decision making would matter. If there is only one preference type with $\alpha_2 > 0$, there may be a strategic value in everyone avoiding whatever that type's least-preferred color is. But I will assume that any societal agreement on paint colors will be done by giving power to the state to make that choice, not through private strategic play.

are high.[23]

Figure 5: Constraints with Other–Regarding Preferences
$\gamma$ =0.1

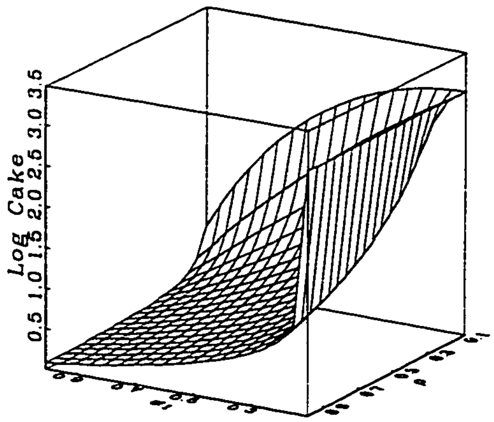



Figure 6: Constraints with Other–Regarding Preferences
$\gamma$ =0.2

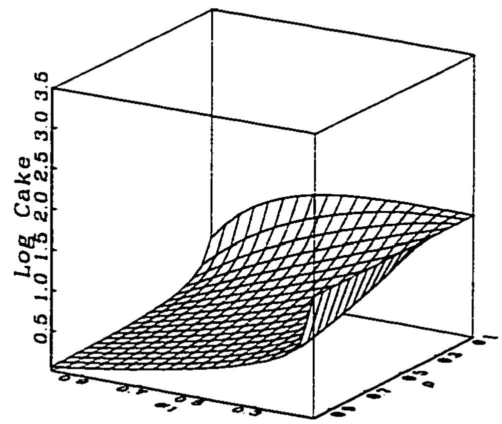



Figure 7: Constraints with Other–Regarding Preferences
$\gamma$ =0.5

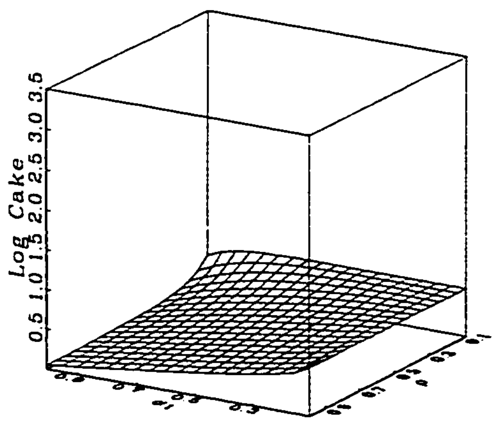
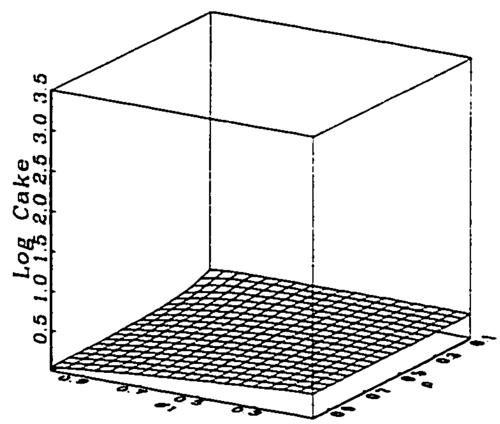



Figure 8: Constraints with Other–Regarding Preferences
$\gamma$ =1




## 5.2 Illiberalism with Other-Regarding Preferences

If the state is making the choice of house color, we need to think again about the rotation of power and the size of various groups in addition to the various parameters.

[23] For all of these graphs, I have assumed a single-play game, so that the minimum required cake (the z-axis) is calculated assuming an equal division. In a repeated game under these conditions, the division of the cake will matter little for the possibility for stability. That is, whether one person is in power for life or everyone rotates over time, the changes in expected lifetime utility are small.

What changes, however, is that $\rho$ and $\alpha_2$ no longer matter. Because all the house colors are the same, $h_i = h_{-i}$ for everyone, the utility function reduces back to the no-liberty case without other-regarding preferences. With amber houses, utility will be:

$$U_{i \in \chi_1} = [1 + c_i^{\gamma}]^{\frac{1}{\gamma}} \tag{28}$$

$$U_{i \in \chi_2} = [\tfrac{1}{2^{\gamma}} + c_i^{\gamma}]^{\frac{1}{\gamma}} \tag{29}$$

$$U_{i \in \chi_3} = [0^{\gamma} + c_i^{\gamma}]^{\frac{1}{\gamma}} \tag{30}$$

Likewise, the quantities of cake needed to maintain cooperation are the same as those in section 3.1.2. (See Figure 2.)

The more important question is which approach is likely to be more useful in fostering stability under these circumstances: a state choice or liberalism? As long as $\alpha_2 > 0$, it turns out that an illiberal state, coupled with shifts in power over time, is *always* going to be better than allowing all individuals to make their own choices. In many circumstances, even a fixed power structure making the choice will do better than allowing people to choose for themselves.

Figure 9: Constraints with Other–Regarding Preferences

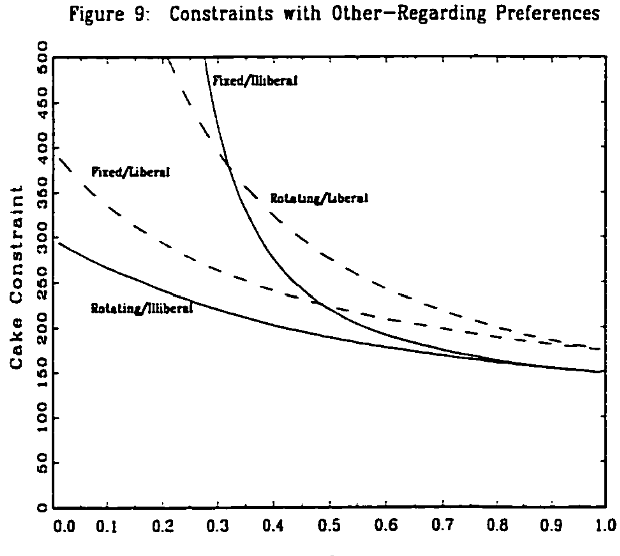



Figure 10: Constraints with $\alpha_1$=0.25, $\rho$=0.25

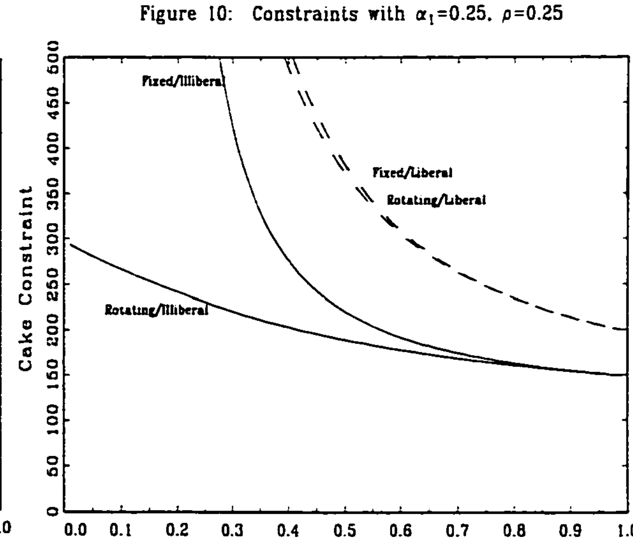


Figure 9 illustrates the constraints for $\rho, \alpha_1 = 0.5$. Figure 10 illustrates the constraints for $\rho, \alpha_1 = 0.25$. If $\rho$ and $\alpha_1$ are high enough, liberalism can be easier to maintain than a fixed, illiberal regime, as illustrated in Figure 9. But where the weight on others' houses is high, and the degree of substitutability with one's own house is low, liberalism makes political stability more difficult.

In a world in which individual behavior generates disutility for others, *no one* is happy when all individuals do what they want. When the state makes a single choice, one group will get its first-best outcome, and only one group will have its worst possible outcome. If that outcome can be further improved by allowing all groups access to power over time, we effect a compromise in expectation that is simply not possible in actual choice. A plausible real-world example is the legal status of abortion in the United States. One side of the debate is unable to accept the liberal choice (legal abortion), and the other side is unable to accept the illiberal choice (no legal abortion). But each side continues to expect with positive probability that the situation will change with future changes in the composition of Congress and the Supreme Court. Should there be a constitutional amendment to decide the question once and for all, I would suspect there would be exit by the losing side.[24]

One of the problematic correlations in the empirical literature is that civil rights are so tightly linked with GDP per capita. Most economists have waved their hands about this relationship, not really able to offer any explanation for why this might be so. (In general, the arguments take two forms: a society cannot be rich without rights, or a society cannot have rights until it is rich.) The above scenario does suggest that there may be societies (ones with meddlesome preferences) that are

[24] Of course, not all collective choices lend themselves to frequent reversals. There may be a first-mover advantage in laying down policies that are difficult to change. On the other hand, if a group in power tries to set its preferred choices in stone, that itself might induce exit.

not rich enough to be liberal. Attempts to grant liberties would lead to instability. Outside efforts to force such societies to become liberal might generate enough instability that the societies would never become rich enough to sustain a liberal state!

### 5.3 Alternative Production Functions

To this point, I have developed the model of other-regarding behavior assuming a world where coalitions have no productive capacities beyond the sum of their parts. It does, however, make a difference to worry about coalitions that themselves have gains to economic cooperation. With other-regarding preferences, coalitions with the *same* preferences may prove to be unusually difficult to satisfy, because they would not have to sacrifice in the cultural dimension were they to exit. In Appendix B, I illustrate the problems for political stability under two sets of assumptions: anonymous production functions, and production functions that are correlated with preferences for house color.

The results are particularly interesting where productivity is type-dependent. The analysis suggests that if there exists a group of a certain type that has an economic advantage (at least in exit), there is a wide range of parameters for which this economic advantage translates into control over political outcomes (see Appendix B). Where it does so, however, income distribution may not look as unequal as at first we might suspect. Rather, income distribution is highly unequal under circumstances in which the economic exit values are unequal but the cultural decisions change with those in power. There is more redistribution towards the economically disadvantaged when the economically powerful also control the cultural choice. This result suggests that democracies with significantly skewed asset allocations are likely to remain highly unequal in *ex post* distribution of economic goods. By contrast, stable dictatorships and oligarchies would have to redistribute *more* towards those not favored in the cultural collective choice to maintain stability. These results have anecdotal support as well. Income distribution in authoritarian Indonesia is considerably more equal than in democratic Thailand, and income distribution for Thais has become less equal since Thailand became a democratic society.

## 6 Conclusions

The model developed here offers considerable flexibility in parameterizing a range of stylized societies. But the parameters are not without real-world intuition, and the comparative statics offer empirically testable predictions. The results suggest that liberalism might be a luxury good whenever there is diversity of cultural preferences in conjunction with other-regarding behavior. In cultural dimensions where there is low substitutability with economic goods, allowing groups with all preference types potential access to power might be the only way for societies to accommodate such other-regarding behavior. With utility functions that are only self-regarding, quite the opposite is true. Liberalism is cheap. It is the collective choices that are costly, and diversity might therefore be the luxury good.

Income distribution matters, but not in the simple way one might expect. Patterns of land ownership ought to generate different empirical relationships with political stability than other forms of wealth. In countries where only a few own most of the land, redistributive efforts are likely to face great difficulty, because the elites cannot take their source of wealth with them. Where land is held by many, in a relatively even distribution, the prospects for stability should be better than for mobile forms of wealth. In culturally diverse societies when only one group has power, net income distribution must favor the disenfranchised groups, for stability to be maintained.

The model has identified circumstances in which there is a correlation between economic clout and cultural outcomes, as well as several other important socio-politico-economic relationships that have not been explored up to now. The literature has long recognized that cultural differences can be problematic for political stability. My model offers new intuition for how such conflicts might be ameliorated, and when they might never be.

Furthermore, I have established an intuition for modes of exit that might substitute for political violence and therefore that violence may result when these other avenues are closed. Given that most countries of the New World had closed their doors to immigration by 1930, (and many prior to World War I), we imagine that such restrictions may have contributed to the instability in Europe. At the same time, it suggests that the massive emigration at the turn of the century was indicative of problems far earlier. Given that most empirical tests of instability have used violence as the dependent variable, the model strongly recommends additional explanatory variables for such tests: measures of the options in all other forms of exit. Alternatively, one might look to socio-political factors, not just relative wages, in explaining migration flows.

In short, this paper offers a new way of looking at politico-economic choices that individuals make. I hope to develop this insight in future research through further modeling, empirical tests, and applications to case studies.

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## A The Value of Cooperative and Noncooperative Equilibria

As with many repeat-play games, the question of maintaining a more "cooperative" equilibrium in this context is one of current temptation versus future punishment. In this case, the temptation is always to grab all the cake when one is in power, instead of sharing equally with one group or perhaps both other groups. I assume that the game is played infinitely and that each of three groups has a $\frac{1}{3}$ chance of being in power in any period. Members of the groups all have the same exit value, and each group is the same size. In general, "grim trigger" punishment strategies, where punishment consists of non-cooperative behavior from period $t = 1$ onwards, provide the most effective deterrent against current temptation. That is, all will continue to share cake among groups as long as other groups do the same. Observing that the group in power has grabbed any more will result in infinite punishment—in the form of equally unequal cake divisions.

First, we can dispense with any strategy that gives the group with its *least* favorite color the majority of the cake. It turns out that an equal division of cake, or even one where those in power take all the cake, will generate higher expected utility than one where those in power give most, or all, of the cake to the worst off in the cultural dimension. So the temptation to cheat, followed by punishment that everyone will take all the cake when in power, is always of higher expected utility than trying to placate the worst-off group.

Alternatively, groups could play a strategy where those in power share the cake equally with the group whose second-choice color is their own first choice. Then the expected utility of "cheating" and taking all the cake (followed by an infinite series of such strategies) is:[25]

$$EU(cheat) = [1 + \frac{3C^\gamma}{N}]^{\frac{1}{\gamma}} + \frac{1}{3\delta}\{[1 + \frac{3C^\gamma}{N}]^{\frac{1}{\gamma}} + \frac{1}{2}\} \tag{31}$$

$$EU(cooperate) = [1 + \frac{3C^\gamma}{2N}]^{\frac{1}{\gamma}} + \frac{1}{3\delta}\{[1 + \frac{3C^\gamma}{2N}]^{\frac{1}{\gamma}} + [\frac{1}{2}^\gamma + \frac{3C^\gamma}{2N}]^{\frac{1}{\gamma}}\} \tag{32}$$

Which of these offers higher expected utility depends on $\gamma$, $C/N$, and $\delta$. Figure A.1 illustrates the upper-bound values of $\delta$ for which the cooperative equilibrium can be sustained for a range of $\gamma$ and $C/N$. Where $\delta \geq 0.4$, the values have been cropped to 0.4, so that the picture is readable. Along the ridge where $\delta$ is high, the spikes rise as high as $\delta = 2$, but they reflect individual points.

Alternatively, players could try to divide the cake equally among all members of society in every period. Then the relevant calculus is between:

$$EU(cheat) = [1 + \frac{3C^\gamma}{N}]^{\frac{1}{\gamma}} + \frac{1}{3\delta}\{[1 + \frac{3C^\gamma}{N}]^{\frac{1}{\gamma}} + \frac{1}{2}\} \tag{33}$$

and

$$EU(cooperate) = [1 + \frac{C^\gamma}{N}]^{\frac{1}{\gamma}} + \frac{1}{3\delta}\{[1 + \frac{C^\gamma}{N}]^{\frac{1}{\gamma}} + [\frac{1}{2}^\gamma + \frac{C^\gamma}{N}]^{\frac{1}{\gamma}} + [\frac{C}{N}]\} \tag{34}$$

Figure A.2 illustrates the maximum level of discounting under which a cooperative equilibrium can be maintained. With the exception of a strange spike in a very poor society ($C/N \approx 0$), $\delta$ would have to be implausibly low. Even so, one might argue that discount rates are even higher in such poor societies, such that the current temptation to cheat will always be too much.

In general, it seems unreasonable to believe that $\delta$'s are less than 0.10, and perhaps are at least 0.20 in a very poor society. Only in knife-edge situations can a cooperative equilibrium (usually one which is only partially cooperative, as in case

[25] Recall that the infinite series $\sum_{t=1}^{t=\infty} \frac{1}{(1+\delta)^t} = \frac{1}{\delta}$.

A) be sustained with a $\delta > 0.20$. These results suggest that for most combinations of cake and elasticity of substitution, players will be unable to maintain such a cooperative equilibrium.

Figure A.1: Largest Delta to Maintain Cooperation, Case A

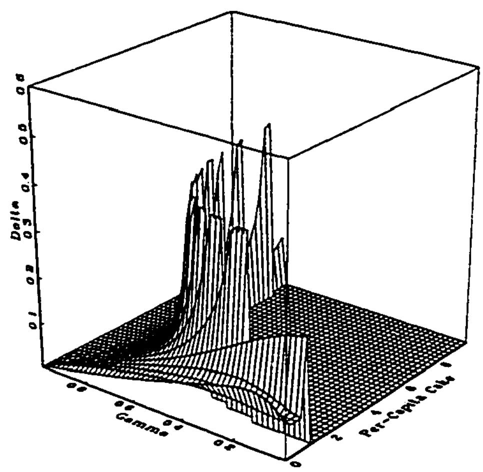
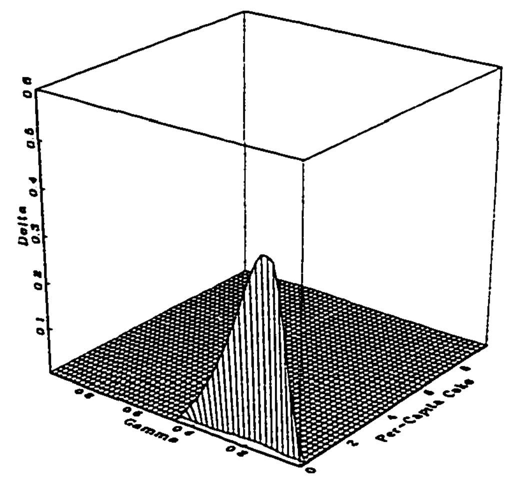



Figure A.2: Case B




## B Alternative Production Functions

There are two avenues of exploration for modeling productive proper coalitions. First, the degree of convexity of the production technology will be important to the possibility of stability. In this scenario, I assume that productivity does not depend on the identity of the members of the coalitions, only on the size of the coalitions. But more interesting results come from a situation in which productivity is correlated with preference-types. Both are explored below.

## B.1 Anonymous Production Functions

Figures B.1 and B.2 assess the relative value of coalitions for two anonymous production functions. The results with other-regarding preferences are not unlike those for self-regarding preferences.[26] What is interesting is that the most problematic coalition—that of $\chi_1 \cup \chi_2$—does *not* do best to rotate power. It is better for the coalition to fix the cultural choice as the first choice of one group and the second choice of the other. The optimal way to split the cake depends on $\gamma$, but the figures take a fixed division for all $\gamma$ to illustrate the point. If the technology is convex enough, small coalitions of a single type are not a threat to stability.

Figure B.1: Exit Options. $S^2$ Technology

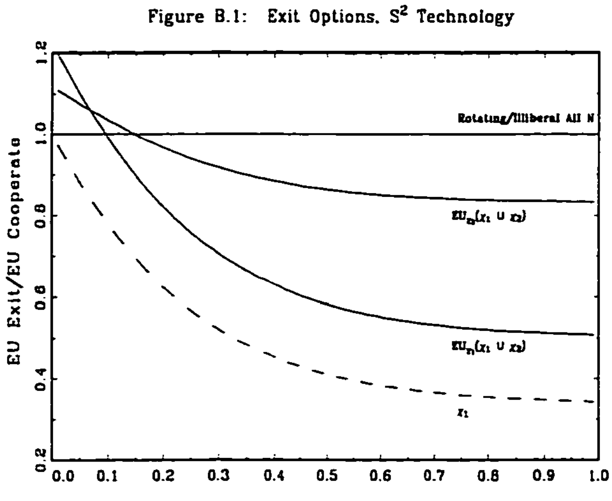
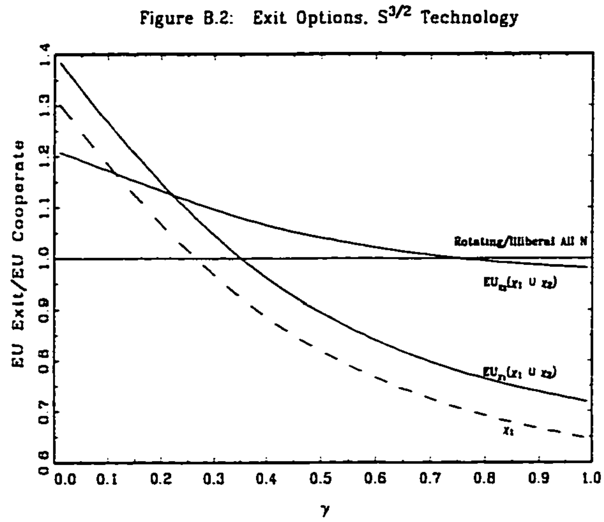



Figure B.2: Exit Options. $S^{3/2}$ Technology




## B.2 Type-Dependent Production Functions

More interesting is the case where productivity is not anonymous, but is correlated with preference types. If certain cultural groups owe their wealth to different types of productive activity, they will have different options. Alternatively, one could imagine a Becker-type model where certain social tastes develop within one's economic class. Figure B.3 illustrates the following scenario. For $\chi_1$, productivity is of the form

[26]The results look just the same as in the self-regarding case because the utility functions reduce to the same formula with illiberalism as with self-regarding preferences.

$V(S \subset \chi_1) = |S|^2$. For $\chi_2$, $V(S \subset \chi_2) = |S|^{3/2}$. For $\chi_3$, $V(S \subset \chi_3) = |S|$. To keep things simple, I will assume that there are no additional gains to any coalition of two types, such that $V(\chi_1 \cup \chi_2) = V(\chi_1) + V(\chi_2)$.

The asymmetry of exit options in the economic dimension changes the optimal power structure under certain circumstances. Figure B.3 shows that for very low values of $\gamma$, the easiest system to maintain as stable is one in which the power structure (and therefore the cultural choice) changes over time, but everyone agrees to divide the cake in the same fixed proportions each period—a "cooperative" equilibrium that had no particular value in the symmetric games. However, Figure B.4 illustrates that this cake division will be far from equal. The Gini coefficient hovers around 0.75, which in the real world translates to Brazil.

For all higher values of $\gamma$, the most stable system is a fixed, illiberal power structure that favors $\chi_1$[27] That is, amber will be the color of the houses (the first choice of $\chi_1$), and the division of cake will be fixed. Figure B.4 graphs the Gini coefficient for this regime, which for low and middle values of $\gamma$ is much less unequal than with a rotating power structure.

