

Political Strategies and Nonconvergence:

An Introduction to the Credible Polity as a metastructure for the Weightless Economy^ψ

Abstract

Studies have contested the result of eventual convergence in economic income across countries and have suggested instead a polarization of the global distribution of income into only two clubs of convergence at the extrema. I argue that a similar pattern exists for political regimes as well. Together these results appear to be a challenge for conventional comparative political economy. However, I suggest how adopting a simple evolutionary game theoretic view on the subject allows an explanation for these parallel clubs of convergence in political regimes and economic income within the framework of existing research in democratization theory.

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1. Introduction

About the time Modernization Theory first suggested that tendencies for democratization emerge endogenously in economic development, the literature in economic growth was asking questions such as - Does the distribution of income in per capita for the world tend to collapse over time toward its upper extreme? Is the initial level of income for a country thus negatively correlated with its income in the long-term equilibrium? Can we expect convergence in economic income? While this proposition was tested and the convergence relationship established much later, the groundwork had already been laid by then.ⁱ These two literatures are not unrelated. In fact, far from being unrelated, convergence in economic income and the dynamic proposed by Modernization Theory gives obvious support to theories of eventual convergence in political regimes to democracy - which immediately brings the 'End of History' argument to mind. While the fundamentals of Modernization Theory were called into question based on its empirical validityⁱⁱ, the notion of political regime convergence or, we might prefer, the notion that liberal democracy emerging triumphant, did not seem to fizzle out.ⁱⁱⁱ

It is therefore interesting that recent literature debates results of convergence in economic income on methodological reasons and using simple alternate methods suggests that the global distribution of income might be stratifying instead.^{iv} They suggest nonconvergence in economic income across countries. Specifically this literature talks of the global distribution of income tending towards twin clubs of convergence - a high-income club and a corresponding low-income club with all middle-income countries eventually converging to one of these two clubs in the limit.

I start this paper by discussing a corresponding finding for political regimes as well. Under a wide variety of specifications, the global distribution of political regimes tends to show nonconvergence results as well. This is counterintuitive to those political scientists who might expect a complete convergence to democracy in "steady state". These two results - nonconvergence in political regimes and in economic income are jointly significant results for our field and deserve attention. Here I suggest a simple theoretical construct based on evolutionary game theory that allows us to deal comfortably with these results. A major problem with evolutionary game theory is that the results it produces are predetermined arbitrarily through the functional form. I therefore suggest a mechanism that allows instrumental behavior by political actors to be introduced. This behavior is disciplined on the micro and macro levels. On the micro-level political actors are guided by the first principles of political competition and the strategies they adopt are therefore couched in the language of multidimensional spatial voting theory. For the internal validity of this political-behavior at the macro level I introduce the Credible Polity concept, which is inspired by an interesting nonconvergence result - the Weightless Economy - and, therefore, neatly brings the argument back full circle.

In section 2 I begin by elaborating on the nonconvergence results. In section 3 I propose an evolutionary approach to explaining these results. Section 4 introduces the Credible Polity concept. I conclude with some brief remarks. The appendix to this paper introduces a new theoretical construct, (that is also amenable to being augmented by case-specific qualitative analysis) which suggests how political behavior might be controlled at the macro-level. This also helps connect the micro-level politician learning strategy and the macro-level Credible Polity in a single framework.

2. Nonconvergence in political regimes and economic income

While the topic of the methodology behind the analysis of convergence in economic income is interesting in its own right, it would better be the subject for an article in itself.^v For the purpose of this note however, the essential message will suffice for the uninitiated.

In essence, the neoclassical model for economic growth predicts convergence in economic income across countries in steady state when the growth rates of all variables of interest such as capital and labor are constant. This steady state is in fact stochastic and, in that sense, equilibrium error may affect relative positions or ranks of countries within the collapsed distribution. The result has typically been tested by demonstrating a negative coefficient on the initial income variable in a cross sectional regression with growth rates as the regressand. For convergence across countries, differences in educational attainment, political regime, infrastructure, openness and so on are often controlled for and conditional convergence is analyzed instead. Else these differences can somehow be held constant and absolute convergence can be tested, for instance, for within regions or states bound by a single union. Given some of the restrictive assumptions of the neoclassical growth model, it is surprising to find that studies find evidence in favor of convergence nonetheless.

One of the problems with this approach to analyzing convergence has been shown to be similar to Galton's fallacy of regression to the mean. (Quah, 1993) A cross sectional regression of this sort cannot produce anything but a negative coefficient on the initial variable of the series even in the hypothetical situation of a diverging cross-sectional distribution. Indeed, as can be easily replicated, this negative coefficient exists in a regression of change in institutional democracy levels on initial levels of institutional democracy for the Polity dataset just as well as it does for economic income. Any implication of convergence to the same level of democracy or income across the cross section from this artifact cannot be drawn reliably and conditioning the regression on suspect correlates such as the degree of enfranchisement or the level of openness of the electoral process is thus just as irrelevant as making any theoretical or philosophical assessments about the health of democracy in the world. Another related criticism with convergence analysis relates to the invariant finding of a 2% rate of convergence in

economic income under a wide variety of settings. This has been shown to be – in large part - a product of a unit root process in income streams for countries. Likewise there also exists strong evidence of unit root processes in the regime variables for Polity.