Figure B.3: Constraints with Type-Dependent Productivity

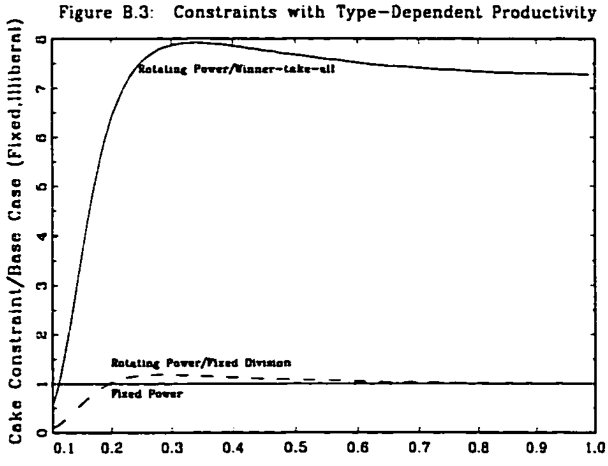
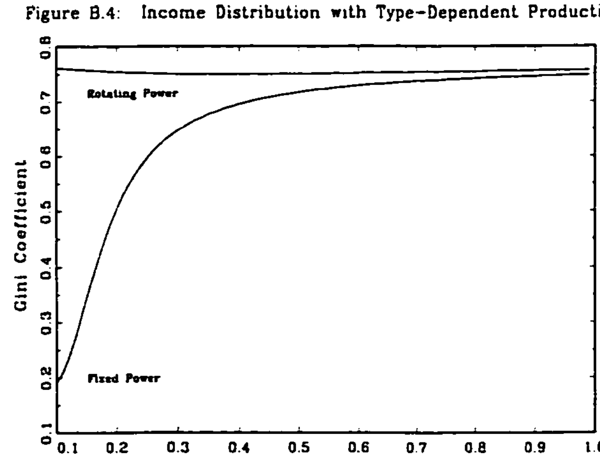



Figure B.4: Income Distribution with Type-Dependent Producti




[27]Actually, the power structure could be anything, as long as it is recognized that amber must always be chosen. Although those choosing the vectors may change, the outcomes do not; so $\chi_1$ is effectively in power all the time.

# Distributive Rules as Evolutionary Outcomes

## 1 Introduction

There is a classic problem in the social-choice literature that asks how to divide a cake among three individuals. The question is classic not only because of the historical importance of cake in social unrest (see Antoinette, 1789), but because it remains an open question as to how best to *answer* the question. In the cake-division problem are conflated three separate problems. First, there is the question of distributive justice, or whether the amount of cake each person receives is an equitable share. Second, there is the means by which the three individuals come to agree on the division, which is a question of society aggregating individual preferences into a collectively made choice. Third, there is a question of implementation, or whether the three individuals will reveal whatever information is necessary for the socially chosen division to be enacted.

Recently, philosophically-minded game theorists have investigated the possibility of an evolutionary answer to the question of cake division. The premise is simple: if dividing the cake equally offers differential evolutionary fitness, individuals who choose such an egalitarian strategy will become more prevalent in the population, and thus a "norm" of equity emerges in the society. I take the insights on the evolution of norms as fundamentally sound, but reject the notion that the individuals are the strategic actors of interest. Rather, I suggest that the *societies* are the ones who choose the rules of the game, and therefore the distributive outcomes. The model developed here allows societies to gain differential advantage by choosing distributive rules that foster political stability, and therefore economic growth. Over time, the successful rules promote growth and development, and become global norms of distributive justice.

The model offers positive, predictive theory on the cake-division problem. This proves to be unusual, in that previous approaches to the question have had difficulty actually predicting how the cake will be divided. The reason is that for each of the three problems mentioned above—distributive justice, preference aggregation, and implementation—there remain unresolved issues. Consider the question of distributive justice. We have no consensus from an ethical or philosophical point of view that certain norms of allocation are *a priori* more fair or equitable than others. If there were such a consensus, then one might be able to argue that distribution should be according to what is fair. Philosophers offer rigorous argument in favor of their own form of distributive justice, but the arguments are premised on assumptions that are just as subjective. John Rawls offered a logical "proof" of the justice of his proposed distribution. He argued for a strongly egalitarian distribution of initial endowments, using a "veil of ignorance" argument to suggest that such outcomes were more just because individuals would themselves choose them (Rawls, 1971). Harsanyi (1977) showed, however, that the results presumed an implausibly high degree of risk aversion, and suggested that under more reasonable assumptions on risk tolerance, individuals would choose a utilitarian outcome, thus maximizing the size of the cake, irrespective of the division.[1] The recent convolution of distributive justice and bargaining theory, which Barry (1989) describes as "justice as mutual advantage," has been more mathematically rigorous but has also offered contradictory prescriptions. See Roemer (1996) for a discussion of the arguments.

But if individuals disagree on the standards of justice, perhaps a social judgment

[1] Harsanyi's result was proved formally by Maskin (1978).

can still be made by aggregating individual preferences. A vast literature, starting with Arrow (1951), has developed to investigate the possibility of mapping individual preferences into a social-welfare function, from which distributive outcomes, as well as other choice problems, could be ranked. The problem is both philosophical and mechanical. Philosophically, we want the aggregation procedure to adhere to our normative constraints and take everyone's preferences into account, but to be useful it must offer a deterministic choice. Even if individuals have vastly differing ideas of "fair" outcomes, if the aggregation of preferences were to adhere to the normative principles, such as non-dictatorship, then the outcome according to the social rankings might satisfy our quest for a fair or just outcome.

Although the approach remains one of great intuitive appeal, a host of impossibility results suggests that we cannot have both deterministic social choices and all the normative features we desire (Arrow, 1951). The Arrovian approach focuses on the ethical appeal of the *process*, thus addressing the justice of the means of distributive choices, rather than ends. In a similar spirit, Nozick (1974) argues for justice through the preservation of individual rights, rather than the justice of the resulting distribution. But there is no universal acceptance of the proper process any more than of the proper result.

Finally, even if we could agree on what was fair, or find a social choice rule that was acceptable, we would have to find a way to make individuals express their preferences. The bargaining solutions on which recent philosophies have been based assume that threat points are common knowledge to all players. But more realistically, individuals will have to reveal information about themselves in order to share in the "mutual advantage" of the bargain, unless we develop a mechanism that divides the cake irrespective of individual traits. Consider the egalitarian bargaining solution, which splits the surplus evenly after paying everyone his reversion point. Players will have an incentive to claim a higher than actual threat point. If the reversion points are not known, it will always pay for an individual to claim his threat point is higher than it is, reducing the perceived surplus by the amount of his exaggeration, but increasing his resulting share by $(n-1)/n$ times the amount of the overclaim.

There are more sophisicated mechanisms that reduce this incentive to lie, but in general, implementation requires that individuals not only have differing characteristics such as threat points, but that those characteristics are tied to differing preferences. Moore (1992) offers an elegant exposition of the demands of truthful implementation. Early, and ubiquitous, impossibility results in the mechanism-design literature have had much the same impact as Arrow's did on the social-choice pursuit (Gibbard (1973), Satterthwaite (1975)). In general, truthful implementation, even where individuals can only be one of two types, turns out to be very difficult. Although having a social choice that *was* implementable would be helpful, simply being so should not afford the rule special status. We can always randomly select one person to take all the cake, leaving the other two with nothing. It is, in expectation, an equal division of the cake, and it is easily implementable. It does not, however, look promising as a distributive rule that would stand the test of time. On the other hand, a rule that can not be implemented is of no use at all.

Since we have not been able to pin down either what societies "should" do or what they "can" do, we are left without any foundation to say what they "do," in fact, do. We have very little theory that predicts the distributive choices that societies make.[2]

[2] Of course, we have much more theory about what the pre-tax distributive outcomes will be. Neo-classical economics would predict that individuals are paid their marginal product.

However, there has been a recent interest in answering this question from very pragmatic considerations. Philosophers and economists, with an eye on evolutionary game theory, have asked the following question: If *how* we play the games determines the payoffs, and payoffs represent "fitness" in the evolutionary game of survival of the fittest, then do social norms of conduct "evolve," in the same manner that physical traits do? The social choice literature has dipped into evolutionary biology to look at individuals playing games over time, to see if certain norms, or game strategies, generate better evolutionary fitness for the players. It turns out that distributional games are a natural starting point for this literature, because the outcomes (cake) can be mapped in a straightforward manner into physical well-being, and therefore survival.

Binmore (1990), Skyrms (1997), Gibbard (1981), and Sugden(1986) have all investigated the evolution of social norms, and attempted to reach conclusions in various ways. What the approaches have in common is that the games are played as random pairings of individuals, as in Maynard-Smith (1982). The structure of the games is inherently non-cooperative, but also non-rational. The format is that individuals are matched against one another in random pairings. The individuals do not learn strategies, but are born with a strategy (ostensibly embedded in an inheritable gene.) But given the rules of the game, certain strategies will provide higher pay-offs, and those individuals will replicate themselves at a higher rate.

Sugden's focus is on social conventions, as opposed to distributional outcomes, and he starts from a coordination game—such as on which side of the road to drive—which obviously has two possible stable equilibria. Binmore is more on point, setting up a bargaining game over an economic good with decreasing marginal utility of the players. His game produces a utilitarian outcome, but if individual "fitness" is multiplicative across years, rather than additive as he assumes, the evolutionary result is the Nash bargaining solution, not the utilitarian one. Skyrms actually asks the cake-division question, with linear utility, and produces both an egalitarian outcome and a multiple-equilibria result, depending on the rules of the game.

In the above articles, there are at least four predicted evolutionary outcomes. The multiple results suggest a limitation to this approach in making predictions about distributive outcomes. The results depend on the game being played, much as the moths in pre-industrial England evolved white wings to blend in with the birch trees, and those in post-industrial, sooty, England evolved black wings to blend in with the grime. Consider, for example, the two versions of the divide-the-dollar game that Skyrms considers. In the first game someone chooses a share, and the other person can accept or reject the share. In the other game, the two players make simultaneous bids which they receive only if the sum of the bids is less than one dollar. In the first game, there are several possible strategies that could evolve. In the second game, the evolutionarily stable strategy is an equal split. Individuals may evolve to the best strategy for the game they are faced with, but how do we know which game they are playing? How do the games evolve?

The difficulty is that the games are set by society as a whole. Thus, the distributive outcomes are the result of a game, which is chosen collectively, paired with the strategies chosen by the individuals. In effect, then, the distribution itself is chosen collectively, because given the behavior of individuals that will evolve, the rules determine the outcomes. If we know that individuals who play Binmore's game will evolve a utilitarian strategy, then to collectively choose Binmore's game is to choose a utiliarian distributive rule. From Arrow's result, there are unanswered questions as to *how* a society will come to a collective agreement about a rule, but we know empirically that they do.

Whether a distributive rule will remain in place, and perhaps come to be more common, will depend on how successful it is. But how are we to judge "success?" Presumably, success should be judged by the same standards that individual strategies are judged by: the level of economic well-being that they provide. If the rule were to give all the cake to a random member of society, we have an intuition that such a rule might not last long, because the other members of society die when they have no food. In a less extreme form, we imagine that the other members of society revolt and want to claim their share, and such instability would stunt the growth process. At a minimum, distributive rules should foster stability.

An alternative to the evolutionary approach that focuses on the individuals is to look at the evolution of societies, as they provide differential "fitness" to their members. A society is a collection of individuals who agree to a "social contract" of the distributional game they will play. Societies do not evolve and pass on traits, but societies that promote economic well-being will allow their members to survive and multiply. The individuals that collectively choose successful rules will come to be more numerous than the individuals in the society with a failed social contract. Eventually, individuals in failed societies will either die out or join other societies. So over time, certain social contracts will come to be more prevalent, if they differentially advantage the individuals involved.

The distributional outcome of a game will be successful if the members of the society will agree to it *ex post*. In the first essay in this volume, I lay out the argument for defining the stability of a political system to be the acceptance by its members of the outcomes (Timmer, 1998a). More specifically, I assume that to be stable, a society must make individual members at least as well off, in terms of utility, as the members' next best options. It is unreasonable to assume that members of a society have no options other than those that the society gives them. Rather, being a part of a society has an opportunity cost, and thus the society should be thought of as an agreement to cooperate to make individuals better off. Stability, *ex post*, simply means success in making all the members better off than their exit option.

From this perspective on the evolution of distributive outcomes, the question is *not* what behavior evolves in individuals, but whether there exist distributive rules that are more likely to keep society functioning, in that the members continue to agree to cooperate. The continued cooperation promotes economic growth. A failure to maintain cooperation constitutes political instability, which stunts the growth process and could possibly dissolve the society. Even though a society is unlikely to dissolve completely when it fails to increase the well-being of its members, it may experience other sorts of behavior that can undermine its ability to prosper, such as black markets, work slow-downs, and rioting. Such societies will not have the level of economic growth of more stable polities (Barro, 1991), and will become smaller in economic share, if not in numerical frequency. Thus, the distributional rules that will come to dominate are those that minimize instability, as defined here. Rawls (1971) argued that the equal division of the means of production would be the most politically stable distributive rule. But his argument hinged on individuals in the society *feeling* that their allocation was fair, and therefore accepting the distribution. Here, the acceptance criterion is simply that of individual rationality, where individuals will choose more over less.

The logic of an individual-rationality constraint on social cooperation is clear, but if we know everyone's options, it is not a very interesting problem. All bargaining solutions divide the surplus above and beyond players' threat points, so there are many possible distributive rules that make everyone better off. In cooperative games, where both individuals and coalitions have threat points, the core is the set from which we start. Even after throwing out the distributive rules that don't choose a core allocation, we still have lots of options, and there will be argument over which point in the core we want.

The problem of interest has its roots in the impossibility of implementation discussed above. Individuals can not be relied upon to reveal their types, so it is not reasonable to expect that the exit options are known. We must, therefore, be working in a world of uncertainty. The question then is which kinds of rules actually do better, *ex post*, when implemented in an uncertain world. Faced with only expectations of individual and coalitional options, which social contracts are more likely to find the core?

This paper asks just that question of several cooperative game-theoretic solutions and bargaining solutions. For the most part, the solutions have foundations in the literature on distributive justice which justify their selection. The choices suffer from sample-selection bias, in that the rules are currently in favor, and therefore may themselves have been evolutionarily favored. Imagine all the distributive rules employed in now-defunct societies! One modern example is the Marxist rule, where distribution is according to need but production is according to ability to produce. It is obvious that such a rule, were it to be characterized formally, would lead to less stability than rules that are individually rational. But no one seems to be advocating Marxist principles as a useful distributive rule anymore.

The results of the analysis suggest that no one rule is always best. Given the selection bias it is no surprise that each of the distributive rules in the paper can offer the best prospect for stability for a particular array of exit options. If there were distributive rules that fared significantly worse, the societies that advocated them probably no longer exist. The analysis is, however, able to offer some predictions about the sorts of rules that might be prevalent. If every possible set of exit options is equally likely, a market-oriented distributive rule proves to be the most politically stable, as it also does when exit options are structured like income distribution in the United States. But if exit options are highly skewed, looking somewhat like the distribution of incomes in Brazil, a free-market outcome is not the most stable.

The paper is organized as follows. Section 2 lays out the framework for the societies and the rules of the game, so to speak, and discusses the distributive rules under consideration. Section 3 discusses the results of the bargaining-game formulation. Section 4 runs simulations for the cooperative games showing how such rules may or may not evolve as dominant norms. Section 5 draws some conclusions from the analysis.

## 2 The Model

In this section, I develop the formal model of the society and lay out the distributive rules I will consider. In general, the model uses a cooperative game-theoretic framework, and will be developed from that perspective. However, because of the usefulness of bargaining solutions to both philosophers and advocates of closed-forms solutions, I leave open the ability to translate my society into one of a bargaining game, and will discuss bargaining solutions below as well.

## 2.1 The Social Framework

My "society" is a simplified one. It is defined only by the collective agreement of all its citizens to cooperate economically. Thus, there are no institutions or other characteristics that define the group other than their continued agreement to act cooperatively. There is only one dimension to the allocational space.[3] Normally, I will consider the allocated good to be an economic one (cake), but there is no reason that the dimension could not be interpreted in other ways.

The basic premise is that there are gains to cooperation, realized in a larger cake to divide. Individuals, and small coalitions, can also produce cake, but the sum of production of any partitioning of the society will be less than the cake produced by all members acting together. The society will have a larger cake if its citizens continue to cooperate, a set of smaller cakes if the society breaks up into smaller coalitions. Rationally, individuals in the society will cooperate only if they receive as their distribution at least as much as they could produce for themselves.[4] If they do not cooperate, everyone will suffer economically.

More formally, the game is set up as follows. Define individual utility in the standard way: $U_i = f(x_i)$, with $f'(x_i) > 0$. If we want to be able to transfer utility directly among players—the case of *transferable-utility games* (TU games)—then utility must be linear in the good we have to transfer, which in a one-good world implies that the utility function is linear, or $U_i = x_i$. TU games are useful because the value of the cake to the society does not depend on how the cake is divided. If

[3]See Timmer (1998a, this volume) for a model of political stability that includes both an economic and a cultural dimension.

[4]I abstract here from the issue of emigration to another society. Although individuals can go off on their own, or form smaller societies with sub-groups from their own society, they can not join another existing society.

utility is not linear, the game is one of non-transferable-utility (NTU game), which does not mean that the *good* cannot be transferred, but only that the utility lost and gained in the transfer do not have to be equal. Therefore, the value of the cake produced—by society or by any coalition—will depend on how it is divided. In general, TU games are essential to analyze a cooperative game, while bargaining games are more suited to decreasing marginal utility of goods.

The collection of citizens, $N$, can be partitioned into smaller groups, $S_k$, of any size. Normalize the total amount of the economic good that the entire society can produce to 1, denoted as $V(N) = 1$. There is an allocation vector, $\{x_1, ...x_N\}$ such that $\sum_{i \in N} x_i = 1$. Each individual will also be able to produce some amount of the good, as will any size subgroup within a society. These values are denoted as $V(S)$, and represent the opportunity costs of cooperation. The set of values for all the coalitions is known as the *characteristic function* of the game.

These quantities are taken to be uncertain in general, but are known to the members of the coalitions. I assume that the productivities of the individuals, $V(i)$, are independent of one another, distributed with cumulative distribution function $F_{V(i)}(\cdot)$ and mean $E\{V(i)\}$. The values of the subcoalitions, of size S, $1 > S > N$, will depend on both the productivities of their members and an additional random component. For example, the productivity of the coalition of players 1 and 2, $V(1,2)$, is a function of $V(1)$, $V(2)$, and some measure of their own gains to cooperation, denoted $SV(1,2)$. The $SV(S)$s are also unknown except to the coalition members, but have a distribution $F_{SV(S)}(\cdot)$ and mean $E\{SV(S)\}$ which are common knowledge.[5]

[5]In what follows, I restrict the games to three players, which avoids having to think about sub-partitions of coalitions. The setup here would be consistent with larger coalitions, but would require ad hoc assumptions about the interaction of all the players.

The assumption that there are gains to cooperation for the coalition of all members of society is captured by the existence of a core to this game, at least in expectation. The necessary condition for the core to exist is that the game is *superadditive.* In this case, it is *expected* to be superadditive:

$$\sum_{k=1}^{K} E\{V(S_k)\} < V(N) \ , \forall S_1, ..., S_K \text{ that partition } N \tag{1}$$

If there were no core, there would not be any expected gains to cooperation for this society as a whole.[6] If the $SV(S)$s are positive, in expectation, then the subcoalitions are expected to be superadditive as well.

The uncertainty is over the "threat" points, defined here as the subcoalitional values. Societies must adopt distributive rules that are played under this uncertainty. The result of such imperfect information is that the location of the core is known only in a probabilistic sense. Although I know of no work that has looked at cooperative games with uncertainty, it is not unreasonable to define them simply in expectation. That is, the Nash solution with perfect information maximizes the product of gains; the Nash solution under uncertainty would maximize the product of the *expected* gains.

The outcome of the game depends on who gets what, and whether the individuals are actually better off with their allocations from the society than they would be on their own. I assume that individuals will cooperate if it is individually rational for them to do so—that is, if they receive more utility in cooperating than otherwise. It is not necessary to establish distributional rules for the sub-coalitions, since we can assume that if $\sum_{i \in S} x_i < V(S)$, those individuals will figure out some way to

[6]Superadditivity is not sufficient for a core to exist. The sufficient condition is that the game be *balanced* (see Moulin, 1988). For most of the games that follow, this should not be restrictive.

exploit that Pareto improvement. Therefore, our cooperation condition simplifies to the assumption that if we have actually selected a point in the core, cooperation occurs.

$$\sum_{i \in S} x_i \geq V(S) \ \forall S \subset N \tag{2}$$

The behavioral rules are simple. There are no threats made by coalitions for a certain share of the pie. There is no revelation game to discover outside options. The model does not seem to capture any of our ideas of battling political interests. But in fact, such games would not be useful, because of the implementation problem.[7] Only *ex post*, if a coalition really did not receive $V(S)$, would there be a credible threat that could be made, but it would have to be costly in order to be credible. Farrell (1993) shows that credible, non-babbling, cheap talk can occur only under the same circumstances as those where implementation is possible. In this one-dimensional game, individuals can credibly claim to deserve a larger share of the pie only by incurring actual costs. But these costs are precisely what we are trying to avoid as a society—the costly political statements such as rioting, emigration, black marketing, etc.

Therefore, only by choosing a core allocation can the society avoid costly renegotiation and instability. If all of the coalitional values were known with certainty, the distributional question would be one of social judgment, subject to the constraint of continued cooperation. But under uncertainty about the values of $V(i)$ and $V(S)$, there may be certain distributional rules that fare better than others in fostering continued cooperation. Societies have everything to gain in finding those rules that work best, precisely to avoid the costly instability of missing the core. In the sec-

[7] The cooperative games need transferable utility to be well defined, which does not produce the required "single-crossing property" for implementation (see Moore, 1992.) Cooperative solutions and bargaining solutions are implementable only when the threats are common knowledge.

tions that follow, I will assess the conditions under which the various distributive rules outperform their competition.

The maximand I am interested in is the *ex ante* probability that the allocation chosen is one that fosters continuing cooperation. Thus, the distributive solutions will be evaluated by the probability that all individuals receive a higher utility in cooperating than otherwise:

$$\Pr\left\{\sum_{i \in S} x_i \geq V(S) \;\; \forall S \subset N\right\} \tag{3}$$

Since this is just the probability of stability, the rules that offer the highest value for equation (3) will offer the best prospects for evolutionary success.

## 2.2 The Distributive Rules

Given that there are infinitely many possible ways to divide a cake, it will be useful to reduce the choices to those that seem both promising and ethically supportable. The goal here is to look at distributive choices that bear some resemblance to our normative views on distributive justice. The example used above—where one individual took all the cake—is not interesting because it neither seems like it would generate stability nor does anyone suggest that such a division would be fair.

There is a trade off, however, between the outcomes that are most tractable and those that seem to offer the best intutition for how societies function. The tractable solutions are the bargaining games, while the cooperative game-theoretic solutions have the best intuition.

### 2.2.1 Bargaining Games

Bargaining games are useful both for analytical simplicity and because their format has attracted philosophers. They are essentially cooperative games without mid-sized coalitions. (Likewise, cooperative games are really just bargaining games allowing cooperation among subsets of the bargainers.) I will assess four bargaining solutions under uncertainty, to provide an initial intuition for the model. I will consider the Utilitarian, Egalitarian, Nash, and Kalai-Smorodinsky bargaining solutions.

Let $v_i = v(i)$ be the "threat point," to use standard terminology. Here, $V(S) = \sum_{i \in S} v_i$ for $1 < S < N$, so that subcoalitions have no value beyond the sum of their members. Define for our game $I_i = V(N) - \sum_{j \in N \setminus i} v_i$. $I_i$ is the most an individual could claim of the surplus after paying off everyone else's threat values.[8] The solutions are as follows:

Nash Bargaining Solution

$$\max_{x_1, \dots, x_N} \prod_{i \in N} \{U_i(x_i) - U_i(v_i)\} \tag{4}$$

Kalai-Smorodinsky Bargaining Solution

$$\frac{U_i(x_i) - U_i(v_i)}{U_i(I_i) - U_i(v_i)} = \frac{U_i(x_j) - U_i(v_j)}{U_i(I_j) - U_i(v_j)} \quad \forall i, j \in N \tag{5}$$

[8] A more general definition of $I_i$ can be found in Kalai (1985).

Egalitarian Bargaining Solution

$$U_i(x_i) - U_i(v_i) = U_i(x_j) - U_i(v_j) \;\; \forall\, i, j \in N \tag{6}$$

Utilitarian Bargaining Solution

$$\max_{x_1 \dots x_N} \sum_{i \in N} \{U_i(x_i)\} \quad \text{or perhaps} \quad \max_{x_1 \dots x_N} \sum_{i \in N} \{U_i(x_i) - U_i(v_i)\} \tag{7}$$

The distribution vectors these rules prescribe, $\{x_1, x_2, ..., x_N\}$, will be evaluated for the likelihood they foster stability. Because there are no coalitions to worry about, the probability of stability reduces to the more simple probability that each individual is better off than his exit option:

$$\Pr\{U_i(x_i) \geq U_i(v_i) \;\; \forall i \in N\} \tag{8}$$

Since it is assumed that the $v_i$s are independently distributed, the above equation can be written as the product of the probabilities that each individual is made better off. Since utility is monotonically increasing in $x_i$, this simplifies to:

$$\prod_{i \in N} \Pr(x_i \geq v_i) \quad = \prod_{i \in N} F_{v_i}(x_i) \tag{9}$$

In the section that follows, these solutions will be evaluated in terms of their prospects for maintaining stability, under several assumptions about the nature of the games.

### 2.2.2 Cooperative Games

The more interesting dynamics come from cooperative games, where I will consider six distributive rules for allocating the unit of economic good in a cooperative game.

Three of the rules are the cooperative equivalents to the solutions used above—the Nash solution, Kalai-Smorodinsky, and the Egalitarian solution. In addition, I will consider the the Nucleolus and per-capita Nucleolus, which are highly egalitarian solutions, and the Shapley value, which is not well defined for bargaining games but has very nice properties in cooperative games.

The Nash and Kalai-Smorodinsky solutions have not previously been formulated to consider multiple "threat" or disagreement points. Although bargaining theory has evolved to consider multi-player disputes, it has not in general allowed for any cooperation among proper coalitions. (But see Hart and Mas-Colell, (1996) for an attempt to remedy this.) Here, I characterize both the Nash solution and the Kalai-Smorodinsky solution in terms that allow consideration of the claims of proper coalitions.

Below, I define each allocative rule and offer a short justification for choosing these particular rules for comparison.

<u>Shapley Value</u>

$$x_i = \sum_{0 \leq s \leq n-1} \frac{s!(n-s-1)!}{n!} \sum_{\substack{S \subset N \setminus i \\ s=|S|}} \{V(S \cup \{i\}) - V(S)\} \tag{10}$$

The Shapley value gives individuals a weighted average of their marginal contributions to coalitions and thus has plausible "efficiency" claims as a distributive rule. Moulin (1988) argues that the Shapley value is utilitarian in spirit—except that it focuses on the marginal, not the absolute, utility. Since the Utilitarian solution is indeterminate with transferable utility, it will be useful to have a solution that is, at least, utilitarian in spirit. Another argument in favor of using information on marginal contributions comes from Roemer (1994), who argued that failing to give individuals their marginal contribution may be considered a form of exploitation.

Perhaps the best reason to consider the Shapley value is that it is the only solution that depends solely on the marginal contributions, and thus it is the closest rule in spirit to a market solution. In general, we think of free-market societies paying members their marginal products, which is precisely what the Shapley value does. The Shapley value weights the marginal contributions to avoid the problem of convex technologies, where the sum of the marginal products is greater than the whole.

Nucleolus

$$\max\left\{\min_{S\subset N}\left[\left\{\sum_{i\in S} x_i - V(S)\right\}\right]\right\} \tag{11}$$

The nucleolus is egalitarian, and it is perhaps what Rawls (1971) would have argued for if he explicitly had addressed the fact that individuals come to the party with some hostess gift or other. It is a maximin program, maximizing the surplus over threat points of the minimal surplus to any coalition. It is as egalitarian a split of the *surplus* as possible, but it is a split of surplus and not an even split of the total, as in the pure egalitarian solution.

Per Capita Nucleolus

$$\max\left\{\min_{S\subset N}\left[\frac{1}{|S|}\left\{\sum_{i\in S} x_i - V(S)\right\}\right]\right\} \tag{12}$$

The philosophical argument in favor of egalitarianism has a long history, and it seems important to consider egalitarian solutions. Although the per-capita nucleolus has received almost no attention in the literature, the PCN is to my mind a more logical translation of the egalitarian bargaining solution than the more often used nucleolus. It is also a maximin program, but is concerned with the gains *per person*, rather than for the coalition as a whole.

Nash Bargaining Solution

$$\prod_{S \subset N} \frac{1}{|S|} \left\{ \sum_{i \in S} x_i - V(S) \right\} \tag{13}$$

Oddly, Binmore (1995) states that *no one* would argue that the Nash bargaining solution has any foundation in ethics. It has, however, been widely studied as the solution to a number of non-cooperative division games, whose rules have been justified as fair processes (Zeuthen (1930); Binmore, Rubenstein, and Wolinsky (1986); Rubenstein, Safra, and Thomson (1992)). The Nash objective function is essentially a compromise between an egalitarian solution and a utilitarian one, in that the function is concave—somewhere in between linear and lexicographic.

One of the strengths of the Nash solution is that it is invariant to affine transformations of the utility scale. But such invariance means that my attempt to weight the coalitional gains by their sizes is meaningless. So I can simplify the solution as follows:

$$\prod_{S \subset N} \left\{ \sum_{i \in S} x_i - V(S) \right\} \tag{14}$$

Kalai-Smorodinsky Bargaining Solution

$$\frac{\sum_{i \in S} x_i - V(S)}{V(N) - V(N \setminus S) - V(S)} = \frac{\sum_{i \in T} x_i - V(T)}{V(N) - V(N \setminus T) - V(T)} \quad \forall S, T \subset N \tag{15}$$

Gauthier (1986) advocated the Kalai-Smorodinsky solution, because he viewed the solution as one of ethically fair, proportionate "relative concession." The solution is similar in spirit to the Shapley value; it too focuses on individual monotonicity. That is, if an individual can claim a larger potential gain, the *actual* gain should be larger, proportionately. The difference is that the Shapley value considers what the individual does to raise utility prospects for all, whereas the Kalai-Smorodinsky solution considers what the maximum utility to the individual would be, subject to the individual rationality constraint of others. Here, there is no easy way to decide what these individual rationality constraints would be, because they would depend on the distributive rules of the sub-coalitions. Therefore, I will define $I_S$ as the 1 unit of economic good less the coalitional value of the other part of N. (Ideally, $I_S$ would be calculated using the partition of $N \setminus S$ that maximizes $\sum_{i \in N \setminus S} v_i(T \supset i)$, but if the game is superadditive in sub-coalitions, $N \setminus S$ will be that maximizing partition.) In the case of variably sized coalitions, equation 15 cannot generically hold without constraining the coalitional values. One possible way to capture the spirit of Kalai-Smorodinsky rule but avoid this problem, and the one I will use in what follows, would be to solve the following program.

$$\min_{S,T,\subset N} \left( \max_{S,T,\subset N} \left| \frac{\sum_{i \in S} x_i - V(S)}{V(N) - V(N \setminus S) - V(S)} - \frac{\sum_{i \in T} x_i - V(T)}{V(N) - V(N \setminus T) - V(T)} \right| \right) \quad (16)$$

This is just the same way that Rawls handles the problem with pure egalitarianism—if you can't equalize, you maximize the lowest element. Here, I want the equation to be equal for each two coalitions, so I minimize the maximal difference.

Egalitarian Solution

$$x_i = x_j \quad \forall i, j \in N \quad (17)$$

The pure egalitarian solution may seem obviously ill-defined for the purpose of my game here. I include it, however, not only because of the strong philosophical attachment, but because it is an extraordinarily simple rule of thumb that societies can apply without any information. If, under certain circumstances, it proves to work not too badly, then argument can be made that it may survive the evolutionary test despite not admitting any useful information with respect to stability.

The problem in evaluating these rules is that only two, the Shapley value and the Egalitarian Solution, have explicit solutions. Clearly, the PCN and Nucleolus are programming exercises, and it turns out that both the Nash and Kalai-Smorodinsky solutions have $\sum_{s=1}^{n} \frac{n!}{s!(n!-s!)}$ elements with only $n$ choice variables. So they cannot be characterized cleanly, without constraining the coalitional values to be some linear combination of each other.

Further complicating matters is the difficulty in assessing the probability of stability. Because the subcoalitions are not independent from their members, the probability of stability is not merely the product of the probabilities of success for the individual coalitions, but:

$$\Pr\{stability\} = \bigcap_{S \subset N} \Pr\{\sum_{i \in S} x_i = V(S)\} \tag{18}$$

The solution to the above does not necessarily have mathematically tractable form. Given the difficulty in evaluating the cooperative game solutions, it will be useful to return to the bargaining games to develop the intuition of the model. Then, in Section 4, the cooperative games will be evaluated by numerical simulation, sinced closed-form solutions are not possible.

## 3 Bargaining Games

Bargaining games share a common philosophy with cooperative games, but they are appropriate models under circumstances that differ in two ways. First, bargaining games do not offer any role for coalitions other than the coalition of the whole, so they are not useful when we might be specifically interested in groups of players getting together to improve their outcomes. Second, bargaining games *do* allow for various utility functions of the players to be considered, which is difficult to do with cooperative games. In fact, bargaining games are not well suited to transferable-utility formats, because the utility-possibility frontier is linear. All bargaining solutions will prescribe the egalitarian outcome (an equal split) under these circumstances.

Therefore, it will be necessary to choose a non-linear utility function for the players. A useful form of the game uses log-utility: $U_i(x_i) = ln(x_i)$. Remembering that the total amount of the good has been normalized to 1, the solutions for log-utility games are as follows:

<u>Nash Bargaining Solution</u>

$$x_i \ln \frac{x_i}{v_i} = x_j \ln \frac{x_j}{v_j} \tag{19}$$

<u>Kalai-Smorodinsky Bargaining Solution</u>

$$x_j = \frac{1 - \sum_{i \in N} v_i + v_j}{N - (N-1) \sum_{i \in N} v_i} \tag{20}$$

<u>Egalitarian Bargaining Solution</u>

$$x_j = \frac{v_j}{\sum_{i \in N} v_i} \tag{21}$$

<u>Utilitarian Bargaining Solution</u>

$$x_j = \frac{1}{N} \tag{22}$$

It does not matter which of the two versions of the utilitarian solution we use, because the solutions are identical. The Nash solution can be characterized only implicitly, so it is not easily comparable to the others. However, it is possible to illustrate numerically the probability of stability under the Nash solution, the results of which follow.

### 3.1 Uniform Distribution

Consider a mathematically tractable case where $v_i$ is distributed uniformly over $[a_i, b_i]$, with constant variance. For nice interior solutions, assume that $b_i \geq 1/N \ \forall i \in N$. Also define the average bounds on the distributions as $\bar{a} \equiv \frac{1}{N}\sum_{i\in N} a_i\,; \bar{b} \equiv \frac{1}{N}\sum_{i\in N} b_i$. Then, a little algebra reveals the following probabilities of stability, listed in descending order:

Egalitarian Bargaining Solution

$$\Pr(\cdot) = \left(\frac{1}{N}\right)^N \prod_{i\in N}\left(\frac{1-Na_i}{b_i-a_i} - \frac{\bar{a}+\bar{b}-a_i-b_i}{(b_i-a_i)(\bar{a}+\bar{b})}\right) \tag{23}$$

Kalai-Smorodinsky Bargaining Solution

$$\Pr(\cdot) = \left(\frac{1}{N}\right)^N \prod_{i\in N}\left(\frac{1-Na_i}{b_i-a_i} - \frac{\bar{a}+\bar{b}-a_i-b_i}{(b_i-a_i)[2-(N-1)(\bar{a}+\bar{b})]}\right) \tag{24}$$

Utilitarian Bargaining Solution

$$\Pr(\cdot) = \left(\frac{1}{N}\right)^N \prod_{i\in N}\left(\frac{1-Na_i}{b_i-a_i}\right) \tag{25}$$

The Utilitarian solution does poorly because it does not admit any information about reservation values (because of the logrithmic utility function.) It is clear that if everyone is drawn from the same distribution, $U[\bar{a}, \bar{b}]$, all the solutions will coincide. When the distribution parameters are individualized, the difference between the solutions is embodied in the third term, which averages to the same value for all the solutions, but has the highest variance in the Utilitarian solution. Thus, the product of these terms will be lowest for the Utilitarian solution.[9] The variance of

[9] The variance of the each component of the utilitarian solution is $\frac{N}{var(v)}^2 * var(a_i)$. The variance for the Kalai-Smorodinsky solution is $[\frac{N}{var(v)} - \frac{2}{2*var(v)-(n-1)*var(v)*(\bar{a}+\bar{b})}]^2 * var(a_i)$. For the egalitarian solution, the variance is $[\frac{N}{var(v)} - \frac{2}{var(v)*(\bar{a}+\bar{b})}]^2 * var(a_i)$.

the Egalitarian solution relative to the Kalai-Somordinsky solution comes down to a question of whether $N(\bar{a}+\bar{b}) > 2$, which is just the condition that there is expected superadditivity.[10] As long as cooperation is possible in expectation, the Egalitarian solution fares better than the Kalai-Smorodinsky solution. It is interesting to note that when we cannot expect gains to cooperation, the Kalai-Smorodinsky solution is ranked above Egalitarianism. This result suggests that in cases where stability is very unlikely, it is more important to be "proportionately" fair than to share equally. (Conversely, egalitarian solutions have a stronger advantage when the core is large.)

The Nash Solution actually outperforms all three of the above solutions, under the simplifying conditions stipulated above. The details of the number crunching can be found in Appendix A. The basic setup was to randomly draw games from a uniform distribution across the entire game space, as specified above (for example, that $b_i > \frac{1}{N}$.) Solving the probability of stability for each of the bargaining solutions indicated that Nash outperforms the other three by about one percentage point.

### 3.2 Lognormal Distribution

It seems unlikely that a society's priors would be so uninformed as to suppose that the threat points were uniformly distributed. More likely is that society has a fairly good idea of the threat points, but with some room for error. Consider the case where the threat points are distributed log-normally, with mean and variance common knowledge.

Although the probability of stability is not of much interest in equation form,

[10]To have expected gains, we need the sum of the expected values to be less than 1. $E(v_i) = \frac{a_i+b_i}{2}$, so $\sum_i E(v_i) = N * \frac{\bar{a}+\bar{b}}{2}$. Thus, superadditivity requires that $N(\bar{a}+\bar{b}) > 2$.

the rank orderings are, because they generally confirm the results of the uniform distribution above. The Nash solution always does the best, which is not surprising because the solution maximizes the product of the difference of log-utilities. Likewise, the probability of stability with log-normally distributed threat points will also be the product of a complicated function of the differences in log variables. What is interesting is that no one solution always runs second, but the Kalai-Somorodinsky and Egalitarian solutions trade off for second place. Again, the Utilitarian solution fares poorly.

Although these results are not likely to hold for all combinations of utility functions and distributions, I do not want to pursue all those possibilities here. Bargaining games are not the appropriate model of a political world. Hopefully, they offer some insight into the nature of the problem, but the important results will come from games that recognize the formation of proper coalitions.

## 4 Cooperative Games

Although the bargaining games above offer useful intuition about the nature of the problem, the real concern for stable societies comes from groups of individuals within a polity. Secessionist movements, rebellions, even underground economic activity are not merely the combined acts of individuals working on their own behalf. Instead, these are groups that perceive mutual gains to working together. In this section, I will assess the differential prospects for stability of cooperative-game solutions, which explicitly allow for gains to cooperation among subcoalitions.

Consider a three-member society. One reason is for simplicity. The possibilities are endless enough with only six sub-coalitions that it does not seem to add much to go to larger numbers of groups. But there is also more intuition from three-person games, if each "person" represents an interest group, an economic class, a religion, etc. In this way, the three "people" can be thought of as coalitions of like-minded individuals. Each group has some level of utility it can achieve by itself, in cooperation with one other group, and in full cooperation in the society. Again, the size of the cake is normalized to 1. I assume that the individual threat points, $V(i)$, are distributed log-normally. Each subcoalition has a value:

$$V(i,j) = V(i) + V(j) + SV(i,j) \tag{26}$$

The $SV(i,j)$'s represent the additional gains to cooperation of the two players. This value is also assumed to be distributed lognormally, with the same variance as the individual threat points. (Therefore, the values of two-person coalitions have a higher overall variance than do the values of single individuals.)

It is a rather arbitrary task to think about assigning values to all possible coalitions in a society. Because the distributive solutions do not all have closed forms, however, they can only be judged by defining the characteristic functions for the games. The only obvious focal point to start with is the symmetric game. Under symmetry, where $E\{V(S)\} = E\{V(T)\} \forall S, T \subset N \; s.t. \; |S| = |T|$, all of the solutions will yield the same distribution, that of $x_1 = x_2 = ... = x_N = 1/N$. That result is not particularly interesting, except to note that at least the solution coincides with the solution for maximizing the probability for stability as long as the distributions are also identical for coalitions of like size.

More interesting is to look at the asymmetric case, where the rules offer different allocations. No one rule is consistently better than the others, and none is consistently worse (with the exception of the Egalitarian rule, whose disadvantage is proportional to the skewness of the game.). Under the assumptions made here, it is easy enough to find $E\{V(S)\}$ such that each of the six rules offers a higher probability of stability than the other five. So if our societies have very precise information about the nature of their characteristic functions, it is reasonable to suppose that each of the rules could be the most successful, and that all rules would "survive" over time.

This outcome would seem to be a less positive result than we might hope for. If no one of these solutions has an unconditional advantage in assuring political stability, it seems we could not offer much in the way of normative advice. But these results beg the question of how often such distributions of coalitional values occur. If it is unlikely to have such a game as that for which the Nash solution is optimal, for example, that fact would offer support for the other solutions, at least relative to the Nash solution. More to the point, distributive rules are usually considered part of the social contract, which is more permanent than the characteristic functions are likely to be. Income distributions, population size, productivities, and technologies all change over time. Under the "veil of ignorance" of how our society will change, what social contract should we agree to in order to maximize the likelihood of stability and economic well-being over time?

There are an infinite number of games that could conceivably be played. I will look at the possibilities in three different ways. The first step, and probably most insightful, is to look at the entire game space, and select games uniformly and randomly from the space. Second, I will look at some theoretically plausible values for individual and coalitional values and draw games from a distribution around those values. The intuition here is that we may have some idea about the nature of the game we would play, but not complete certainty. Using these results, I will show how repeated games will lead to the dominance of certain distributional rules.

Still, the results suggest that which rules are "best" depends on the expected values of the game. To pin down the results even further, I will look at several sequences of games as the values shift from one distribution to another. These results help illustrate how certain rules may do well initially, but then fall out of favor as the world changes.

### 4.1 Replicator Dynamics

Evolutionary game theory uses "replicator dynamics" to model the increasing prevalence of successful strategy types. Here, it is a misnomer, because I do not allow my societies to die or to procreate. Instead, societies that foster stability allow for economic growth to proceed at a normal rate, while unstable societies stunt the growth process. Over time, my more successful societies will come to dominate the world economy.

Using a simple Solow growth model with no depreciation or population change, growth in the capital stock per capita will be:

$$\dot{k} = s \cdot f(k) \tag{27}$$

Assuming that savings is a constant fraction of current output, and that our production technology is simply $f(k) = Ak^{\alpha}$, growth in output per capita will be:

$$\frac{\dot{y}}{y} = \alpha s A k^{\alpha - 1} \tag{28}$$

In the more "optimistic" scenario, I assume that any instability results in current output equal to the coalition that was better off in exiting, a reduction from the optimal output from cooperation. The marginal return on that capital will be higher (because it is a smaller stock), but the overall growth in output relative to the previous period will be lower. Assume that the base rate of growth in a stable economy is 3%; then the unstable economy will have growth equal to:

$$\frac{\dot{y}}{y} = 3\% \cdot V(i,j)^{\frac{1-\alpha}{\alpha}} \tag{29}$$

where $V(i,j)$ is the exiting coalition. Recall that the overall cake is normalized to 1, so $V(i,j)$ will always be less than one, by assumption.

The above equation is really a best-case scenario, in that it assumes that although the society loses its gains to cooperation for a single play, the remaining members still invest and produce, so that stability may return in the next period. In a more "pessimistic" view, I will also show what happens over time if instability results in zero growth for the unstable year. The clear difference between the two assumptions is the costliness of instability, and therefore the advantage of having a more successful distributive rule. If failure is not very costly, then even bad rules can survive for long periods of time.

## 4.2 The Entire Game Space

First, I want to assess how these rules would fare if enacted in a world where there is really no information about how the coalitional values are distributed. Of course, in each period, the expected values will be known before implementing the rule, but how do the rules fare if the expected values are expected to have *any* value with equal likelihood? I assume that a core will exist in expectation, and that both the individual threat points and the superadditivity of each coalition are non-negative. The true values are assumed to be distributed log-normally, and each rule is assessed according to the probability of stability (Equation 18.) I have drawn 1000 games from the space and tabulated the probabilities of stability under each distributional rule. Each game drawn represents one time period, and the growth of the economies using a given rule is just a weighted average—by the probability of stability—of growth in the stable and unstable states. (I use these same 1000 games for each additional millenium, under the assumption that 1000 games is enough to characterize the distribution.) Appendix B offers the details of how the economies are calculated over time.