Therefore, the suggestion made by economic growth theorists is that a more direct examination of the global distribution of income is required. (Quah, 1993) One relatively simple manner of looking at this is through a Markov-chain fractile-state transition matrix, which can calculate the probability of movement across fractiles over a given period of time. More mobility in the center fractiles compared to the end fractiles shows the tendency of the distribution to polarize. This is one of the simplest and most convincing methods by which nonconvergence to twin clubs of convergence for economic income has been shown.

A natural question to ask is whether this holds for political regimes as well. Indeed, even simply plotting a histogram such as the one shown in Figure A for the institutional democracy variable in the Polity dataset gives reason for pause. Twin clubs of convergence in the attainment of democracy do appear to be forming over time. And, as suspected, a transition matrix such as the one shown in Table One also shows similar results that indicate a polarization of the ergodic distribution of political regimes. The off-diagonal elements, while obviously to be taken less seriously due to estimation inefficiency, generally also show more mobility in the center. This result appears to be rather robust under a variety of specifications, and, as Figure A illustrates, this dynamic seems to be even more exaggerated in the post-war years. Table Two shows that analyzing only those countries that have had at least 140 years to show convergence and changing the definition of political regime to one adjusted for the autocracy-score also indicates nonconvergence. While these tests are certainly not definitive characterizations of the ergodic global distribution of political regimes in and of themselves, the message of twin clubs of convergence in political regimes it provides is quite clear.

The manner in which the stationary distribution of political regimes repeats itself over time is of fundamental import to this idea. Indeed the very idea of unending waves of democracy in the world is premised on the notion of a replicating stationary distribution. Figure B shows the mean global autocracy and democracy scores as well as the autocracy adjusted democracy scores. Convergence to perfect democracy for the global distribution of political regimes does not appear imminent at all. In fact, if anything, it appears from the figure that the global distribution has converged to a stochastic steady state about a mean composite regime score of zero and not ten. However, this is pure speculation. A chartist interpretation of the plot could also be yet another confirmation of incipient nonconvergence.

3. An evolutionary approach to explaining nonconvergence

So how can we explain twin clubs of convergence in economic income and political regime within a single dynamic that is also consistent with our present understanding of democratization and growth when an explanation premised on explaining development using political regimes has been shown to be tentative or even ineffectual? (Przeworski and Limongi, 1993) Here I suggest adopting an evolutionary game-theoretic view to this problem.^{vi}

Evolutionary game theory is appealing for three very specific and compelling reasons. First, it is particularly adept at dealing with the tracking of changes over long periods of time. Evolutionary processes tend to take a long time to show dramatic results. And evolutionary game-theoretic models mimic this dynamic by studying the resistance of a particular equilibrium over another. If the players of one strategy have a relatively more lucrative payoff, they are able to gradually and systematically increase their “fitnesses” and eventually dominate the players of other strategies. Good strategies also tend to have higher resistances to minor “mutations” and require instead a much more sincere effort by players of other strategies to tip the outcome in their favor. War and revolution appear obvious candidates in this regard. The equilibrium distribution of the total population determines the strategies that are “evolutionarily stable”.

Second, the concept of resistances of strategies played by subpopulations allows the incorporation of a number of key insights in democratization studies relating broadly to demographics. For instance, an explanation such as higher observed fertility rates in autocracies as an evolutionary strategy that allows for a repressed population to increase its numbers to keep its fitness levels constant in the face of repression or even to tip outcomes in their favor becomes possible.^{vii} Relative class power and distributional conflicts have always been a pivotal element in democratization stories and fits in rather nicely with the notion of resistances of strategies.

Third, it allows for the adoption of a single objective strategy by politicians to produce divergent results by simply playing the game through a sufficiently large number of iterations. I provide an example of a simple learning strategy that can be developed from first principles of political contest. However, first I present an example of an evolutionary game that can simulate the empirical patterns we observe.^{viii}

3.1 Analysis of the Evolutionary Game

Let us consider an evolutionary game a little more closely. Figure One presents an example. The two players relevant in that game are a unified population body and a unified politician body. The game can very well be modified, according to the problem at hand to have instead two kinds of politicians or two pacts between politicians and various classes in the population, as is often the case.