In Figures 1 and 2, I illustrate the results of games drawn from this space. Figure 1, the more optimistic scenario, plays out over 12,000 time periods. Figure 2, with more costly instability, has much more dramatic results in that time span. The results show the small, but non-trivial, advantage of the Shapley Value. Economists should not be surprised, since the Shapley value is the only rule that allocates according to marginal product. Thus, there is some support for the idea that market economies will come to take over the globe. Cameron (1989) places the beginnings of commercial trade at around 8000 B.C., so the timing is just about right!

### 4.3 "Real-World" Games

The above scenario assumes uninformed priors about the kinds of games society might be playing. It may be that the expected values of each coalition are not precisely known, but that we have some information to inform our selection of rules. If so, does that warrant a different choice than the Shapley Value? The short answer is there are worlds in which the market-oriented choice is not the best one. On the other hand, narrowing down the expected world still offer the Shapley Value a range of dominance.

Since I want to look at a random selection of games, I am drawing expected values from a distribution that itself has some expected value and variance. The expected values are all drawn from truncated-normal distributions. Once the expected values are drawn, the solution for each distributional rule can be calculated, and the probability that such a solution will actually lead to continued stability. For all of these games, I assume that the actual values are lognormally distributed around the expected values. Appendix B details all of the means and bounds of these distributions.

I have selected four scenarios that seem like they might be plausible, or at least have a connection to the real world.

**Scenario 1: Symmetric Game.** Each player, and each coalition of two players, has an expected value drawn from the same distribution.

**Scenario 2: Income Distribution in the United States.** Using data on income distribution from the World Bank (1996), I have made a rough calculation of the tercile pre-tax income shares in the United States and scaled these so that the overall gains to cooperation are the same as in Scenario 1. The pre-tax incomes are meant to be a rough indicator of the exit options for the players.

**Scenario 3: Income Distribution in Brazil.** As for the United States, distribution data for Brazil were used to estimate tercile shares, which were then scaled to the same level of gains to cooperation as the other scenarios.

**Scenario 4: A Political Game.** In this game, coalitions of two political groups only have value if they are adjacent on the liberal-conservative spectrum. Liberals and moderates can cooperate; liberals and conservatives cannot. The gains to cooperation between moderates and conservations and between moderates and liberals are not the same. An alternative interpretation is one of ethnic groups, where two of the three may have more ability to cooperate with each other than with a third group.

| Mean Expected Values | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 |
|---|---|---|---|---|
| E{E{V(1)}} | 0.15 | 0.032 | 0.016 | 0.15 |
| E{E{V(2)}} | 0.15 | 0.135 | 0.064 | 0.15 |
| E{E{V(3)}} | 0.15 | 0.284 | 0.370 | 0.15 |
| E{E{V(1,2)}} | 0.50 | 0.333 | 0.159 | 0.60 |
| E{E{V(1,3)}} | 0.50 | 0.630 | 0.772 | 0.20 |
| E{E{V(2,3)}} | 0.50 | 0.837 | 0.868 | 0.40 |

For each scenario, I solve for the six distributional rules. Each solution will offer a probability for stability. The societies evolve as in section 4.2 above. In general, the difference between the various rules is small, and becomes obvious only when the impact plays out over a long period of time. Figures 3–10 illustrate the results. For each scenario, I present the results in two figures: the more favorable growth scenario for instability and the more pessimistic.

Scenario 1 is illustrated in Figures 3 and 4. It is clear from Figure 3 that all of the rules fare much the same. In general, all of the probabilities are within a percentage or two of each other in their probability of stability. Of course, if the game is actually symmetric, each rule gives the same result, so the fact that the rules are all similarly successful should not be surprising. Under such a selection of games, we might not expect that anything interesting would happen over time. But the Shapley Value does slowly show its advantage. The results look very much like those for the entire game space, which they should, since the symmetric distribution looks not all that different from the uniform.

Figures 5 and 6 illustrate Scenario 2, which are games drawn from a distribution around income distribution in the United States. The actual game of the U.S. distribution is not won by the Shapley value, but by the Kalai-Smorodinsky solution. But clearly, the Kalai-Smorodinsky advantage is not robust to permutations of the game. If we knew for certain that the coalition values were expected to be the U.S. distribution, then we would choose KS, but if we only expect such a distribution, we would be better off to stick with a market approach.

Since there is no guarantee that the Shapley value is in the core, my intuition was that as income distribution became less equal, the Shapley value would do less well than those solutions that are always in the core, such as the per-capita nucleolus. Indeed, the advantage of the Shapley value does fail when the distribution becomes as skewed as in Brazil (Figures 7 and 8). The intuition might be that market-oriented economies do particularly well in fostering stability when the initial allocations are not too highly skewed. When assets are extremely unequal, a more "proportionate" rule, such as the Kalai-Smorodinsky solution, should be used. We should not be surprised given the stability of a market system in the United States that the Shapley value fares so well, but perhaps, given the increasing inquality in the U.S. over time, we should expect increasing political instability in the absence of changes to the distributional rules.

Scenario 4 further illustrates that when coalitional values are imbalanced, market-oriented rules are not as successful as the bargaining solutions. The political game allows one of the two-member coalitions to have negative expected gains to co-operation. The individual players have positive values, as do two of the three coalitions. Figures 9 and 10 illustrate the dynamics. Surprisingly, although the Kalai-Smorodinsky solution does marginally better, three rules (KS, Nash, and the Nucleolus) successfully compete for long periods. It is not surprising that the Shapley value does poorly, because the Shapley value will penalize the players who cannot cooperate together, even though that coalition would never form.

My intuition on these games suggests that in a world where everyone contributes positively to a society, a market solution will, in general, be the most stable solution. The exceptions are when the environment becomes too skewed towards any one group, or when there are coalitions that do not work well together. When there are coalitions that cannot have any value on their own, a solution which gives them a positive share of the pie will work better.

## 4.4 Sequences of Games

The Shapley Value seems to do very well under a variety of economically motivated games. Kalai-Somorodinsky seems better suited to non-economic environments and highly skewed distributions. But can we identify a point, as the scenario evolves from one to another, when Shapley loses out to the Kalai solution? I have set up three series of games which evolve from one scenario to another, in order to look at these dynamics.

First, in Figure 11, I start at Scenario 1 and end at the U.S. income distribution from Scenario 2. Each game in between is just a linear combination of the two. Each game is played repeatedly for 40 time periods, to allow for some differential growth, before moving on to the next one in the sequence. All the solutions do equally well in the symmetric game. At the very end, the Shapley value loses out to the Kalai-Smorodinsky. Figure 12 maps the probability of stability with the Shapley value relative to that for the Kalai-Somorodinsky solution. Shapley seems to have its biggest advantage in a world that is only half as skewed as the United States.

Figure 13 shows the evolution of the distribution from symmetric to that of

Brazil. The dynamics here are much clearer than for those in Figure 11. Initially, all the solutions are doing well, followed by a time when the Egalitarian solution quickly loses ground to the Shapley, Nash, and Kalai solutions. As the distribution skews further, the Shapley Value loses out too.

Figure 14 takes the U.S. distribution as a starting point but allows the gains to cooperation to gradually increase. (Since the game is normalized to 1, this shows up as a decrease in the coalitional values.) The intuition is that these gains result from economic growth in a market economy. The division of labor raises productivity and the gains to cooperation, but these gains do not translate into better outside options for the individual, precisely because of this division of labor. As the figure shows, growth is good for stability, which we knew (Londegran and Poole, 1990). More precisely, growth through division of labor is good for stability. Marx and Marglin argued it differently, but here division of labor is stabilizing. As all the distributional rules fare significantly better as the "economy" grows, egalitarianism "catches up" to the others. Market economies that foster the division of labor provide for increasing growth and stability, but at a certain level of economic well-being, redistributive transfers that generate more equality will not significantly decrease stability from the optimal solution.

Although it is beyond the scope of this paper, an interesting extension would be to allow growth to foster stability, as well as stability to foster growth, as in the simulations above. The differential advantage of distributive rules would be that much clearer when stability itself, through the growth process, brought an additional measure of stability.

## 5 Conclusions

It seemed like a simple enough question to ask: which distributional rules offer a greater probability of political stability? Although the answers were not so simple to find, the results are surprisingly clean. In general, more egalitarian solutions—the nucleolus, the per-capita nucleolus, and the pure egalitarian solution—are dominated by more proportionate solutions: the Kalai-Smorodinsky bargaining solution and the Shapley value. My priors strongly favored the quasi-egalitarian rules that select the center of the core of the games. The dominance of the Shapley value in the general case is perhaps the most surprising. Of course, looking at history for intuition might have led me to favor markets more. Given the fact that no one considers the Shapley value to have any ethical foundation, distributions based on marginal product are surprisingly common in the world. Perhaps we now have a new explanation why.

The story these numbers tell, at least as I interpret it, is as follows. In societies in which individuals have much the same productive capacity—for example, in traditional agricultural societies with little specific human capital—egalitarian solutions will do as well as any other and perhaps would be preferred if there were some degree of risk aversion. As these economies industrialize (and as Kuznets postulated), marginal products will diverge as workers enter different productive activities. Under these conditions, the optimal strategy is to pay a person his marginal product. The market economy emerges. As growth continues and the gains to cooperation increase, societies become more stable, but they also become better able to sustain equalizing transfers from the more productive to the less productive.

But more importantly, if income distribution becomes too skewed, the market system is no longer the most stable. The theory predicts that market-oriented systems will be the most viable at the beginning of the industrialization process. As asset ownership becomes concentrated, the social contract needs to move away from marginal products towards the "proportionate concessions" that Gauthier advocated.

It should not be surprising that as modern economies have developed, they have evolved towards welfare states.

Figure 1: Evolution in the Game Space; Favorable Scenario

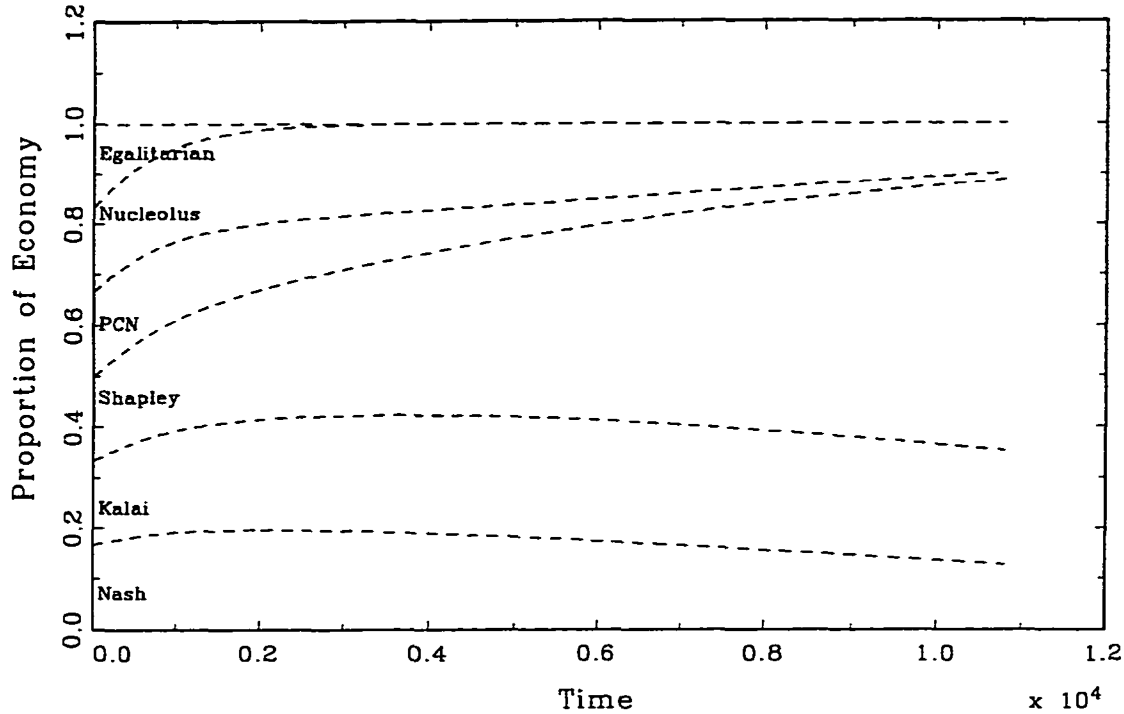



Figure 2: Evolution in the Game Space; Pessimistic Scenario

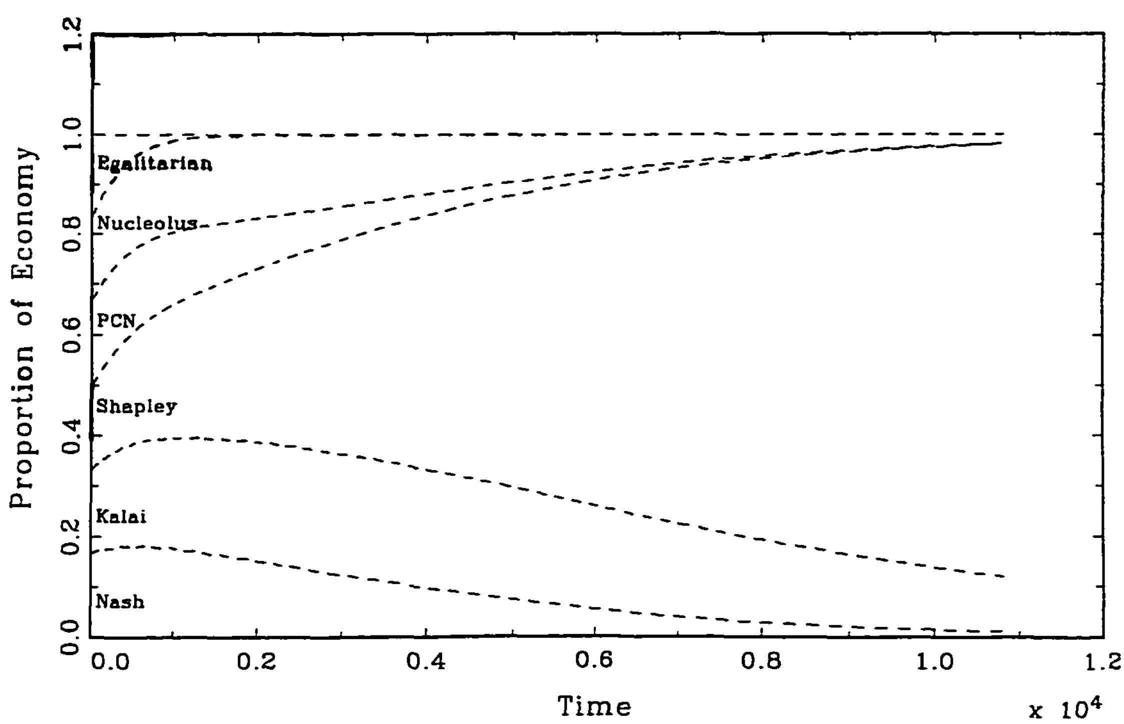


Figure 3: Evolution with Symmetric Values; Favorable Scenario

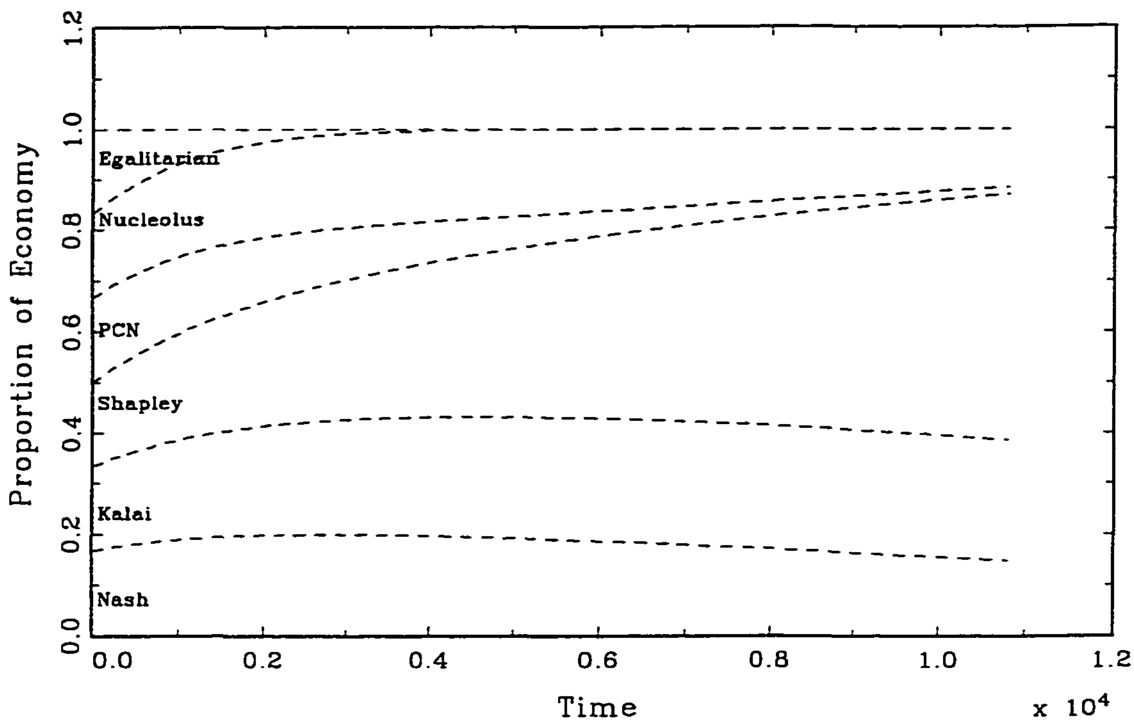



Figure 4: Evolution with Symmetric Values; Pessimistic Scenario

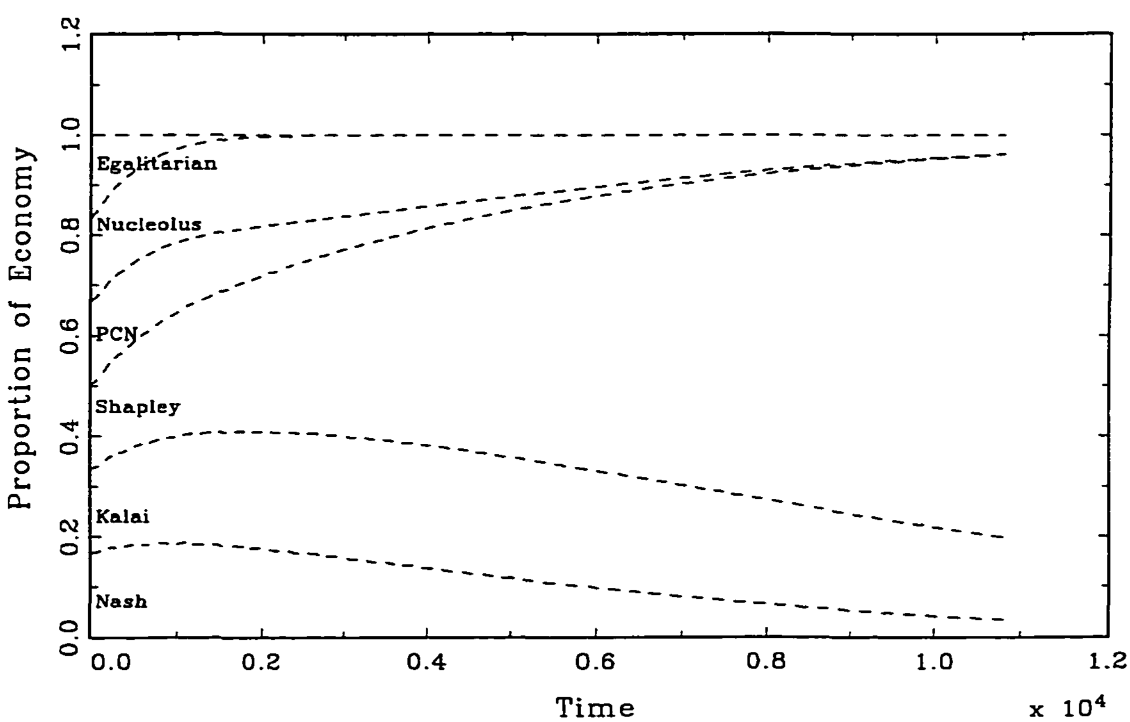


Figure 5: Evolution with U.S. Distribution; Favorable Scenario

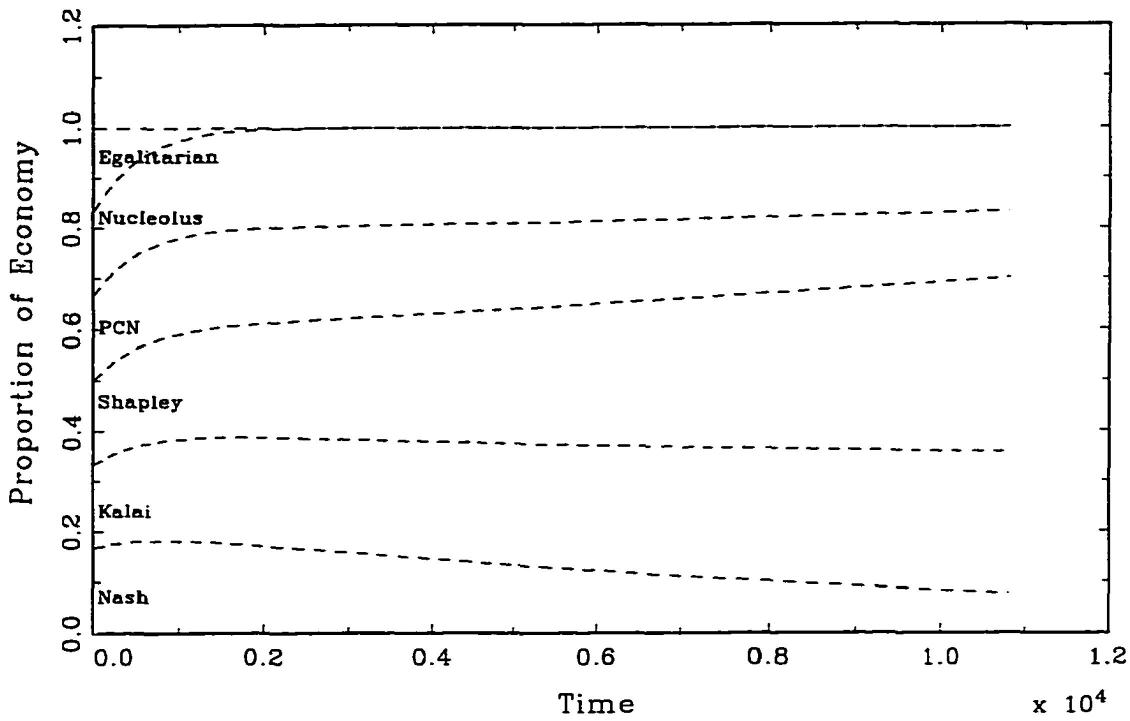



Figure 6: Evolution with U.S. Distribution; Pessimistic Scenario

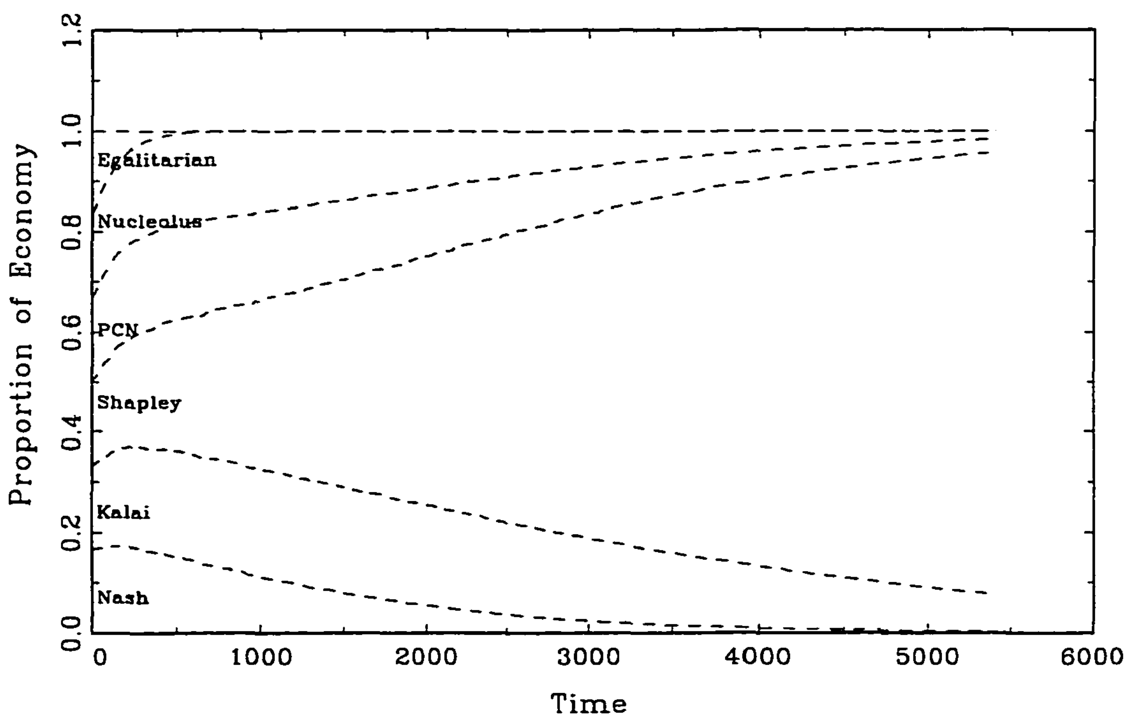


Figure 7: Evolution of Brazilian Distribution; Favorable Scenario

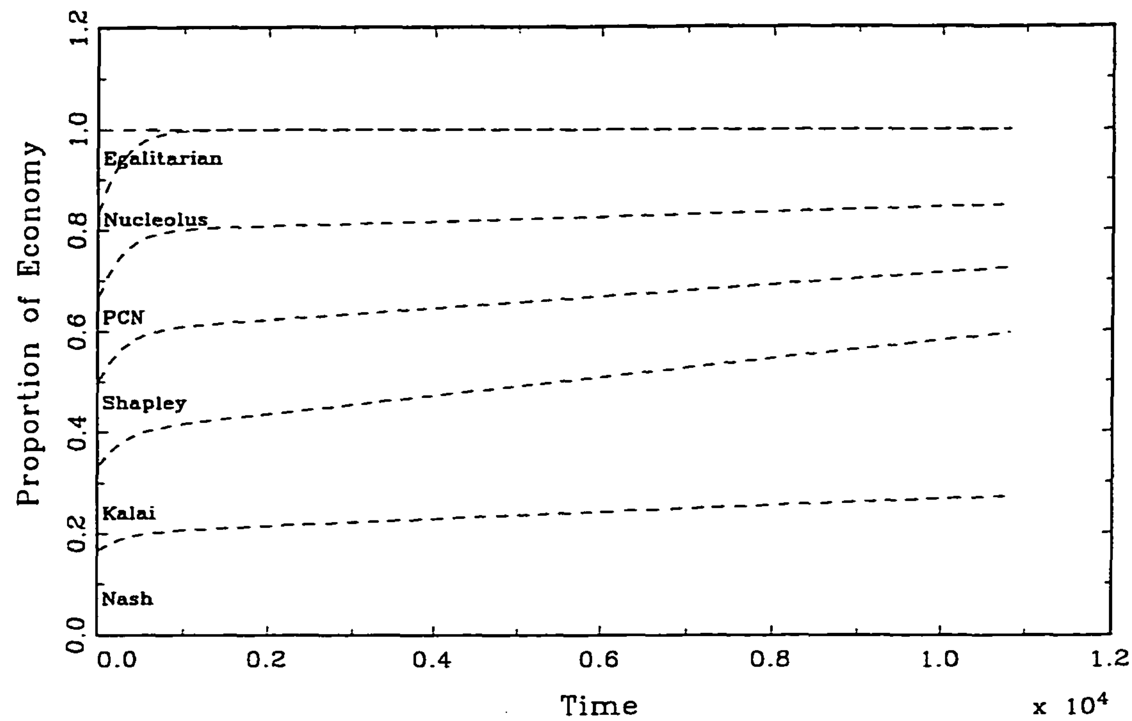



Figure 8: Evolution of Brazilian Distribution; Pessimistic Scenario

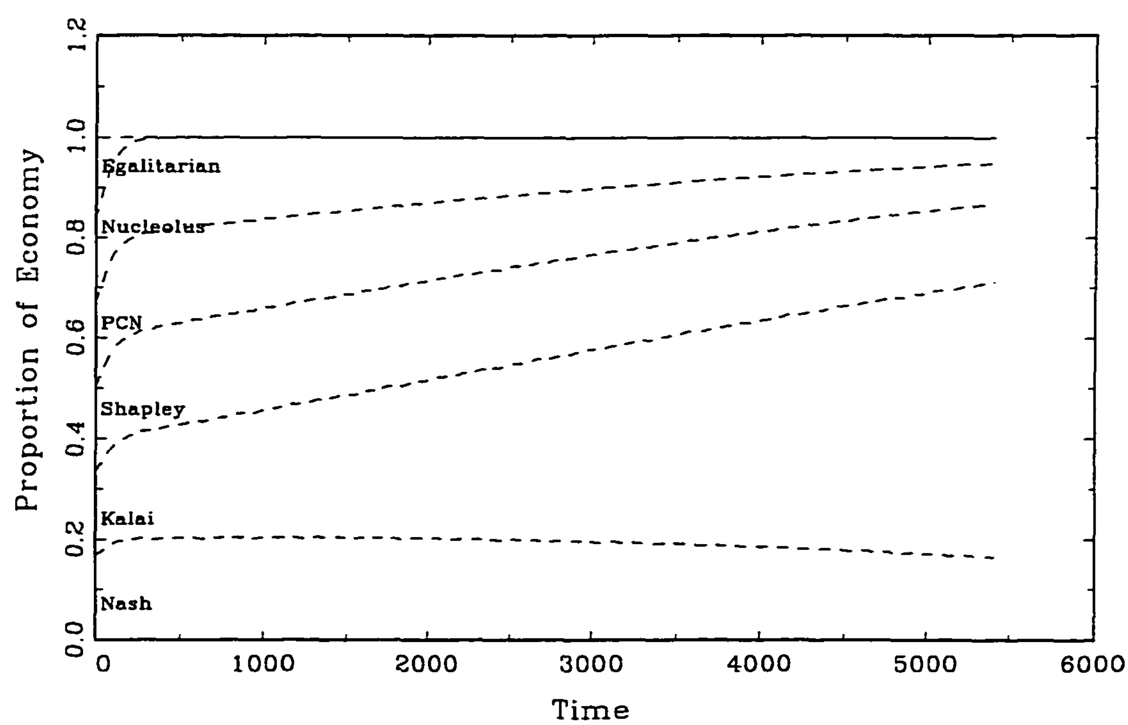


Figure 9: Evolution of a Political Game; Favorable Scenario

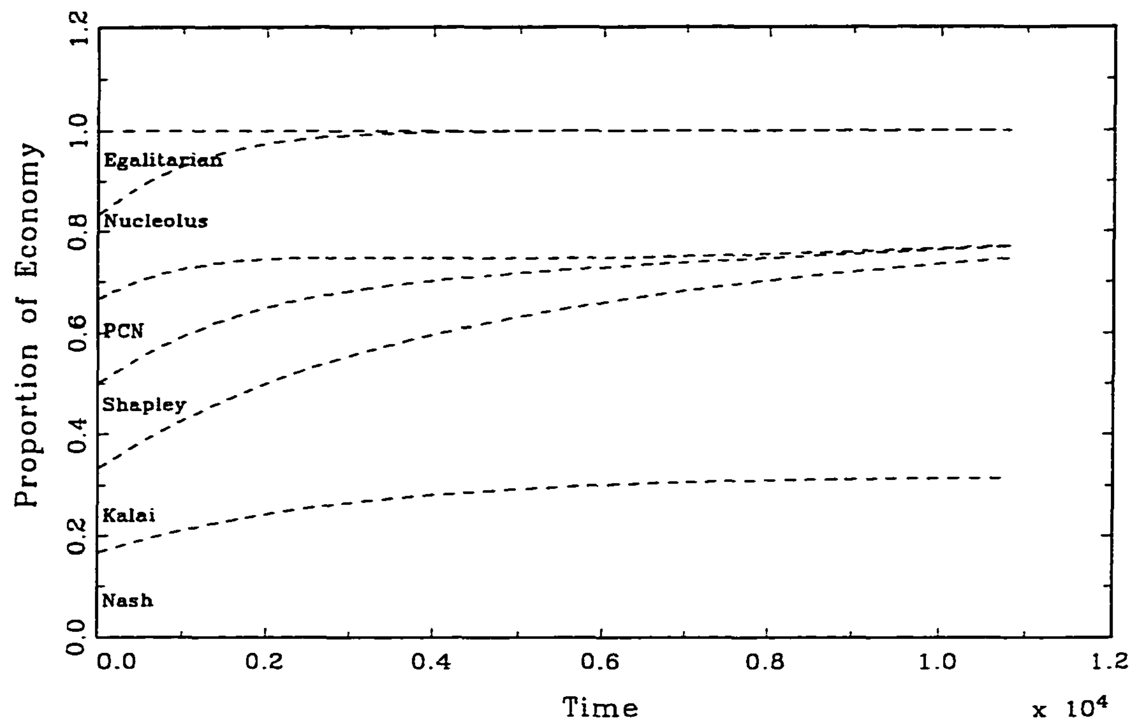



Figure 10: Evolution of a Political Game; Pessimistic Scenario

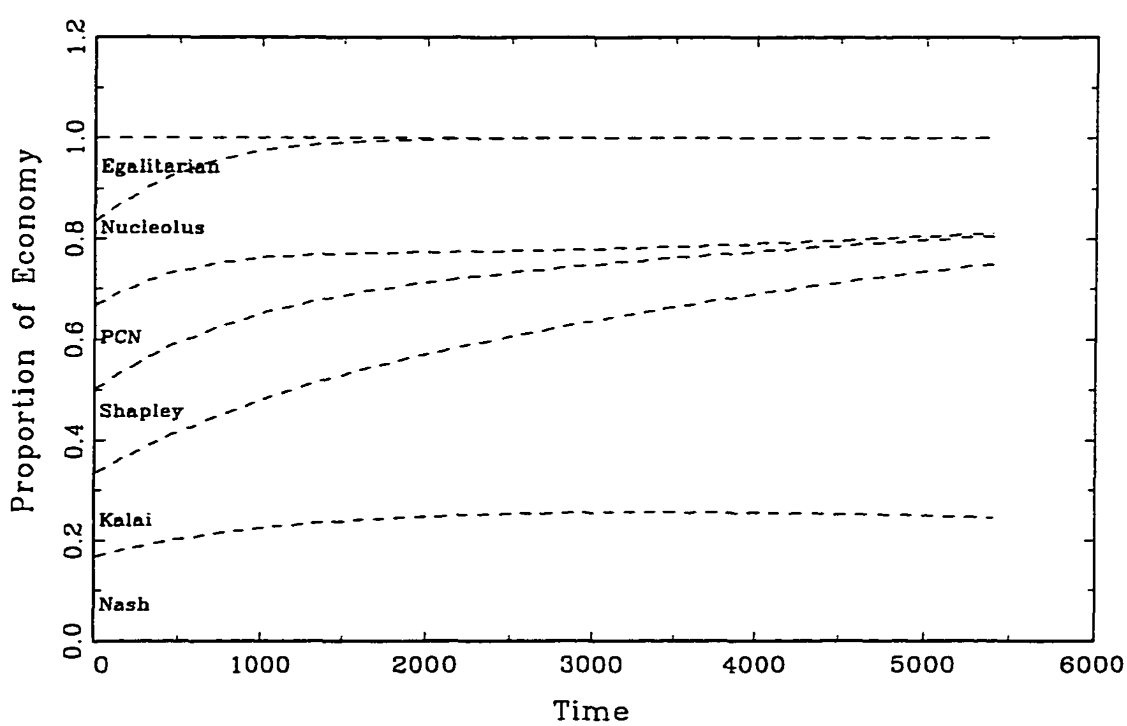


Figure 11: Evolution from Symmetric to U.S. Distribution

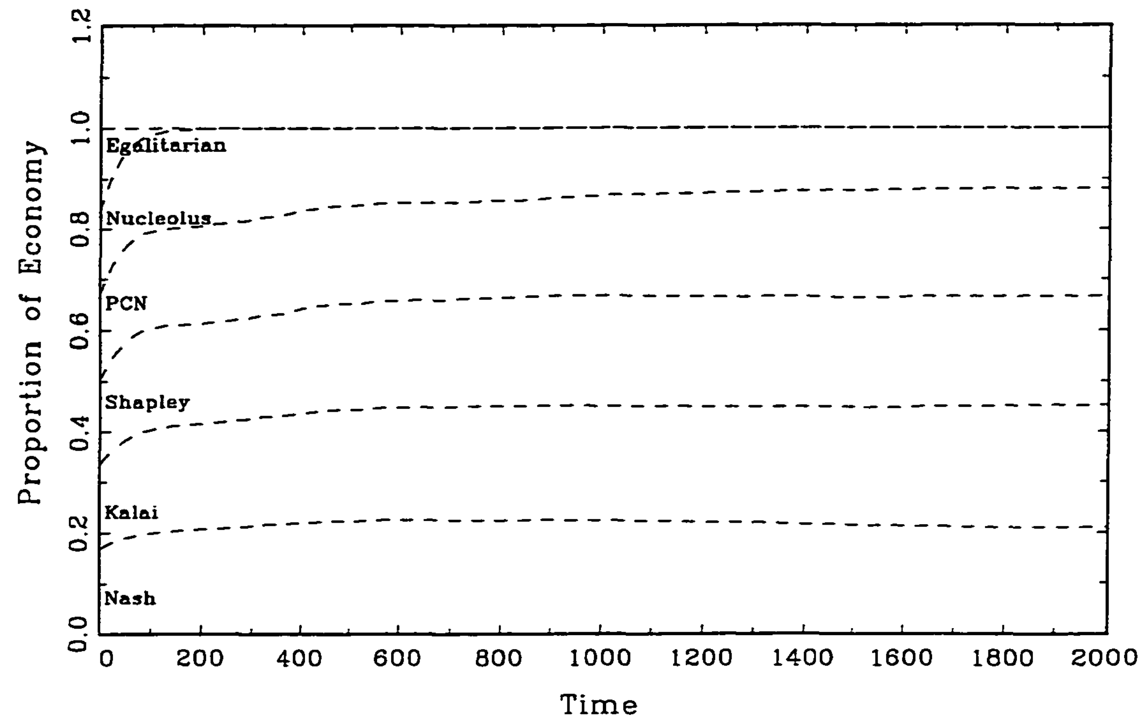



Figure 12: Evolution from Symmetric to U.S. Distribution

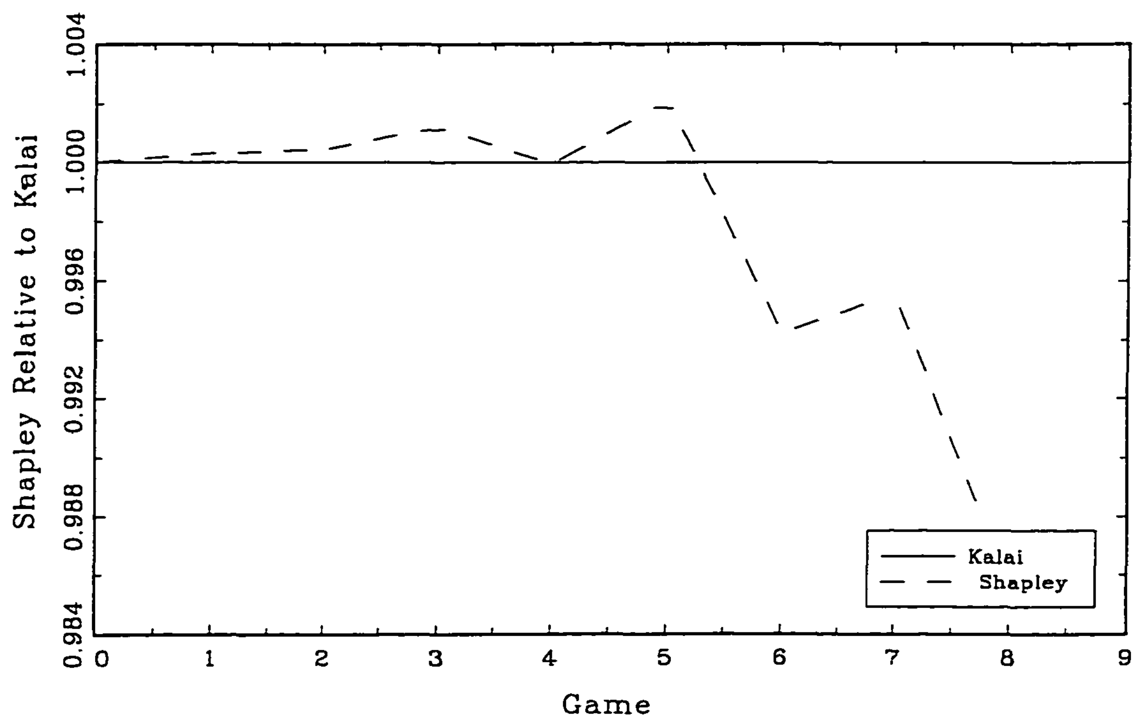


Figure 13: Evolution from Symmetry to Brazilian Distribution

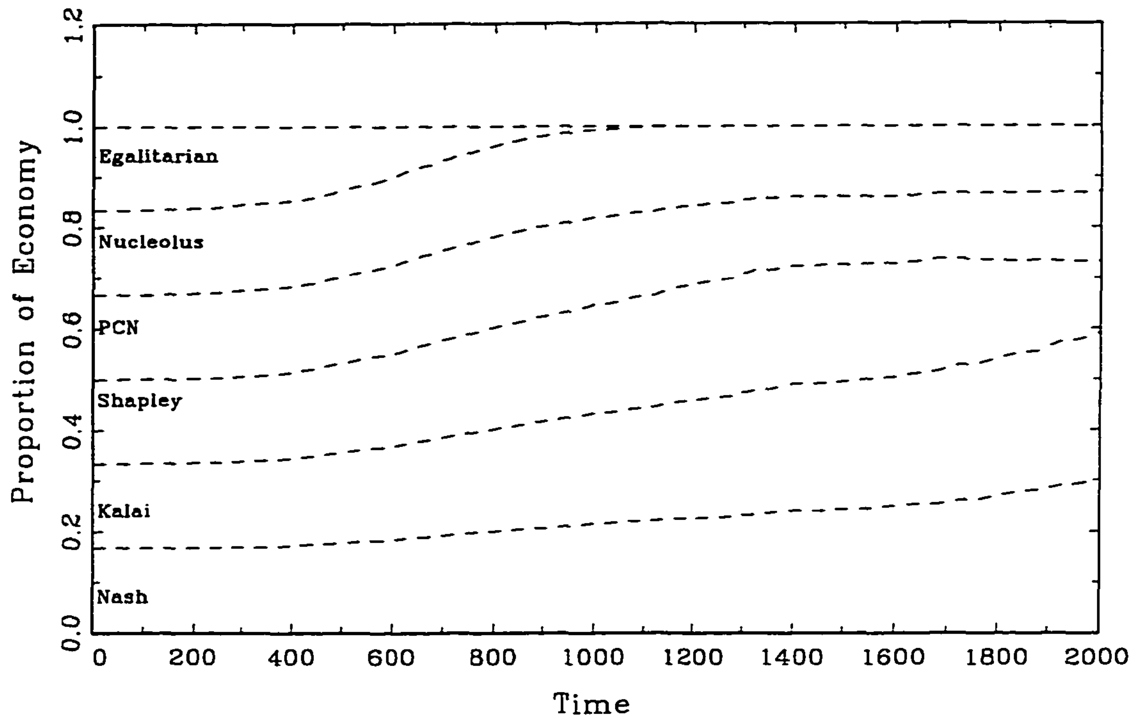
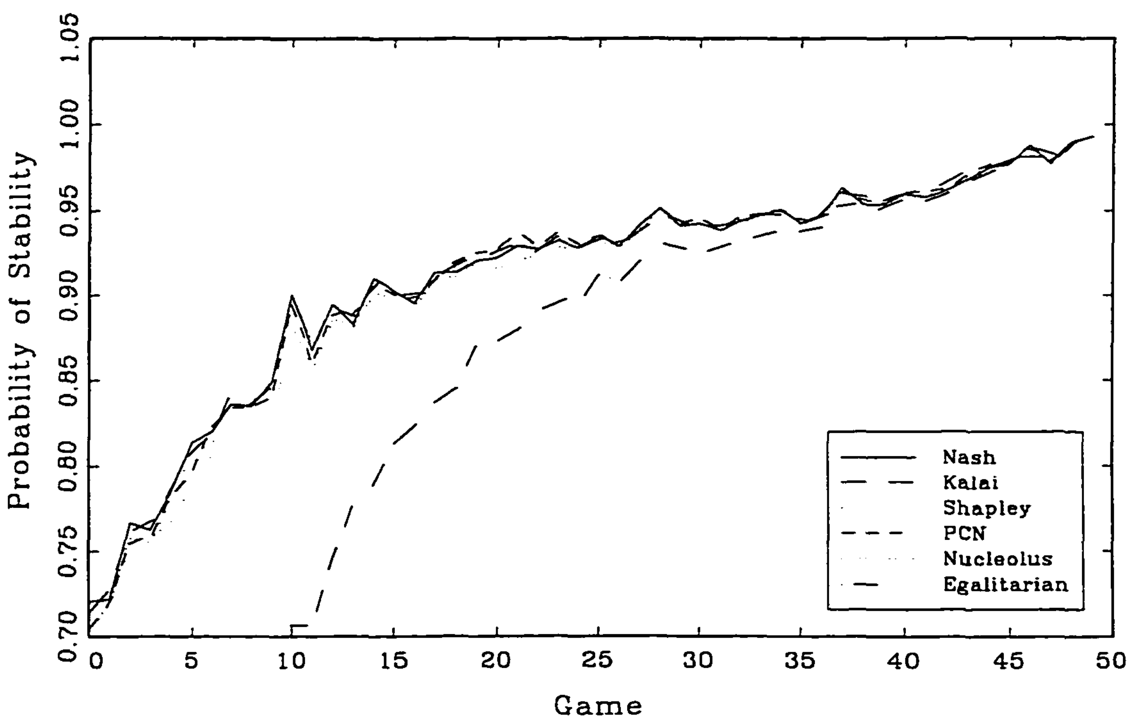



Figure 14: Increasing Gains to Cooperation



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# A Comparative Success of the Nash Bargaining Solution

Assuming a three-player game, the expected threat points were drawn from a uniform distribution over the entire game space. Individual players had minimum threats of 0.0, and maximum threats of 0.3. (Recall the normalized cake of size 1.) The Nash bargaining solution, as well as the Egalitarian, Utilitarian, and Kalai-Smorodinsky solutions, were calculated assuming logarithmic utility. The probability of stability was calculated both for a uniform distribution of threat points and for lognormally distributed threat points.