		POLITICIANS	
		<i>Reform</i>	<i>No Reform</i>
POPULATION	<i>Reform</i>	10,10	5,9
	<i>No Reform</i>	4,6	6,12

Figure One: An Evolutionary Game

In this game however, the players can choose from two strategies – Reform or No Reform. We can denote these strategies by R and NR. Now let the average fitness of the players playing a particular strategy be F_R^t and F_{NR}^t , superscripted by time. Also, let the average fitness of the entire country at the outset of the game – that is the population and the politicians – be denoted by \bar{F}^0 .

The average fitness at time 1 of the players playing the reform strategy is thus autoregressive and can be written as

$$F_R^1 = F_R^0 + n_r^0 \Delta F(R, R) + n_{nr}^0 \Delta F(R, NR) \quad (1)$$

where $n_{r,nr}$ stands for the proportion of players playing each strategy.

Similarly, for the no reform strategy the fitness can be written as

$$F_{NR}^1 = F_{NR}^0 + n_{nr}^0 \Delta F(NR, NR) + n_r^0 \Delta F(NR, R) \quad (2)$$

Here note that while I have not done thus for the sake of simplicity, since our game was not symmetrical in payoffs, it is important to write fitness equations for each player separately.

We can now write the replicator dynamics for this game as follows. The assumption, to be more accurate, that needs to be made is that the game lasts a long time and that changes over a given time period are infinitesimal.

$$\frac{\partial n_r}{\partial t} = \frac{n_r (F_R - \bar{F})}{\bar{F}} \quad \text{and} \quad \frac{\partial n_{nr}}{\partial t} = \frac{n_{nr} (F_{NR} - \bar{F})}{\bar{F}} \quad (3)$$

With this information it is now possible to model the fitness of a strategy over time. As an example, consider the game we had considered above. For each player, we can write the fitness function as

$$F_R^t = F_R^{t-1} + n_r^{t-1} \Delta F(R, R) + n_{nr}^{t-1} \Delta F(R, NR) = F_R^{t-1} + n_r^{t-1} R_{p,l} + n_{nr}^{t-1} R(NR)_{p,l} \quad (4a)$$

and

$$F_{NR}^t = F_{NR}^{t-1} + n_{nr}^{t-1} \Delta F(NR, NR) + n_r^{t-1} \Delta F(NR, R) = F_{NR}^{t-1} + n_{nr}^{t-1} NR_{p,l} + n_r^{t-1} NR(R)_{p,l} \quad (4b)$$

where the subscripts p and l on the payoffs index the players in the game, namely the politicians and the population.

Specifically, for the population we would have

$$F_R^t = F_R^{t-1} + n_r^{t-1}10 + n_{nr}^{t-1}5 \text{ and } F_{NR}^t = F_{NR}^{t-1} + n_{nr}^{t-1}6 + n_r^{t-1}4 \quad (5a)$$

and for the politicians we would have

$$F_R^t = F_R^{t-1} + n_r^{t-1}10 + n_{nr}^{t-1}6 \text{ and } F_{NR}^t = F_{NR}^{t-1} + n_{nr}^{t-1}12 + n_r^{t-1}9 \quad (5b)$$

Note the following interesting feature of this particular game. Ignoring, for now, the variables on the right hand side in equations 5a and 5b, for the population, playing the reform strategy provides for higher fitness, and for the politicians playing the no reform strategy imparts higher fitness. These contradictory ideal fitness strategies begs the perennial question in evolutionary game theoretic approaches – which equilibrium should result – and might be resolved by looking at resistances. (Myerson, 1997)

The resistance of one equilibrium against another is defined as the maximum number of players playing one strategy required to infiltrate the population of players playing the other strategy before their evolutionary advantage is lost. The definition is awkward and is best understood by way of interpreting the numbers for the game. Specifically, in this game, the resistance of (Reform, Reform) against (No Reform, No Reform) is 3/5 and is thus higher than the resistance of (No Reform, No Reform) over (Reform, Reform), which is only 2/5. Therefore, unless more than forty percent of the total respective populations of the players want to reform, the country will be stable at the unreformed outcome. Similarly at least three-fifths of the reformers must want to reverse reforms for the equilibria to switch to the “inferior” outcome.^{ix} Although it need not always be so, in this game the superior outcome is also the risk dominant outcome. It has been shown that the long run equilibrium of such a game tends to coincide with the risk-dominant equilibrium due primarily to a specification of the process of mutation, which, in turn, can be significant over longer periods. (Kandori, Mailath, et. al. 1993)

While resistances are useful in evaluating the stability of an equilibrium in a game, in studying economic and political reform, especially in transition countries, we are very interested in the time aspect as well as the capability or fitness of a country. That capability may stem from the success of its initial reforms, the dedication of the political elite, or even simply exogenous factors like terms of trade shocks and the ability to get loans for the construction of social safety nets. Transition theorists have always had a hunch that variables with temporal elements in them like the speed of reforms, the number of elections conducted, intergenerational effects and so on are important in their studies. To examine the effects of fitness and time in this evolutionary game we must bring back the variables we ignored earlier. I find it easier to run some sample simulations of the model to keep track of what effects these variables are having.

3.1.1 Some Simulations of the Model

Figures 1 through 4 are examples illustrating the workings of the model outlined above. While the concept of an equilibrium's resistance provides for understanding outcomes in terms of minimum proportions criteria, it says nothing directly about the effect of average starting fitnesses, the rate of convergence to the equilibrium outcome, and so on. Some simple simulations prove rather instructive here in my view.

In figure 1, the initial proportions of reformers and non-reformers have been set to be equal to each other and the initial fitness of the subpopulations is identical. In this case evolutionary advantage "naturally" obtains from the payoffs the players receive in the game. The simulation shows, as expected, that the reform strategy has an evolutionary advantage for the population and the non-reform strategy has an evolutionary advantage for the politicians. Convergence is complete, non-oscillatory and more rapid for the population than the politicians. Note that the figure is not suggesting that the final outcome in the game would be politicians steadfastly playing no reform and the populations obstinately playing reform nevertheless. It only suggests which strategy has an evolutionary advantage for a subpopulation and only one of the reasons why rational individuals might want to play a strategy.

In figure 2 the simulation has been slightly perturbed from the one illustrated in figure 1 by providing the "natural" strategy that the subpopulation is drawn towards a handicap, while still keeping the starting proportions identical. Now the strategy that provides politicians with an evolutionary advantage is that of reform instead. Convergence is direct and rapid. For the population, while handicapping the natural outcome still eventually gives the reform outcome an evolutionary advantage, convergence is now oscillatory and much less rapid. Due to the higher starting average non-reform fitness, the population initially seems to have evolutionary advantage playing the non-reform strategy instead.

Finally, in the figure 3, the handicap for the politicians is reduced, while the handicap for the population is made much more severe. Starting proportions are still the same. Here note that no reform appears to have finally taken over as the strategy with evolutionary advantage for the population. Convergence seems complete, non-oscillatory and very rapid. The decreased handicap for the politicians causes convergence to the reform outcome to be more gradual, but still direct and, by the 264th time period, complete to the 15th decimal place. However, the figure is unable to show clearly that convergence for the population to the non-reform outcome was initially not complete and the "natural" outcome of reform begins to regain evolutionary advantage. In this case, convergence to the strategy with evolutionary advantage for the population is indirect, oscillatory and gradual. Convergence, complete to the 15th decimal place, is achieved only by the 213th time period.

Another way in which we can manipulate the fitness of a strategy in this model is by changing the starting proportions of each subpopulation playing each strategy. The

simulation for figure 4 was run for 50,000 time periods to check for any late unexpected oscillations in evolution strategy. None were found. Then the initial proportion of politicians playing the reform strategy was decreased to approximately 16%. Figure 4 illustrates that now the no reform strategy once again has evolutionary advantage for the politicians in spite of it being disadvantaged at the outset due to lower fitness than the reform strategy.

3.2 A Strategy for Politicians

The simulations are based on a population and a politician subgroup playing either of two strategies – Reform or No-Reform. While these strategies were obviously not pulled out of thin air, and indeed owe to a large body of literature in politico-economic transitions that views the process in a likewise manner, similar simulations might well have been produced using strategies of Converge and Don't Converge, which are ludicrous. To some, it might be of little use to see carnivores with sharp teeth and then impute them to a deliberate decision made eons ago on whether or not to they increased fitness showing of course that they did. What would be more interesting would be to examine how the decision to survive endogenously led to the development of sharp teeth. In similar manner, what might be of more interest is a suggestion of how a decision to survive by the political elite produced democracies or autocracies and high income or low income over the passage of time.^x I suggest therefore that this learning strategy be derived for the politician. This strategy should satisfy the politician's motivations for survival while also giving a solid basis for explaining how twin peaks in political regimes and economic development might occur.

If we forget for the moment the traditional classification of political regimes, we have a situation of some political actors in charge of representing members of their society. Assume that these politicians are rational agents who want to maximize their chances of staying in office and power. In order to do so assume that they must adopt a strategy that promises them success. Assume also that the strategy adopted cannot violate parameters set by the selectorate.^{xi} Development economics tells us that being credible, or rather, having a stock of credibility, allows politicians to undertake economic reform with more chances of success and is thus important for that reason to economic success as well.^{xii}

Consider the very simple case where we operationalize the politician's objective as seeking to maximize residual income. This approximates the scenario where the politician uses his or her office to extract an income or power or anything else he or she might want. Call this Y. The point of import here is that the politician must restrain his or her behavior due to an accountability constraint of the form

$$r(t) < u_i(G)$$

The constituents of the locality must have a utility level higher than the value of this function, which in turn increases at an increasing rate in its argument t, which we can

assume to an undesirable “tax rate” he imposes on them to generate some ‘public good’. It is also possible to see the threat point as determined by a public evaluation of a vector of local policies instead. The material point is that the selectorate want their politician to have credibility and therefore, a potential threat point of recall exists in the society. Solving maximization problems like these gives the typical result

$$\lambda = \frac{Y}{\left(\frac{Y}{G}\right) - r'(t)}$$

which we can interpret as suggesting that the utility to the politician at the margin of the selectorate’s utility will depend positively on the rate of change in the threat point from a given increase in t . The more tolerant his constituency of a higher t , the less likely they are to increase their threat point, and the better off the politician will be. As would be expected, the effect of the marginal utility of the public good to the selectorate appears negatively.