When the threat points were assumed to be distributed uniformly over $[a_i, b_i]$, with $b_i > \frac{1}{N}$ for all players, the Nash solution always offered a higher probability of stability than the other three solutions. Figure A.1 illustrates the relative success. Nash does *not* always do better than the Kalai-Smorodinsky and the Egalitarian solutions with a lognormal distribution of actual threats, as illustrated in Figure A.2.

Figure A.1: Relative Success of Nash Bargaining Solution

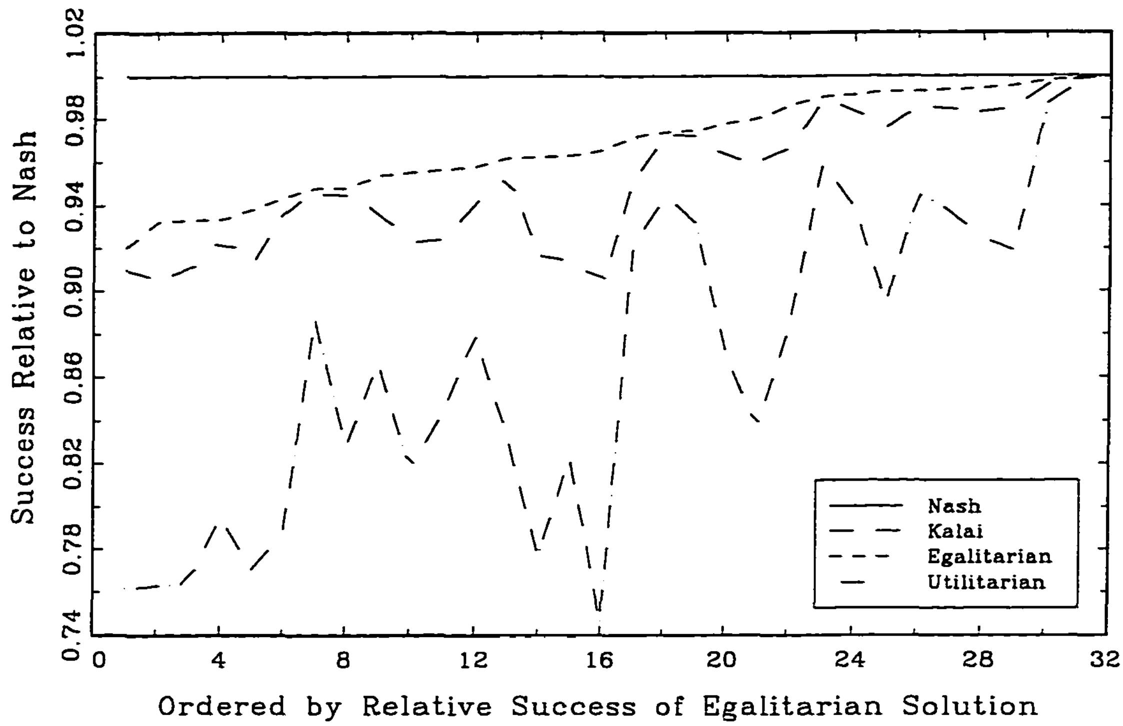
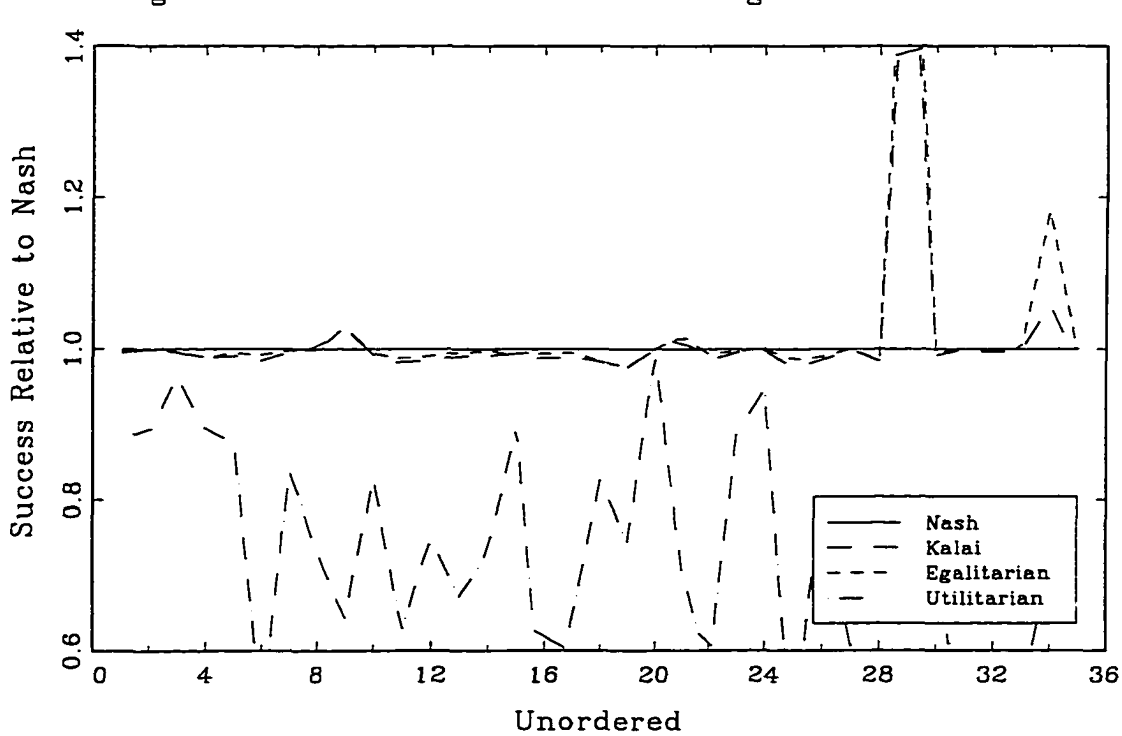



Figure A.2: Success of Nash with Lognormal Distribution



## B Specifications for Cooperative Games

The following presents the details of the simulations on the entire game space, and Scenarios 1 through 4 discussed in the text.

### B.1 Entire Game Space

The size of the cake is normalized to 1, and I restrict the games to three players. The additional assumption that defines the game space is the expectation of gains to cooperation, or expected superadditivity. The expected values are drawn from a uniform distribution, with the following parameters:

| Coalition | Minimum | Maximum |
|---|---|---|
| E{V(1)} | 0.00 | 0.30 |
| E{V(2)} | 0.00 | 0.30 |
| E{V(3)} | 0.00 | 0.30 |
| E{SV(1,2)} | 0.00 | 0.40 |
| E{SV(1,3)} | 0.00 | 0.40 |
| E{SV(2,3)} | 0.00 | 0.40 |

A coalition of two players is expected to be $V(i) + V(j) + SV(i,j)$. The maximum value of any partition is 1.0, and the minimum is 0.0.

Figures 1 and 2 are produced by drawing 1000 games from the above distributions. The solution vectors $\{x_1, x_2, x_3\}$ were calculated for each distributive rule. The probabilities of success for each rule were calculated assuming that the individual values and coalitional superadditivities were lognormally distributed around their expected values, with variance equal to 0.1. Although there were likely to have been games for which the probability that a coalition had a value greater than 1 was significant, this should not have affected the results qualitatively.

For each time period, the growth rate was calculated as a weighted average of growth under stable outcomes and growth under unstable outcomes. The weights were just the probability of success and failure, respectively. Thus, for each game drawn, each distributional rule was effectively played in many societies simultaneously, some of which would succeed in maintaining stability *ex post*, and some of which would fail. The successful societies grew at 3% per year.

In the more optimistic scenario, instability is only temporarily costly, and allows growth at a rate proportional to the surviving two-member coalition. Following Equation 29, the unsuccessful societies grew at:

$$\frac{\dot{y}}{y} = 3\% \cdot V(i,j)^{\frac{1-\alpha}{\alpha}} \tag{30}$$

where $V(i,j)$ is the value of the highest-valued coalition of two players, and I assume $\alpha = \frac{1}{3}$. So the average growth rate of all societies playing a given distributional rule would be:

$$P(stability) \cdot 3\% + (1 - P(S)) \cdot 3\% \cdot V(i,j)^2 \tag{31}$$

In the more pessimistic interpretation of instability, there is zero growth when the rule fails, so average growth for a given rule would be:

$$P(stability) \cdot 3\% \tag{32}$$

Figures 1 and 2 show the cumulative growth in these societies through the 1000 games drawn. The size of the global economy is renormalized in each period, to illustrate the relative gains by the more successful rules.

## B.2 Real-World Games

For each scenario, 1000 games were drawn at random from truncated normal distributions. The following tables show the means and upper and lower bounds of the distributions from which the games were drawn.

**Scenario 1: Symmetry**

| Game: | | Lower Bound | Upper Bound |
|---|---|---|---|
| E(E{V(1)}) | 0.15 | 0.0 | 0.30 |
| E(E{V(2)}) | 0.15 | 0.0 | 0.30 |
| E(E{V(3)}) | 0.15 | 0.0 | 0.30 |
| E(E{SV(1,2)}) | 0.20 | 0.0 | 0.40 |
| E(E{SV(1,3)}) | 0.20 | 0.0 | 0.40 |
| E(E{SV(2,3)}) | 0.20 | 0.0 | 0.40 |

**Scenario 2: The U.S. Income Distribution**

| Game: | | Lower Bound | Upper Bound |
|---|---|---|---|
| E(E{V(1)}) | 0.032 | 0.00 | 0.30 |
| E(E{V(2)}) | 0.135 | 0.00 | 0.30 |
| E(E{V(3)}) | 0.284 | 0.15 | 0.45 |
| E(E{SV(1,2)}) | 0.166 | 0.00 | 0.40 |
| E(E{SV(1,3)}) | 0.378 | 0.10 | 0.50 |
| E(E{SV(2,3)}) | 0.418 | 0.20 | 0.60 |

**Scenario 3: Brazilian Income Distribution**

| Game: | | Lower Bound | Upper Bound |
|---|---|---|---|
| E(E{V(1)}) | 0.016 | 0.00 | 0.10 |
| E(E{V(2)}) | 0.064 | 0.00 | 0.15 |
| E(E{V(3)}) | 0.370 | 0.20 | 0.50 |
| E(E{SV(1,2)}) | 0.079 | 0.00 | 0.20 |
| E(E{SV(1,3)}) | 0.386 | 0.10 | 0.40 |
| E(E{SV(2,3)}) | 0.434 | 0.20 | 0.50 |

**Scenario 4: A Political Game**

| Game: | | Lower Bound | Upper Bound |
|---|---|---|---|
| E(E{V(1)}) | 0.15 | 0.00 | 0.30 |
| E(E{V(2)}) | 0.15 | 0.00 | 0.30 |
| E(E{V(3)}) | 0.15 | 0.00 | 0.30 |
| E(E{SV(1,2)}) | 0.20 | 0.10 | 0.50 |
| E(E{SV(1,3)}) | -0.10 | -0.20 | 0.00 |
| E(E{SV(2,3)}) | 0.10 | 0.00 | 0.40 |

Figures 3–10 illustrate the evolution of these scenarios over time. The methodology is exactly as for the entire game space.

### B.3 Sequences of Games

For Figures 11 and 13, the six distributional rules were solved for a series of 50 games. Each coalitional value is a linear sequence starting at its initial value and increasing in equal increments to the final value. Figure 11 illustrates a sequence starting at the symmetric game and ending at the expected values for the U.S. income distribution. Figure 13 starts with a symmetric game and progresses to the distribution in Brazil. The table below indicates the starting and ending values for the games.

| | Figure 11 | | Figure 13 | |
|---|---|---|---|---|
| | Start | End | Start | End |
| E{V(1)} | 0.15 | 0.032 | 0.15 | 0.016 |
| E{V(2)} | 0.15 | 0.135 | 0.15 | 0.064 |
| E{V(3)} | 0.15 | 0.284 | 0.15 | 0.370 |
| E{SV(1,2)} | 0.50 | 0.166 | 0.50 | 0.079 |
| E{SV(1,3)} | 0.50 | 0.378 | 0.50 | 0.386 |
| E{SV(2,3)} | 0.50 | 0.418 | 0.50 | 0.434 |

The evolution over time was generated allowing each of the 50 games to be played 40 times, with the corresponding growth cumulating over time.

Figure 14 illustrates the probability for stability as the gains to cooperation increase, starting from the distribution of income in the United States The starting and ending values were as follows:

| | Figure 14 | |
|---|---|---|
| | Start | End |
| E{V(1)} | 0.032 | 0.00 |
| E{V(2)} | 0.135 | 0.00 |
| E{V(3)} | 0.284 | 0.00 |
| E{SV(1,2)} | 0.166 | 0.00 |
| E{SV(1,3)} | 0.378 | 0.00 |
| E{SV(2,3)} | 0.418 | 0.00 |

# Using Politics to Keep Up with the Joneses: New-World Immigration Policy and Relative Incomes

*A house may be large or small; as long as the surrounding houses are equally small it satisfies all social demands for a dwelling. But if a palace rises beside the little house, the little house shrinks into a hut.*[1]

## 1 Introduction

From the mid-19th century through the first third of the 20th, the major economies of the New World were the recipients of a mass migration out of Europe. The top five country destinations—Argentina, Australia, Brazil, Canada, and the United States—alone received nearly 55 million immigrants between 1850 and 1930.[2] There has been much speculation as to the impact of all those immigrants on domestic labor markets, and to the consequent impact on immgiration policy itself. Although all five countries were open to immigration at the beginning of the era, all had closed their doors by 1930. The anti-immigrant trend started much earlier than most have presumed—as early as the 1870s there were moves to control the types of immigrants admitted. By the 1890s, the anti-immigrant rhetoric was extremely strong in Canada, Australia, and the United States. By the 1920s, quotas, literacy tests, and outright exclusions were the norm.

The conventional wisdom has always been that the mass migrations drove down real wages in the New World, and that the lack of wage growth precipitated the anti-immigrant policies. Additional anti-immigrant pressure resulted from a shift from flows of immigrants from northern Europe and the United Kingdom to flows predominated by southern and eastern Europeans and Asians. Until recently, the

[1]Karl Marx, as quoted by Easterlin (1974), pp. 111–112.
[2]Data compiled in Timmer and Williamson (1996).

hypotheses have been difficult to test at a national level, because the policies themselves have never been assessed in a systematic way. Immigration-policy indices developed by Timmer and Williamson (1996) allow an empirical look at the relationships between policy and wages and the immigrant flows, but the empirical results cast doubt on both the wage-stagnation story and the "new" immigrant theory.

What shows up in the empirical work is the importance of the *relative* position of the unskilled laborers. The distributional consequences of the absorption of millions of unskilled workers has long been recognized, but only recently has it been suggested that those consequences impacted policy. Of course, the theory for such an impact goes back much further. Nearly fifty years ago, James Duesenberry postulated that individual utility was strongly influenced by the "demonstration effect." Upon seeing a new car on the road, or a new food on the supermarket shelf, individuals would adjust their assessment of how best to make themselves happy (Duesenberry, 1949). He modeled preferences as interdependent; we develop a taste for things we see others consuming, so the consumption behavior of others affects our own utility. This phenomenon, which has since been generically described as "keeping up with the Joneses," suggests simply that our feelings about our well-being are judged relative to others. If no one on the block has a BMW, somehow we are better off than if everyone has a BMW except us.

Some thirty years after Duesenberry, research by Kahneman and Tversky revived the debate over what makes people happy. Their experimental evidence showed that individuals judge their well-being relative to some "reference point" (Kahneman and Tversky, 1979). Individuals perceived losses from their point of reference asymmetrically from gains, suggesting that current utility acts as the zero point in the utility function. Combining this reference point effect with the demonstration effect suggests that, at least in part, individuals gain utility not in keeping up with the Joneses, but in getting ahead of them. More to the point, if individuals feel they are being "left behind" as the economy grows, they will perceive themselves to be worse off, even if their absolute standards of living are improving.

If people do judge themselves in this way, one would predict very different patterns of political behavior from those of people who care only about the absolute levels of their consumption. For one, income distribution and changes in income distribution would matter directly in policy-making. Although this is one of the robust stylized facts of political economy, it has been difficult to model formally without going through a channel of redistributive taxation (See Perotti (1992) for an early example of the genre.) Relative concerns also put a new light on the modeling of protectionism. Two of the great puzzles—protection of declining industries and the use of tariffs instead of subsidies—are easily explained if those in protected industries care about their relative position.

In this paper, I model and test empirically the importance of "getting ahead of the Joneses" in the evolution of restrictions on immigration. Immigration policy has been the focus of much academic theorizing, but with surprisingly little formal modeling and even fewer empirical tests. Trade policy, which has been modeled and tested more thoroughly, has the disadvantage that the interest groups in the short run differ from those in the long run. Immigration policy has the advantage that the interest groups are clearly defined by sources of income, which allows for a straightforward test of relative-income effects. I develop a simple model of laborers and capitalists, who lobby legislators to change policy in their favor. The model predicts that immigration policy will be more restrictive when workers are losing out relative to capitalists, even if their real incomes are rising.

Using the data set from Timmer and Williamson (1996), I test the model on the five New World economies during the period from 1860 to 1930. The results suggest that much of the conventional wisdom about what was driving New World immigration policy has no empirical foundation. In particular, there is no evidence that real-wage stagnation, or low growth in wages, mattered in policy formation. There is also little support for any xenophobic or racist motivations. But a measure of the relative position of unskilled labor proves significant in four of the five countries, including the United States and Canada. Australia is an outlier in several dimensions, notably that economic conditions were important determinants of policy.

The paper is organized as follows: Section 2 gives a brief look at earlier work on New-World immigration and immigration policy. Section 3 lays out the argument in favor of rethinking the standard utility formulation. Section 4 presents the model. Section 5 presents the empirical tests. Section 6 offers conclusions and some further lines of research.

## 2 Immigration Policy

Immigration proves to be particularly well-suited as a policy dimension on which to look at the impact of relative income changes on policy. Distributional consequences of most policy choices, including trade, depend on factors other than income, such as industry and region. But immigration policy affects relative incomes in a reasonably straightforward way, especially if the focus is on unskilled workers. Since immigration policy affects the flow of a factor input (i.e., labor), it is easy to identify the interest groups on either side of the policy debate. In a simplified world, workers are suppliers of the input, and they should oppose increases in supply. Capitalists (or firms, if you prefer) are demanders of labor and should encourage increases in supply.[3] More importantly, we can easily identify changes in the relative positions of the groups simply by tracking labor income over time in relation to aggregate income.

The theory and evidence on the impact of immigration on labor markets is reasonably clear. Wage earners should lose with immigration, as the labor pool increases and pushes wages down. Owners of other factors of production—land and capital—gain from lower wages that make these factors more productive. There have been attempts to measure the historical impact of immigration on wages, and most have found that wages were in fact downwardly sensitive to immigration (Williamson, 1974; Taylor and Williamson, 1994; Green, 1994; Goldin, 1994; Hatton and Williamson, 1995; Williamson, 1995). However, some have found that wages seemed to increase with immigration, but only marginally (Pope and Withers, 1994). The theoretical argument depends on two concerns: whether immigrants can shift the demand for labor enough to offset the increased supply (for example, by employing unused factors of production like unsettled land); and whether the labor markets exhibit disequilibria in the form of unemployment. If labor demand keeps pace with labor supply, then immigration adds as much to the pie as it takes, and as a whole, native labor is not hurt, although there can be distributional effects (Lucas, 1981).

There is a general consensus in the literature that immigration policy, especially prior to World War II, has been sensitive to labor market conditions. At the same time, immigration flows themselves seem to have been sensitive to wage differentials

[3]I am abstracting here from the difference between skilled and unskilled labor, which may be complementary. Foreman-Peck (1992) helps clarify the issue.

and unemployment rates. For example, Claudia Goldin notes that in the late 1890s in the United States there was a new push for immigration restrictions, during a time of economic recession and high unemployment. But immigration flows slowed substantially during this time, reaching a low in 1897, the same year that the first vote on generalized restrictions to immigration was taken in the House of Representatives (Goldin, 1994). Similar sensitivities of immigration flows have been noted for Australia, where the inflow dropped in the 1890s during its recession (Pope and Withers, 1994). This would seem to suggest that the impetus to restrict immigration was more sensitive to the economy than to the levels of immigration.

Little formal modeling has been done to predict immigration policy. Timmer and Williamson (1996) offer a comprehensive survey of the models that do exist and the related theory of trade policy. Foreman-Peck (1992), Benhabib (1997), and Shughart *et al.* (1986) are the few formal models to date, while Goldin (1994) offers empirical support for an informal model.

Neither Foreman-Peck nor Benhabib present any empirical evidence in support of their models, although both suggest that the "quality" of the immigrants will be correlated with policy. Foreman-Peck uses a pressure-group approach. He assumes that the individuals of a country receive their incomes primarily from one source—labor income, capital income, or land rentals. Depending on the franchise, the government maximizes a weighted objective function, which includes these interests. In general, a larger weight placed on labor's interests leads to a more restrictive immigration policy, but he allows for the possibility of two types of immigrant labor—skilled and unskilled. It may be that skilled immigrant labor is a complement to domestic labor, while unskilled immigrants are substitutes. We would then expect to see a policy to encourage skilled immigrants while discouraging unskilled ones.

Foreman-Peck argues that this concern, and not any racism or xenophobia, was responsible for policies restricting Asian immigrants to the Americas and African immigrants to South Africa.

Benhabib (1997) suggests that voters will select for quality. In a model similar in spirit to the growth model of Alesina and Rodrik (1994), he allows for individuals to have varying proportions of their income from different factors. He uses a median voter model to determine how income distribution affects the majority-determined ideal immigrant. Each individual is indexed by the ratio of his relative capital endowment to his labor endowment. Thus, each individual will be impacted differently by an additional immigrant. An immigrant that arrives with no capital, human or physical, will raise the marginal product of capital and lower the wage. (See Berry and Soligo, 1969, for a formal analysis of the welfare implications when workers take their capital with them.) An immigrant who brings exactly the same labor/capital mix as the national average will not affect the relative products, but will not necessarily maximize the income of the median voter unless there is a representative agent. As income distribution skews to the right, the median voter will prefer to restrict immigration to those who bring higher-than-average levels of capital with them.

Empirical work to date has been confined to the United States, in Shughart, Tollison, and Kimenyi (1986) and Goldin (1994). Shughart *et al.* (1986) look at shifting degrees of enforcement of immigration restrictions through business cycles. Their agents are politicians trying to maximize votes by catering to different interest groups. As the economy goes through business cycles, the capitalists' profit curve shifts, and therefore the ideal policy point shifts, resulting in changes in the degree of enforcement against immigration. Shughart *et al.* test their model on data from

1900 to 1982, using two alternative measures of the degree of enforcement. Even taking into account official changes in immigration policy, the size of the enforcement budget, and the party in the White House, the degree of enforcement is significantly, and negatively, related to real GNP. Unemployment and the real wage were also significant explanators, but not as consistently so as real GNP.

Claudia Goldin (1994) looks at a particular episode in U.S. immigration history—the adoption of a literacy test for immigrants. This change in U.S. immigration policy was first attempted in 1897 and was finally successful in 1917, and Goldin analyzes the shifts of positions in Congress that finally got the measure passed over repeated presidential vetoes. Specifically, she assesses the impact of increasing immigration flows and the effects on wages, and the subsequent effect on votes. She measures the change in wages due to a change in the number of foreign born in U.S. cities. Especially after the turn of the century, she finds a significant negative impact on the wages of laborers in certain industries, including artisans and those in the men's clothing industry (a result consistent with earlier historical studies on the United States and Britain: Williamson, 1974, 1990). The change in real wages, in turn, she shows to be a significant explanatory variable in voting to override the presidential veto of the literacy test in 1915. The higher the growth in wages, the less likely was the representative to vote to override.

Although Goldin highlights many additional factors, it is the impact of wage growth on attitudes toward immigration that is the key aspect of Goldin's model for this study. While Shughart *et al.* focus on the level of wages and profits, as does Foreman-Peck (1992), Goldin shows the importance of contrast effects. In areas where wages were rising, there was less push for controls than where incomes were stagnating.

## 3 Alternative Utility Theory

James Duesenberry was not the first to criticize standard utility theory. Many had problems taking tastes as given and fixed (cf. Marshall (1930), Veblen (1899)). He was, however, the first to formalize an alternative specification and test its power in predicting consumer behavior. He suggested that while individuals have a basic range of needs to be met—housing, food, clothing—their assessment of the best way to meet these needs was sensitive to *demonstration*. In effect, an individual's judgment of a good was positively correlated with the prevalence of others' consumption of the good. His empirical results suggested that this formulation provided a better explanation of aggregate savings behavior in the United States than did more traditional functional forms (Duesenberry, 1947).

The implication of this type of behavior is that we can all have higher incomes and consumption levels and yet not be any better off. As aggregate income rises, we develop tastes for more goods and higher-quality goods; this increase in income therefore does not necessarily increase utility. Easterlin (1974) recognized this implication and tested whether or not economic growth has any positive correlation with happiness or well-being. He found that relative income position did correlate with perceived well-being but that improvements in income levels over time, and differences in income across countries, had little impact on happiness. Dudley (1975) reports on surveys of Detroit households from 1955 to 1971. He also finds that self-reported happiness was increasing in relative income position in both years, but that, despite substantial average income gains over time, there was no improvement in the mean level of happiness.

Robert Frank (1985) provides perhaps the most complete discussion to date of the implications of and evidence for such relative effects. Although most of the economic evidence is anecdotal, he cites studies on the biological response to relative position that further support the argument; for example, people's heart rates and blood pressure tend to increase when surrounded by others of higher status.[4] Tversky and Griffin (1991) cite survey evidence that individuals say they would be happier in a firm that paid them more than their coworkers, even if the alternative is to be paid more absolutely (but less relatively.) Solnick and Hemenway (1995) present the results of a survey on relative judgments, which indicate that individuals have concerns for relative position in certain dimensions, especially intelligence, attractiveness, and income.

Of course, relative judgments can themselves be subject to a point of reference. Easterlin's evidence is quite clear that although the poor report themselves to be less happy than the rich on average, the difference in mean well-being is small (Easterlin 1973). Perhaps this small differential is due to habituation to one's position in life. That is, the poor and middle-class do not perceive continual disutility in not being rich. Rather, they lose well-being when they fall even further behind. In fact, the wealthy will also perceive a loss in well-being if they are not keeping as far ahead of others, even if they remain relatively wealthier. This paper postulates that these perceptions of well-being indicate that those whose incomes are not growing as fast as the average, regardless of their absolute or even relative income, will be those with the loudest political voices.

What is the evidence for such habituation? Kahneman and Tversky (1979) brought the argument to economics from psychology, where adaptation-level theory

[4]Frank is also concerned with how we might determine the appropriate reference group, an important issue but one for which I refer the reader to his work (Frank, 1985).

has a long history (Helson, 1964). Their evidence, supporting that of previous inquiries into utility functions, showed that individuals perceive gains and losses asymmetrically. Specifically, perceptions of well-being were convex in gains but concave in losses (Kahneman and Tversky, 1979). Thus, individuals were implicitly making judgments relative to their current position.

Since then, behavioral economists have brought further evidence to support the reference point theory. Tversky and Griffin (1991) show the significance of *contrast effects* in their subjects' judgments of satisfaction. Asked to recall a past event and then asked to judge their current state of well-being, those who were asked to recall a negative event were more satisfied, on average, than those who were asked to recall a positive event. In another experiment, subjects reported greater satisfaction with their own housing after sitting for an hour in a small, noisy, overheated room than did subjects who sat for an hour in a spacious, well-decorated, and well-furnished room. Loewenstein and Sicherman (1991) offered survey respondents several hypothetical income streams over six years. All averaged $25,000 per year, but some were decreasing over time, and others increasing. By a significant margin, respondents preferred income streams that were rising over time, even when presented with the argument that there are opportunity costs to deferred nominal payments. Quattrone and Tversky (1988) present evidence that these relative judgments have potential political consequences. When individuals are risk averse in gains but not in losses, it can be rational to reelect incumbents during good economic times and elect challengers during recessions.

Alternative utility specifications have been empirically useful in explaining anomalies of financial markets. Abel (1990), Campbell and Cochrane (1994), and Constantinides (1990) have used habit-formation models to resolve the equity premium puzzle. Babcock *et al.* (1996) illustrate that modelling relative concerns is useful in predicting the strike behavior of public-sector unions. This paper takes a similar approach in using an alternative utility specification that is intuitively appealing to help explain policy formation.

## 4 The Model

The model focuses on a specification of the utility function of laborers that illustrates how relative-income concerns imply a different policy outcome than a more standard specification. For example, the conventional wisdom on immigration policy is that stagnating real wages will lead to demand for immigration restrictions. Such a result would be straightforward to derive using a utility function where individuals get utility from real income.

To keep the focus on the relative concerns, the model simplifies in a number of dimensions. There are only two interest groups, capitalists and laborers, each with a representative agent (or a class representative.) These agents receive fixed incomes, determined by the current immigration policy. They can, however, spend part of their income to change policy in the next period.

Following Becker (1983), each agent recognizes the political behavior of the other, and the Nash equilibrium occurs where each agent is playing her best response to the actions of the other. The political institutions are modeled as a unicameral legislature which can vote to change policy by simple majority of its members. The agents can offer payments to politicians to change their votes.

A standard reference-point utility function is specified for the laborer:

$$U_t = f({Y_t}^L - \gamma {Y^L}_{t-1}) \quad (1)$$

Here, $\gamma$ is a scaling factor for the reference point ${Y_{t-1}}^L$. The laborer's income is ${Y_t}^L$. By hypothesis, this scaling factor is a function of the aggregate income in the economy, because our worker cares how she is doing relative to the others. The ratio of current GDP to a moving average of past GDP per capita has been used as one such scaling factor (Campbell and Cochrane (1994)). Here, I simplify for the static model, and set:

$$\gamma = \frac{GDP_t}{GDP_{t-1}} \tag{2}$$

Normalizing $GDP_t$ to equal 1:

$$U_t{}^L = f\left(\frac{Y_t{}^L}{GDP_t} - \frac{Y_{t-1}{}^L}{GDP_{t-1}}\right) \tag{3}$$

This specification implies that the worker derives utility from an increase in wage income that is *greater* than the increase in GDP over the previous year. If, for example, the economy grows 3%, but nominal wage growth is sluggish at only 2%, the worker has lower utility than if she receives the 2% raise when the economy is stalled at only 1% growth. Thus, she wants to "get ahead of," not just "keep up with," the Joneses.

Since utility is defined in terms of relative incomes, we can simplify the above:

$$L_t = \frac{Y_t{}^L}{GDP_t} \quad ; \quad K_t = \frac{Y_t{}^K}{GDP_t} \tag{4}$$

So $L_t$ and $K_t$ denote the incomes of the laborer and the capitalist relative to GDP per capita, respectively. By assuming a two-agent economy, the relative shares add to one:

$$Y_t{}^L + Y_t{}^K = GDP_t \Longrightarrow L_t + K_t = 1 \tag{5}$$

However, in future periods, immigration implies that the condition $L_t + K_t = 1$ does not hold, since losses to labor's relative income go in part to the new immigrants, not entirely to the capitalist. To maintain the simplification, I assume that immigrants do not become part of the reference group, and so the denominator is always just the sum of the incomes of the capitalist and the native laborer. Thus, immigration affects the relative positions in a zero-sum way. For a static model, this assumption seems reasonable; a dynamic model would need to specify how immigrants are assimilated into the reference group.

The political game works as follows: Given a current status-quo immigration policy at time $t-1$, each agent knows how income will be split at time $t$. The expected share of labor income, given the status quo, is denoted $E_t$. Pressure on the government to change the policy has costs, but a policy change in favor of the agent will raise her share of income at time $t$.

The members of the legislature are assumed to have single-peaked preferences along the uni-dimensional immigration policy space.[5] Their preferences are distributed logistically around the status quo, such that the mean and median coincide. Given the median voter result of Black (1948), the status quo is the majority-rule equilibrium, unless legislators can be convinced to vote otherwise. In order to change the policy, ideal points of legislators must be moved, which I assume can be done with cash payments. The interpretation is that legislators have a desire to be re-elected, which requires both voter support for their positions and funds for the campaign. Politicians can substitute campaign spending for less-than ideal positions, and so will be willing to shift their votes for enough cash. This approach has been used in other recent political-pressure models (Magee *et al.*(1989), Grossman and Helpman (1994)).

I assume that a single legislator can be moved one unit along the policy space

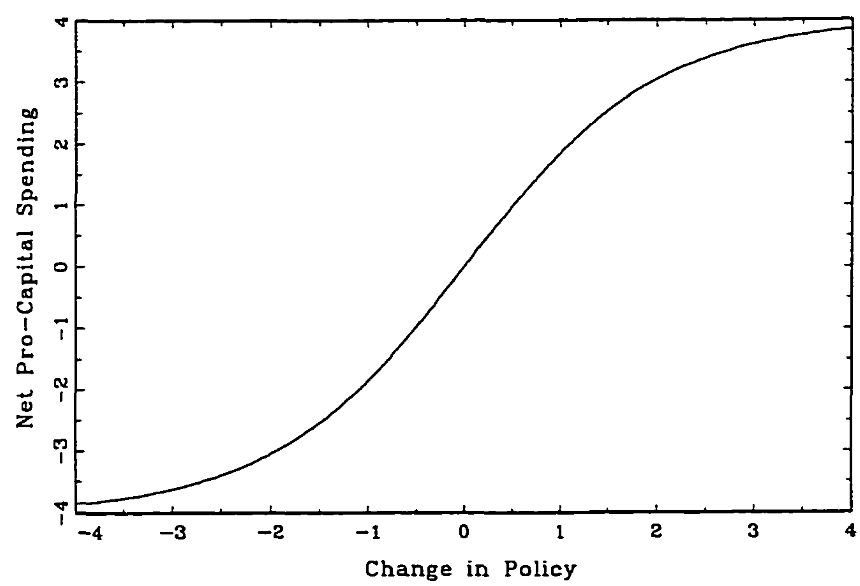
[5]We might further assume that preferences for immigration policy are additively separable from the other policy dimensions.

at cost $\alpha$. Define the shift of political median purchased by the laborer as ${P_t}^L$, and ${P_t}^K$ for the capitalist. $R_t$ denotes the *change* in policy from $t-1$ to $t$, which is just the net purchase by capital, ${P_t}^K - {P_t}^L$, with a positive change favoring more open immigration. Clearly, both agents will try to influence the swing voters, or those near the median, rather than those at the tails of the policy space. But by assumption, there is a cluster of legislators at the center, so any one politician's move only shifts the vote to the ideal point of the next legislator. Thus, a critical mass of legislators must be purchased to have meaningful policy shifts. The *per-unit* cost of a shift is therefore decreasing in the size of the shift:

$$Cost({P_t}^K) = \alpha \cdot \frac{1 - e^{-{P_t}^K}}{2 \cdot (1 + e^{-{P_t}^K})} \tag{6}$$

Figure one illustrates the net spending necessary to effect a policy change.

Figure 1: Policy Cost Function




This change in policy will affect income shares in the following way:

$$E_t = L_t | StatusQuo \tag{7}$$

$$L_t|R_t = L_t = E_t(1 - R_t) \tag{8}$$

Given this fixed response function by the government, each agent maximizes utility given the behavior of the other. Costs of political pressure are additively separable in the utility functions, and enter in as squared terms.[6] The capitalist is concerned over income share, less political lobbying costs. Because $GDP_t$ is normalized to 1, income share is equivalent to income. Thus she is not a relative-income maximizer, but behaves as a profit-maximizing, risk-neutral firm. These are standard assumptions of firm behavior, but are not necessary. In general, the assumptions stabilize the behavior of the capitalist, so that the equilibria are more robust, but do not affect the results substantively. When both capitalists and laborers want to keep up with the Joneses, the predicted policy response is the same.[7]

Noting that $K_t = 1 - L_t$, the problem for each side is as follows:

For Labor:

$$\begin{aligned}
\max_{P_t{}^L} U_t{}^L &= (L_t - L_{t-1})^{\frac{1}{3}} - (\alpha \cdot \frac{1 - e^{-P_t{}^L}}{2 \cdot (1 + e^{-P_t{}^L})})^2 && (9)\\
&= [E_t(1 - R_t) - L_{t-1}]^{\frac{1}{3}} - (\alpha \cdot \frac{1 - e^{-P_t{}^L}}{2 \cdot (1 + e^{-P_t{}^L})})^2 && (10)\\
&= [E_t(1 - P_t^K + P_t{}^L) - L_{t-1}]^{\frac{1}{3}} - (\alpha \cdot \frac{1 - e^{-P_t{}^L}}{2 \cdot (1 + e^{-P_t{}^L})})^2 && (11)
\end{aligned}$$

For Capital:

$$\begin{aligned}
\max_{P_t{}^K} U_t{}^K &= (1 - L_t) - (\alpha \cdot \frac{1 - e^{-P_t{}^K}}{2 \cdot (1 + e^{-P_t{}^K})})^2 && (12)\\
&= [1 - E_t(1 - R_t)] - (\alpha \cdot \frac{1 - e^{-P_t{}^K}}{2 \cdot (1 + e^{-P_t{}^K})})^2 && (13)\\
&= [1 - E_t(1 - P_t^K + P_t{}^L)] - (\alpha \cdot \frac{1 - e^{-P_t{}^K}}{2 \cdot (1 + e^{-P_t{}^K})})^2 && (14)
\end{aligned}$$

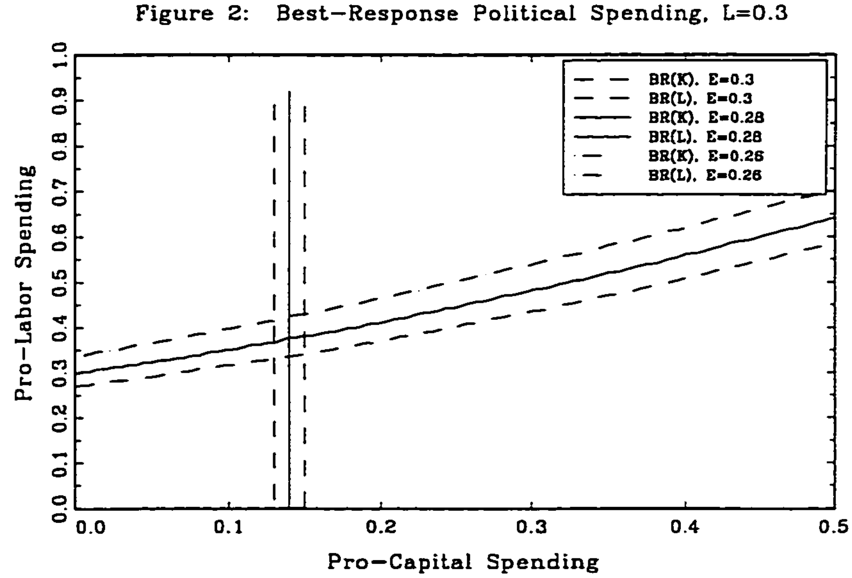
[6]The squared costs are not necesary to the specification.

[7]Appendix A develops a social-welfare maximizing planner model where capitalists have the same relative concerns that laborers do.

Utility of the capitalist is independent of current relative incomes, except as $L_{t-1}$ influences the choice of $P^L$. This allows the function to be globally concave in $P^K$ for all $P^L$ and $E_t$. Labor's utility is much more sensitive to whether or not relative income is rising or falling over time, and it has two local maxima under a wide range of assumptions about $L_{t-1}$ and $E_t$. In response to $P_t^K$, the global maximum shifts between the local maxima, leading to abrupt changes in the best-response curve. Fortunately, the response curves are continuous in the region of the intersection with the best-response curves of capital.

Figure 2 illustrates the best-response curves for an initial relative labor income of 0.3 and three different expected relative positions, $E_t$.[8] The Nash-equilibrium policy results when the political spending by labor and the capitalist are best responses to the spending by the other, or where the curves intersect. As we would predict, the equilibrium response is increasingly pro-labor as expected position falls. Capital's response is actually not sensitive to the political behavior of labor (because it enters the utility function additively), but it will spend less the higher is its expected gain in income share.

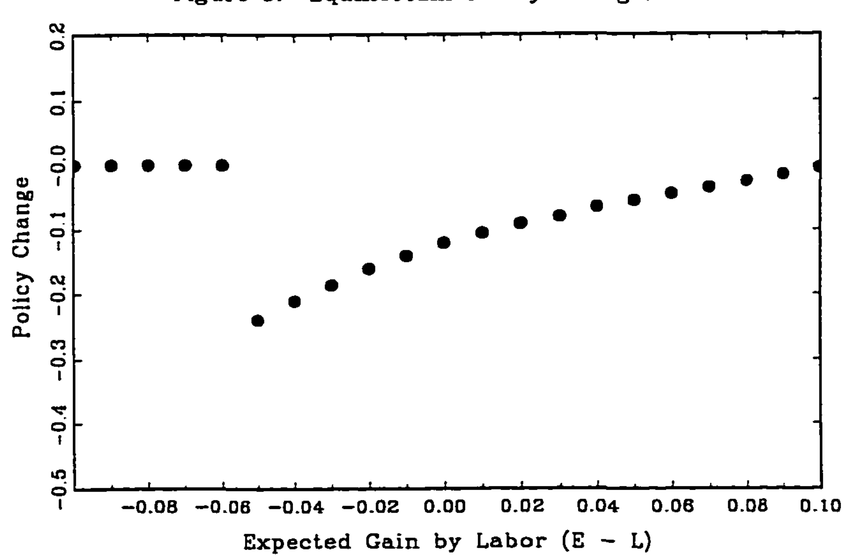
Figure 2: Best-Response Political Spending, L=0.3




[8] With a representative-agent laborer, income is presumed to be less than the capitalist, therefore the income share is less than 0.5.

Figure 3 maps the policy-response equilibria. Recall that the policy response is just the net shift of ideal points purchased by the capitalist. A negative response indicates a pro-labor shift in policy, resulting from more money spent by labor than by capital. The equilibria depend on how labor is expected to fare in period $t$—that is, how large $E_t$ is relative to $L_{t-1}$. Figure 3 illustrates the equilibria for an initial labor share of 0.3—$L_{t-1} = 0.3$. For most plausible expectations about labor's income in period $t$, the immigration policy is expected to shift in favor of labor's interests. However, if relative income is expected to fall too drastically, labor's best response is not to waste resources on political pressure. If labor is expected to lose 20% of its share or more, it spends no resources on political lobbying. Empirically, such a drop in wages is implausible. Labor's relative income would not likely decline as rapidly as would be necessary to induce such political apathy.

Figure 3: Equilibrium Policy Change. L=0.3




Because of the asymmetries in the utility functions, the equilibria imply that even if labor is expected to gain income share, labor will out-spend capital and force a small change in policy. This implies a drift in favor of labor even if immigration is *not* expected to drive down wages. So we might predict a general policy drift towards less open immigration, even where there is no evidence that immigration is hurting native labor. This might help to explain why the 19th-century reaction to immigration was so strong, even when the estimated impact on native labor was relatively small (Williamson, 1990).

Although the paper reports the results for a given income ratio and parameterization of the utility function, none is particularly sensitive to these parameters. Alternative degrees of risk aversion, pressure costs, and initial income positions generate similar patterns of equilibria, although the magnitude of the policy response may differ. The social-welfare maximizing political agent, presented in Appendix A, shows equilibrium behavior consistent with the above.

## 5 Empirical Results

The data on which I test the model consist of eleven independent economic and immigration variables, and an index of immigration policy. The following sections discuss briefly the expected impact of the variables on policy and the construction of the variables. The results of the regressions are presented in section 5.3.