Therefore, in this kind of setup, if the politician were to increase the tax rate, and, for the selectorate, the marginal change in the threat point is very high compared to the increase in their marginal utility from consumption of the public good, then the politician will have to ‘care’ more about the selectorate’s utility. This is an intuitive result and is the basis for a learning strategy for survival.^{xiii} In order to satisfy his or her objective successfully, the politician must learn the behavior of his or her selectorate’s accountability constraint.

However, this, in my view, is yet vague. This is just another way of saying that the politician must, at the margin, learn to oppress effectively. It says nothing about how this helps him stay in office and little about how he or she can accumulate the credibility capital necessary to pull off successful reform.

Here multidimensional spatial voting theory, under assumptions of Euclidean preferences, suggests a useful insight into the exact manner in which the objective of staying in power automatically creates credible politicians.

In the case of a two dimensional issue space^{xiv} the yolk is defined as the circle of minimum radius that intersects all median lines and is thus a measure for how the particular combination of ideal points represented causes the issue space to depart from the usually uninteresting case of a single unbeaten point. While this is not always true, it is generally true that the size of the yolk shrinks with more heterogeneous preferences as Figure C illustrates. Obviously it behooves our politician to locate himself as close to the yolk as possible. But what of the accountability constraint that is so crucial to generating credibility?

This can be achieved by adopting a learning strategy of locating oneself on the issue space inside the ‘finagle circle’, or more formally the competitive solution, which is an even smaller area within the yolk of the issue space that outlines the size of minimal

adjustments needed to a platform and promises victory without losing any credibility at the least and usually gaining even more credibility. The idea of an accountability constraint is modeled using the size of the radius of the finagle circle, which, in turn, measures the selectorate's 'finagle tolerance'. (Wuffle et. al., 1989)

Now note here that with the strategy of locating oneself in the finagle circle, it has been shown that as more and more people are enfranchised or somehow begin to be represented on the issue space the size of the finagle circle becomes strictly smaller and smaller.^{xv} This is an interesting result because it implies more specifically that all that is needed is heterogeneity in the selectorate's preferences to ensure politicians with higher credibility capital. There might even be reason to believe that heterogeneity, working in this model through higher accumulated credibility capital by relevant political actors, might lead to better democracy. The idea is simply that since heterogeneity decreases the size of the finagle circle, if the unbeaten political actor must locate himself within it, then he must consequently be doing the will of the masses more times than a political actor operating within a larger finagle circle. Heterogeneity, when achieved and not when there is simply a potential for it, should therefore be related to better democracy, a claim contradictory to the status quo of the literature, which tends to look at latent heterogeneity in society (using fractionalization indices) and not in the political space itself.

Indeed if we look at the patterns in the data, we observe encouraging trends. Using data from the World Audit Organization based on Freedom House and Transparency International among others, out of a total of some 129 countries that can legitimately be classified as democracies, I find that 88 are more akin to an ideal type presidential system and the remaining 41 are more akin to a textbook parliamentary system. World Audit ranks democracies based primarily on civil liberties, freedom of the press and the level of corruption and we find that the mean democracy rank in presidential regimes is more than two times lower than in parliamentary regimes (approximately 80 compared to 38 with about 13% more variance in rankings for presidential regimes). Due to their definition of democracy rank, it is unsurprising that they find that parliamentary regimes also have much higher press freedom than do presidential regimes, a variable that contributes in no small measure to increased heterogeneity (a mean rank of 30 compared to 51 with little difference in variance). It is worthwhile to consider what the relationship between credibility capital and heterogeneity looks like to see why this is not an entirely fruitful manner of looking at the issue of political regime choice.

There is reason to believe that credibility capital is accumulated at a decreasing rate in heterogeneity. If the relationship were convex instead then, taken to the limit, increasing heterogeneity would cause relatively lesser and lesser flexibility for the politician over time till the finagle circle collapsed on a single unbeaten point which represents maximum possible credibility and is the upper bound on the relationship.

The problem here is that this can conceivably be achieved at any amount of heterogeneity provided the placement of the ideal points on the issue space is such that it satisfies two conditions. First, that the ideal points of the selectorate are an unbiased sample of the larger population and the true ‘full-heterogeneity finagle point’. Credible autocrats, after all, do what is the true will of the people. Second, assuming, of course, that this point itself is not perturbed over time. But of course this point does shift over time with exogenous shocks, changing preferences, socioeconomic modernization and so on. And if it does then it becomes less and less likely that the first condition of unbiasedness will hold. This is why I believe that some suspect that economic development is actually held back by a select political economic elites for fear of a politician replacement effect at work every time the status quo is jolted. (Acemoglu and Robinson, 2002)

Apart from shocks to the issue space itself, there are also other reasons to believe why full credibility might not be attained. I believe the role of what Huntington calls interest-aggregating political institutions such as parties is crucial, for, they are able to specialize over a subset of the issue space and systematically internalize points turning up in that area of the issue space. If parties can speak for their members, then the size of the party-defined finagle circle can be kept relatively stable even as heterogeneity increases. A stable party platform provides credibility to the party and allows the party to continue internalization of ideal points over time, but prevents the ‘full-heterogeneity finagle point’ from obtaining. This result is very similar to Tsebelis’s (1995) observation that collective veto players are able to move the status quo in situations where individual veto players would be unable.

The only other strategy that this setup would allow to be played against this one is obviously one of the politicians disallowing entrance into the issue space in the first place and surrounding themselves with loyal followers, or in other words, limiting heterogeneity (because random issue-space infiltration causes the strategies to behave like corner solutions). This would allow them to define the characteristics of the finagle circle for themselves including its location and its size. A side effect of this strategy is of course the lack of credibility the politician suffers and therefore a tendency for economic reform to fail from being seen as purely redistributionary. Both strategies played in pure form produce non-convergence results, but there is no strict direct correlation between democracy and subsequent higher income even though fewer barriers to entry in the issue space is a quality of institutional democracy. Similarly there is no necessary correlation between autocracy and lower income even if repression is the hallmark of autocracy since it is quite possible that the party defined finagle-circle closely coincides with the real finagle circle as defined by the entire electorate.

While this, therefore, neatly achieves the objective of providing a probabilistic link between regime type and economic development, a missing link here is the motivation

behind the necessity of a premise where credibility is important in politics. Here I introduce the concept of a Credible Polity, which approaches the problem of the role of political credibility in economic development from a different and very forward-looking perspective.

4. The Credible Polity

4.1 Politics in Knowledge Centers

Agglomeration or clustering of economic activity in cities has been studied extensively and is typically shown to be related to minimizing both transportation costs for a production line and the negative externalities of proximal production while concomitantly maximizing the advantages of increasing returns through scale and scope economies.^{xvi} This dynamic, while very relevant, does not seem wholly appropriate for knowledge products of a Weightless Economy that theoretically incur negligible transportation costs.^{xvii} Indeed, what is different about agglomeration in the weightless economy is that it seems to be driven by consumer demand instead. A high consumer demand for a knowledge product implies its popularization, which in turn leads to improvements and enhancements in a path dependent manner. A low consumer demand or controlled consumerism would thereby increase the long-term cost of adjustment and this would lead to clustering. Spatially, this represents itself in the form of thriving cities while temporally this provides some motivation for observing the non-convergence results in economic income across countries discussed above.

Quah (1999, 2001) suggests the instructive story of a failed Industrial Revolution in 14th century China, where, the possible long-term advantages of being a vastly technologically advanced society of its time went to waste due to a monarchy that regulated consumer demand closely. Eeckhout and Jovanovic (2002) suggest how even exclusive free riding off the innovators can still lead to inequalities since the effort expended by the laggards is suboptimal.

The studies reveal a fascinating empirical regularity. If consumer demand is taken to be pivotal in developing knowledge clusters then it is natural for a political scientist to ask how this consumer demand fosters in one polity continually and how it can be inculcated by a government seeking reform? The answer provided by one of the early authors of the weightless economy appears to be twofold – devolution of power to city governments and, generally, minimalist and non-interventionist government that provides the metastructure for the unfettered functioning institutions. (Coyle, 1998) There is definitely merit in these suggestions, however they seem rather cursory for a topic of this magnitude and provide little if any role to systematic analysis from a political science perspective.

I therefore introduce here a similarly unadorned but hopefully more systematic answer to the same question by introducing the concept of a Credible Polity. A credible polity is simply one that abides by two simple principles. First, a credible polity has *complete*

political representation and has *zero* barriers to entry in being represented *directly*. And second, a credible polity is characterized by political representatives with *only one* objective – maintaining power. A polity satisfying both conditions completely is a credible polity in pure-form – or a fully perfect credible polity – and, I will argue, is more than is required to generate the symbiotic relationship between the political and the economic spheres that leads to clustering of economic activity that aids development and long-term income.

The organization of this part of the paper is as follows. In the following section, I outline the more carefully the necessity of the two characteristics and other features of the credible polity. I then examine the effects of relaxing some stringency in the principles of a credible polity. I then suggest, how the credible polity is related to the economy by suggesting its specific relationship with the weightless economy. Finally, I make remarks to introduce the appendix to this section of the paper, which is a formalization of the mechanism of control in the credible polity.