### 5.1 Predictions

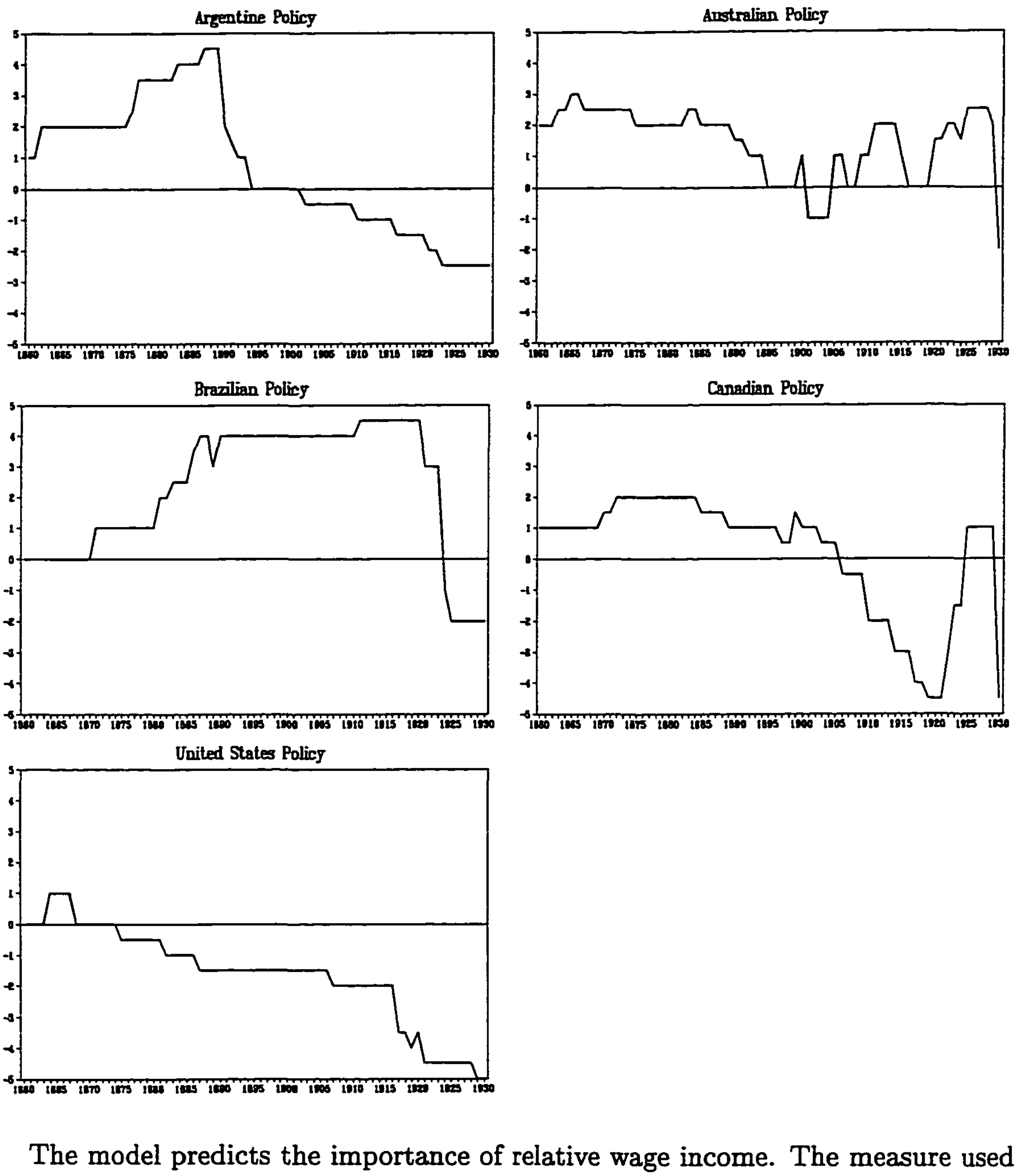
Although the model is fairly simple, it generates strong implications about how policy should respond given a set of economic conditions. The most straightforward is from Figure 3. We would expect that immigration policy will become more restrictive if labor's relative income is falling. In levels form, when labor's position is low relative to capital, immigration policy should be restrictive; when labor's relative income is high, immigration should be allowed more freely.

The model is set up in expectations, and there are two important variables that affect the expectations of laborers about their future: unemployment and the immigration rate. Following Todaro (1969), expected wage income should be the expected wage scaled by the rate of employment, or $(1-U)\cdot E(w_t)$. Thus, high unemployment should also lead to a closing of the doors. How do workers form expectations about their future wage? One plausible variable would be the immigration rate—high current volumes of immigrants would lead to expectations of decrease in wages in the future, or at least a decrease in wage gains. Thus the model would suggest that high immigration rates could trigger a policy response. Furthermore, the identity of the immigrants may matter. If immigrants who have lower reservation wages pose more of a threat to wages (by shifting supply more at lower wage levels), there may be a correlation between the human-capital level of immigrants and policy.

The model makes no predictions about the role of real wages. Other variables, such as economic growth, may affect relative incomes, but they should have no additional impact on policy once relative wages are taken into account.

## 5.2 The Data

The dependent variable is an index of immigration policy developed by Timmer and Williamson (1996) for five countries: Argentina, Australia, Brazil, Canada, and the United States. The index runs from +5 to -5, with a higher index number indicating a more favorable position on immigration. The time period under consideration is 1860 to 1930, the period of the greatest change in immigration policy in the New World. Prior to 1860, few of the receiving countries were paying much attention to immigration policy at the national level, and as a result, the doors would generally be considered open. By 1930, however, all five countries were effectively closed to immigrants. The figures below show the evolution of the policies over time.




The model predicts the importance of relative wage income. The measure used for relative labor income is the nominal wage of unskilled workers in urban areas divided by nominal GDP per capita. The literature has offered additional economic variables to consider, such as real wages and economic growth. Shughart *et al.* show that in the 20th-century U.S., the business cycle was critical. Goldin shows that regionally, real wage growth was an important predictor of legislator's behavior. In addition, there are a number of variables characterizing the flow of immigration, which may prove important. Much of the rhetoric of the 19th century immigration debates was decidedly racist, and it remains to be tested whether measures of anti-foreign or racist sentiment are more significant than the economic variables. Appendix B describes each variable in detail along with the sources. Table 1 gives a brief description.

**Real Wage** Wages of urban, unskilled labor, adjusted for the cost of living.

**Wage/GDP** Nominal wages (as above) divided by GDP per capita.

**Wage/Land** Nominal wages divided by land values.

**Unemployment** Estimated as the residual from regressing GDP on a time trend.

**Growth** Growth in real GDP per capita.

**Foreign Population** Percentage of the current population that is foreign-born.

**Immigrant Wage** Immigration-weighted average of real, unskilled wages in the region of origin.

**Immigration Rate** Gross immigration divided by total population.

**Stock/Flow Gap** Sum of the squares of the difference between percentage of the foreign-born population from each region and current immigration from that region.

**Threat** The product of the immigration rate and the inverse of the relative wages in the region of origin, relative to the destination.

Three of the immigration variables merit explanation. The "immigrant wage" is an average of the wages of unskilled workers in the region of origin, weighted by the percentage of immigration from that region. The "stock/flow gap" measures the difference in ethnic makeup of the current immigrant flow from the existing population of foreign born. The measure is just the sum of the squares of the differences between the percentages of composition. That is, if the foreign-born population is 10% English, but the current flow of immigrants is only 5% English, then 0.0025 is added to the measure. The "threat" variable measures the degree by which the wages of immigrants at the region of origin fall short of wages in the destination, multiplied by the volume of immigration. The goal was to quantify the potential erosion of unskilled wages due to immigration.

## 5.3 The Results

The dependent variable is not ideal for regression analysis, because in many of the countries, policy was sticky and unchanging for long periods. Adding in the lagged dependent variable to the right-hand side helps with the results, and can be justified in that the model predicts the stickiness of policy because of the clustering of politicians at the status quo. Thus, knowing where our policy is is an important explanatory variable.

Table 2 presents the cleanest regression result for each country. Real wage stagnation does not emerge as the critical factor, but the results speak clearly to the importance of relative concerns. Relative wages are consistently significant and of the predicted sign. As relative labor incomes fall, policy becomes more restrictive. Australia proves to be an exception, in that policy seems to have been responding more to current economic conditions—economic growth and unemployment—than to anything else. In Argentina, the battle seems to have been between labor and landed interests.[9] In addition, changes in real wages were significant, and in the direction predicted: a drop in real wages would correlate with a more restrictive policy. Brazil's immigration policy was extremely slow to change, but eventually the doors did close, apparently pushed shut by a collapse of relative wage income.

Table 2: OLS Regression Results—Dependent Variable is POLICY

| Variable | E(+/–) | Argentina | Australia | Brazil | Canada | U.S. |
|---|---|---|---|---|---|---|
| Constant | | 0.704 | -0.305 | -0.499** | -4.370*** | -0.680** |
| | | (0.990) | (-0.560) | (-2.316) | (-3.123) | (-2.152) |
| Wage/GDP(-2) | (+) | | 0.007 | 0.004*** | | |
| | | | (1.183) | (2.784) | | |
| Wage/GDP(-4) | (+) | | | | 0.030*** | 0.005** |
| | | | | | (3.536) | (1.990) |
| Wage/Land(-2) | (+) | 0.005* | | | | |
| | | (1.969) | | | | |
| Growth | (+) | | 3.166** | | | |
| | | | (2.273) | | | |
| Unemployment | (–) | | -0.034*** | | | -0.007 |
| | | | (-2.959) | | | (-1.404) |
| Δ(Real Wage) | (+) | 0.014* | | | | |
| | | (1.944) | | | | |
| Imm. Wage(-4) | (+) | | | | 0.014 | |
| | | | | | (1.108) | |
| Foreign Pop.(-2) | (–) | -4.688* | | | | |
| | | (-1.755) | | | | |
| Policy(-1) | | 0.779*** | 0.716*** | 0.979*** | 0.716*** | 0.956*** |
| | | (12.413) | (8.125) | (28.322) | (8.620) | (27.511) |
| Observations | | 31 | 70 | 68 | 57 | 70 |
| R-squared | | 0.956 | 0.668 | 0.926 | 0.845 | 0.964 |
| Adj. R-squared | | 0.949 | 0.647 | 0.924 | 0.836 | 0.963 |
| Mean dep. var. | | 0.548 | 1.436 | 2.368 | -0.053 | -1.643 |
| Log likelihood | | -13.509 | -69.550 | -58.400 | -69.123 | -13.974 |
| F-statistic | | 142.815 | 32.647 | 406.031 | 96.031 | 595.798 |
| Durbin-Watson | | 2.078 | 1.692 | 1.888 | 1.372 | 2.363 |

***Significant at the .01 level. **at the .05 level. * at the .1 level.
(t-statistics in parentheses)

[9]Using land values, which are only available from up to 1913, reduces the sample consierably.

Unemployment behaves as the model would predict for Australia and weakly for the United States. Periods of high unemployment correspond with immigration restrictions. But other standard measures of economic well-being—growth in GDP and growth in wages—seem to have little impact on policy. Only in Australia does current economic growth have the predicted impact.

There are several variables used to assess whether or not the type of immigration, or its magnitude, mattered in policy formation. If anything, high immigration rates should lower expectations of the future; so immigration policy should be negatively responsive to high immigrant volumes. The immigration rate is never significant or of the expected sign. Only in Argentina is there any direct evidence of xenophobic concerns, where the percent of the population that is foreign-born is a modestly significant, negative factor for openness to immigration.

The measure of the average immigrant wage attempts to capture the skill-level of immigrants as a proxy for quality or reservation wage. Low-wage immigrants would be more likely to push down unskilled domestic wages, and therefore might be of more concern to native workers. But the variable is not significant or of a consistent sign. Likewise, the "threat" to workers never proved significant once relative wages were included in the equations.

It is the conventional wisdom that racism played a large role in immigration policy. The United States, Canada, and Australia all maintained anti-Asian policies. In the United States, it is taken as truth that the literacy test of 1921 and the quotas that soon followed were the result of the "new" immigrants from southern and eastern Europe. The difference between the ethnic composition of immigrant stocks and flows was used as a measure of this "anti-other" sentiment. It has no predictive value. (There is, however, some evidence that the U.S. was successful in reducing the "gap" through its policies. See Table 3.)

In short, the relative income concerns seem to dominate the empirical tests. But note that other measures of wages were excluded. Because of much collinearity among some of the variables, it is difficult to include all of the variables in the regressions simultaneously–particularly multiple measures of wages. But to be fair to competing hypotheses, Table 3 presents the results of regressions of other variables theorized to matter. Table 3 offers the best test of the "stagnating wage" hypothesis, along with the immigration variables that supposedly mattered.

Table 3: Regression Results—Alternative Hypotheses

| Variable | E(+/–) | Argentina | Australia | Brazil | Canada | U.S. |
|---|---|---|---|---|---|---|
| Constant | | 1.827*** | 0.675 | -0.443 | 0.929 | 1.639*** |
| | | (4.422) | (0.783) | (-1.280) | (1.491) | (3.192) |
| Real Wage(-1) | (+) | -0.010*** | -0.007 | 0.005 | -0.006 | -0.032*** |
| | | (-2.671) | (-0.832) | (1.184) | (-1.059) | (-5.779) |
| Wage Growth | (+) | -1.399*** | 1.376 | 0.269 | 0.245 | -0.813 |
| | | (-3.872) | (1.372) | (0.405) | (0.161) | (-1.106) |
| Growth | (+) | -0.078 | 2.778* | -1.184 | 1.204 | -0.615 |
| | | (-0.146) | (1.997) | (-1.118) | (0.825) | (-1.049) |
| Unemployment | (–) | -0.003 | -0.045*** | 0.004 | -0.011 | -0.004 |
| | | (-0.962) | (-3.859) | (1.618) | (-1.471) | (-1.061) |
| Gap(-2) | (–) | | -0.156 | 1.565 | -0.430 | 1.538** |
| | | | (-0.061) | (0.955) | (-1.105) | (2.478) |
| Threat(-2) | (–) | -0.140 | | | -0.333** | |
| | | (-1.336) | | | (-2.484) | |
| Foreign Pop.(-2) | (–) | -4.407*** | 1.600* | | | 4.018 |
| | | (-2.883) | (2.129) | | | (1.085) |
| Imm. Rate(-2) | (–) | | | 25.780 | | |
| | | | | (0.812) | | |
| Policy(-1) | | 0.849*** | 0.569*** | 0.903*** | 0.824*** | 0.522*** |
| | | (19.630) | (5.593) | (16.720) | (10.332) | (6.066) |
| No. of Obs. | | 55 | 70 | 69 | 58 | 70 |
| R-squared | | 0.979 | 0.711 | 0.922 | 0.934 | 0.977 |
| Adj. R-squared | | 0.976 | 0.678 | 0.913 | 0.925 | 0.974 |
| Mean dep. var. | | 0.391 | 1.436 | 2.362 | 0.095 | -1.643 |
| Log likelihood | | -15.875 | -64.654 | -59.765 | -43.325 | 0.583 |
| F-statistic | | 320.283 | 21.796 | 102.476 | 101.562 | 368.150 |
| Durbin-Watson | | 2.050 | 1.674 | 1.660 | 1.988 | 2.243 |

*** Significant at the .01 level. ** at the .05 level. * at the .1 level

Real absolute wages are highly significant in the United States, but in a direction that is hard to explain.[10] As real wages rise, immigration policy becomes more restrictive. Granger tests for causality allow us to reject the hypothesis that policy is raising wages, but not the hypothesis that wages are influencing policy. These results are clear evidence against the hypothesis that immigration policy becomes more restrictive when real wages are falling. For none of the other countries are real wages significant. Likewise, growth in real wages does not have the impact at the national level that Goldin (1994) has suggested. Only in Argentina is wage growth significant, but again in the opposite of the predicted direction.

The Shughart *et al.* hypothesis of the role of the business cycle does not seem to hold for the United States in the earlier period, but it holds up cleanly for Australia. One reason, undoubtedly, is that budgetary information on immigration subsidies was available to help code the Australian dependent variable. The annual spending was more likely to be senstive to current economic conditions than were changes in official policy. Although annual budgets were also used for Brazil, the current economy seems to have had no impact. Unemployment was not a significant factor for the U.S. or Canada, but was at least of the predicted sign.

Canada does seem to respond appropriately to the threat from immigrant labor, with a closing of the doors in response to a higher volume of low-wage immigrants. The significance of the threat variable does not hold up when relative wages are included, but both are consistent with the model, so interpretation is not as important. No country produces support for the hypothesis that "new" immigrants were disliked because they were of different ethnic origin. The U.S. seems to have been

[10] The raw correlation between real wages and policy is -0.97, which explains the much lower coefficient on the lagged dependent variable.

effective in reducing changes to the ethnic composition through policy (hence the opposite, significant, coefficient on the Stock/Flow Gap.) Because of correlations, I have avoided having more than two immigration variables in the specifications simultaneously. The results in Table 3 are the most interesting, but additional specifications in Timmer and Williamson (1996, 1998) support the same conclusions.

The evidence is significant that relative income concerns were driving policy, and the evidence against the alternative hypotheses is quite strong. Given how shaky 19th-century data can be, that the Wage/GDP (or Wage/Land) variable survives in most cases suggests that the distributional effects of immigration were important to policy makers. What is perhaps most interesting is how little the policies seemed to be responding to the nature of immigration itself. Although there are undoubtedly other ways to measure the character of the immigrant flow, the ones developed here do not seem to have been causal to the anti-immigrant policies that emerged in the late 19th and early 20th century.

## 6 Conclusions

The micro-level evidence is reasonably persuasive that individuals do care about their relative positions in society. The question was whether a model of this behavior led to better predictions of policy formation than the standard formulations of utility functions. The data developed by Timmer and Williamson (1996) offer new possibilities for testing theories of immigration policy formation. The results are persuasive that the relative position of unskilled labor, not real wages or xenophobia, were important to policy makers. Although the empirical results can not rule out alternative approaches to modelling relative concerns, they do show that policy does not respond to absolute levels of income in the simple way we often presume.

Future research would need to consider a more sensitive dependent variable to test how much weight to give relative versus absolute concerns.

My expectation is that this formulation of preferences will have wider predictive value. If we care about our relative positions, then we actually prefer to gain at the expense of others, or by creating as much deadweight loss as possible. Transfer-seeking behavior would be preferable to productive behavior. Olson (1983) made the point that individuals do not distinguish between the two but that societies vastly prefer productive behavior. Perhaps individuals do distinguish. If so, it is straightforward to explain why tariffs are so prevalent when subsidies are available and more efficient—we do not need an "optimal obfuscation" explanation (Magee *et al.* 1989). I might also hope for evidence that transfer-seeking behavior increases during periods of economic change.

Much of this logic has been widely used to think about policy issues. I am hardly the first to point out, for example, that income distribution matters. Immigration policy has been practically ignored in favor of studies of trade policy, but proves to be a better issue for an empirical look at distributional questions. What I hope to have added is the reasonably simple formalization, which helps to clarify how these relative concerns might translate into pressure for policy change. The empirical results suggest that it is indeed a useful step.

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## A A Social-Welfare Maximizing Agent

Consider a simple formulation of the problem with a single political agent, where both capital and labor care about relative position and changes to that position:

$$U_t{}^L = (L_t - L_{t-1})^{\frac{1}{3}} + L_t \tag{15}$$

$$U_t{}^K = (K_t - K_{t-1})^{\frac{1}{3}} + K_t \tag{16}$$

Taking $R_t$ to be the change in policy, which the political agent can set freely, $L_t$ and $K_t$ can be expressed as:

$$L_t = E_t(1 - R_t) \tag{17}$$

$$K_t = 1 - L_t \tag{18}$$

Suppose that the agent maximizes the following social welfare function:

$$SWF = \alpha U^L{}_t + (1 - \alpha)U^K{}_t \tag{19}$$

Plugging in all of the above, the problem becomes:

$$\max_{R_t}(2\alpha - 1)[(E_t - E_tR_t - L_{t-1})^{\frac{1}{3}} + E_t - E_tR_t] + (1 - \alpha) \tag{20}$$

Maximizing the above yields the following optimal policy response with respect to relative incomes:

$$R_t = \frac{1}{27E_t} - \frac{L_{t-1}}{E_t} + 1 \tag{21}$$

With no expected change in relative incomes, the response is moderately pro-capital. The response becomes increasingly pro-labor as expected position falls. The response becomes increasingly pro-capital as labor is expected to improve its position. Thus, immigration policy under a social-welfare-maximizing agent should be roughly consistent with the policy enacted in the pressure-group model presented in the paper. Of course, maximizing a weighted average of utility can be consistent with vote-maximizing behavior as well.

## B Data Sources

The following variables were used in the empirical analysis. Descriptive statistics and additional information can be found in Timmer and Williamson (1996).

**Policy** The dependent variable is an index of immigration policy, ranging from 5 to -5. A positive score indicates a set of policies strongly pro-immigration; a negative score reflects policies strongly anti-immigration. A zero score reflects either a completely laissez-faire immigration policy—open doors but with no encouragement or discouragement, or reflects a mixture where pro-immigration offset anti-immigration policies.

**Wages** The nominal wage series is an index of the wages of urban, unskilled laborers, 1900=100. For the real wage series, this is adjusted for the cost of living, and rescaled such that 1900=100. Most are from Williamson (1995).

**GDP per capita** Gross Domestic Product is in current dollars, divided by population estimates, from various sources, including Mitchell (1983).

**Land Values** Nominal estimates. Missing years are estimated by linear interpolation. Specific sources for Argentina: K. O'Rourke, A. Taylor and J. G. Williamson, "Factor Price Convergence in the Late Nineteenth Century," *International Economic Review.* (1996).

**Unemployment** Unemployment is estimated as the residuals from regressing GDP on a time trend and the square of the trend.

**Growth** All growth rates are simple percentage changes from current year to the next. For example, for GDP per capita: $(Y_{t+1} - Y_t)/Y_t$.

**Immigration Rate** Annual immigration statistics prior to 1925 are from Ferenczi and Willcox (1929, 1930). Data from 1925 to 1930 are updated from the Department of Commerce (1960). Immigration statistics are available by country of origin. Where immigration is categorized by region, the following categorizations were used: United Kingdom includes England, Ireland, Canada, Australia, and New Zealand. Northern Europe includes France, Germany, Switzerland, Denmark, Sweden, Norway, and the Netherlands. Southern Europe includes Greece, Italy, Spain, and Portugal. Eastern Europe includes Austria, Hungary, Czechoslovakia, Latvia, Lithuania, Estonia, Russia, Bulgaria, Romania, and Yugoslavia. Asia includes all of Asia and the Pacific Islands.

**Immigrant wage** Weighted average wage of the country of origin of immigrants, using internationally-comparable real wages of unskilled urban workers from Williamson (1995). Eastern European and Asian wages are unavailable, and estimated as 2/3 and 1/2 of southern-European wages, respectively. Where available, the wages used are from the country of largest emigration from the region. (For example, using Italian wages in the 20th century as a proxy for southern Europe.) Weights are the proportion of immigration from the United Kingdom, North/western Europe, Southern Europe, Eastern Europe, and Asia.

**Threat** This variable was calculated to measure the extent which immigration reflected "unfair competition from cheap foreign labor," that is, a threat to unskilled resident labor. Calculated to interact immigration rates with relative immigrant quality: $Threat = (100 - IMWREL) * IMRATE$. IMWREL captures immigrant quality much as IMWAGE, but in this case relative to the receiving region. It measures wages in regions of emigration relative to wages in the country of destination.

**Foreign Population** For most countries, the foreign-born population is counted every ten years in census data. Using immigration data cited above, and in some cases emigration data, the between-census years are estimated. These estimates are divided by the total population estimates to calculate the percent who are foreign.

**Stock/Flow Gap** Using the annual composition of immigration (grouped as for the Foreign Population variable) and the annual composition of the foreign population, an index was constructed to measure a *shift in the composition* of immigration relative to the current foreign-born population. For each year and for each group the difference between the percentage of immigrants and the percentage of foreign born was squared, and all groups except "other" were then summed. The index has a minimum value of zero, if the immigration flow looks just like the current foreign population. The theoretical maximum value would be 1.

# IMAGE EVALUATION TEST TARGET (QA-3)

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