4.2 The Credible Polity

Let me begin with an important remark. The credible polity is independent of specific political regime type even though a fully perfect credible polity has close resemblance to an ideal form of democratic government and a fully imperfect credible polity has implications that make it appear remarkably like a textbook autocratic government. The credible polity is for this reason a useful tool for studying the relationship between political regimes and economic development without falling into the trap of selecting on the dependent variable that has brought many such analyses under embarrassing scrutiny.^{xxiii}

We can now start by examining the major characteristics of a perfectly credible polity.^{xxiv} The political entity in charge – let us simply call it the government – in such a polity receives no economic rent since there are zero barriers to entry and all supernormal profits are therefore driven away by competitor governments. All governments thus face a perfectly elastic demand for their services. Imagine that a real-time *election* process is at work even while a government is in office with an infinite set of governments in the running. It also represents the entire population directly and there are thus no brokers between a citizen and the political entity. The government itself has no other objective other than staying in power – it desires no legacy (for there is no term-limit), has no charisma (since all governments are identical) and certainly enjoys no loyalty in the form of a sticky partisanship effect.

The name, perfectly credible polity, of such an unexciting polity derives from the fact that the government will have an infinite stock of credibility with its population since the threat of recall is immediate and perfect. An even more interesting feature is that the stock of credibility is set to its maximum possible value at the start of time and even a

theoretical change in government, owing perhaps to a shift in preferences, would not alter its value since adjustment to a new government would be instantaneous.^{xx}

Now let us consider the fully imperfect credible polity, which in turn is a polar opposite of its fully perfect version. The government in this equally colorless setup is a perfect monopoly and thus never has any competitors to contend with. It creates impenetrable barriers to entry into the political sphere at zero cost to itself and extracts maximum rent by virtue of it having a monopoly status. The government, of course, represents no one yet the population has a perfectly inelastic demand for this government.

Credibility in a fully imperfect credible polity is an oxymoron. The population has no threat of recall ever and the stock of the credibility it thus provides its government remains at the lowest possible value indefinitely.

While a more exact derivation of these results would be a digression^{xxi}, it is still instructive to understand intuitively some more formal foundations for these hypothetical cases. The usefulness of this abstract construct will hopefully become more transparent if we understand its origins.

Let us again employ the language of spatial voting theory in our analysis since this will help in drawing the connection the learning strategy discussed above. Assume again the simple two-dimensional issue space (packages of guns and butter perhaps being the only choices) with preferences measured in Euclidean distance. Recall the two concepts of the yoke and the competitive solution or the finagle circle. Now we can return to the analysis of the credible polity again. Note that the position of the finagle circle will likely alter with any positive rate of infiltration into the issue space over time or a change in the preferences of those already represented and a concomitant rate of adjustment to the finagle circle becomes an issue in determining the length of time the polity stays out of equilibrium and perhaps loses credibility. In a fully perfect credible polity, of course, the rate of issue-space infiltration is zero since everyone is represented at the start of time. The radius of the finagle circle remains unchanged and, under some conditions, is actually zero, with the finagle point and the median voter being superimposed. Similarly, in a fully imperfect credible polity, the rate of issue-space infiltration is again zero since everyone is disenfranchised forever and any change in the preferences of the population are disregarded. The radius of the finagle circle is the maximum possible value allowed by the issue space since the government can ‘finagle’ to whatever part of the issue space it pleases provided, of course, that it is feasible.

In a polity that exists anywhere on the spectrum between these extrema the rate of infiltration^{xxii} into the issue space and shifts in preferences would matter. An example would be illustrative here. Assume that such infiltrations happen in discrete time and at regular intervals. Elections might be a helpful imagery to have in mind. Every time there is an issue-space infiltration or a shift in preferences, the position of the finagle circle is perturbed. Even with politicians actively seeking to rediscover the position of the finagle

circle, for any time spent politicking from outside the finagle circle or, for that matter, even possibly the yoke, the polity is in disequilibrium and the government loses credibility and popularity. The speed of readjustment is a function of the level and quality of information the polity has about such changes. Disenchantment with the new government in many countries undergoing economic and political transitions occurs precisely because of the poor quality of information politicians have access to at a time when the shifts in preferences *and* the rates of issue-space infiltrations are large and frequent.

Only in a fully perfect credible polity is there no disequilibrium since information is always perfect. In all other cases disequilibrium is managed either by gathering information directly or enlarging the size of the yoke itself. Information can obviously be gathered through polling, canvassing, interviewing and the like. The size of the yoke can be enlarged by making issue-space infiltration rates artificially smaller through the creation of parties or interest groups that internalize the ideal points of its members. Institutional issue-space infiltration then allows for far more flexibility in terms of a larger set of feasible solutions and a more forgiving size of the finagle circle. Shifts in underlying preferences or any change in the composition of members of such institutions would of course change the size and location of the finagle circle (through a change in the institution's own internal finagle circle), however the degree of complexity in finding its new location is reduced manifold.

4.3 The Credible Polity and the Weightless Economy

The emphasis on credibility is in no small measure also a means of critically assessing the latent processes behind the development and aftermath of that very climacteric event, which causes a shift in political regime and, in so doing, makes the entire process much smoother in our understanding. And this emphasis on credibility is not new nor is it unfounded. Scholars in development economics have long recognized its importance as a tool to enable economic reform. In macroeconomic growth theory and political science it has been studied in relation to central bank independence, debt and stabilization and, relatedly, in comparative politics it has been considered crucial in wage bargaining.^{xxxxiii} Credible commitments to party platforms has been a well studied issue in political science in relation to everything from roll-call voting behavior to convergence properties in multidimensional spatial voting models. In international relations, credible commitments have been studied in relation to deterrence theory and the ability of political actors to make agreements at the international level in a two-level game with non-trivial national politics.

Usage of the term credibility in such a plethora of contexts gives it a very amorphous character thus making it uncomfortable for some to see it as a crucial factor. But in this variety of applications, the fundamental common factor is the affect of risk, ameliorated by credibility, on the variable of interest. That is, in essence, also the driving force behind

the credible polity and precisely why it is so closely related to the weightless economy. The credibility capital of a polity determines the political risk investors and consumers perceive and risk in any form dictates where productive capital (in any form) is employed. For without a polity that employs its credibility capital in guaranteeing ownership of the knowledge product and subsequent right to the income stream it produces, the weightless economy would fail to grow. If a weightless economy could grow independently of a credible polity, it would thrive in North Korea and Cuba to the same extent as it does in the US or Germany.

4.4. Some Remarks

The credible polity construct is more than just a method of introducing political relevance to economic development. It is, in itself, also a framework for analyzing transitions in political regimes. And it does so without simply ordering existing regime classifications and providing an argument with an inherent step functional form. The credible polity is a continuous latent process that does not come to life only in times of *transition* in economic systems or political regime. In fact, as the appendix suggests, it is for this reason better formalized using control process engineering theory that is meant precisely for constantly adjusting and readjusting towards an equilibrium and not only when the system is wildly out of equilibrium.

Note that we can start from any specific location on the imperfect to perfect credible polity spectrum less than the perfect and, by application of its two principles, converge towards a perfect credible polity directly, without oscillation and theoretically in one-shot.

Another implication of the analysis here is that as democracies start becoming more and more perfect in the sense implied by credible polities, we should start witnessing fewer and fewer changes in government and a convergence of all candidate governments to the center.

5. Concluding remarks

If the global distribution of political regimes, just like of economic income, shows tendencies to polarize into twin peaks of convergence then a theoretical explanation that ties both dynamics would be helpful to our understanding. While we know that a correlation between democracy and higher income exists, we also know that this relationship is weak. Nevertheless, studies of cross sectional convergence in income are able to show absolute convergence more convincingly for states within countries or countries within a union where political regime is an obvious metastructure which often gets subsumed in other variables of interest.

In essence, we know that regime change and economic development are intrinsically related, but not in a straightforward fashion that allows us to provide a simple story – especially a story like Modernization Theory that would allow us to not have to worry

about either regime change or economic development since one or the other would naturally obtain simply over the course of time. An alternative explanation eludes us however and so I suggest an evolutionary game-theoretic approach, which creates probabilistic trajectories we seek.

Time remains a crucial element from an evolutionary perspective too, but for a specific reason. It allows mutations in groups playing a specific learning strategy to have their fullest effect on the system. Climacteric events such as war or occupation can be seen as epidemics that would suddenly increase (or decrease) the rate of mutation for a particular phenotype or subgroup in a population. Alliances with other groups, repression and revolt would also increase the fitness of some groups over others. In other words, time and such events would allow for the fitness of one group to grow in relation to another eventually to the point where one group and its strategy emerges dominant. The idea of strategies then characterizing a steady state or an “end of history” for the economy and polity is more contentious and of course rests on the notion of the adopted strategy being immune to mutations.

In a game of evolution the strategy a group of players adopts is crucial to their survival. However the strategy adopted must be a simple and logical rule that provides the group with a chance for survival. The strategy I suggest here is simple and logical and based on the first principles of political competition - find and locate yourself in the finagle circle so that you can successfully beat all political competitors. It is a convenient finding then that heterogeneity leads to a shrinking of the finagle circle, which implies a tendency for policy stability and a simultaneous accumulation of credibility capital which is important for economic reform. Heterogeneity also changes the size and location of the finagle circle itself, which under less than perfect competition, would imply that adjustment to it will not instantaneous, without oscillation and complete. This would allow for an alternation of power.

Homogeneity, either intrinsic or contrived would imply a relatively larger finagle circle and relatively lesser credibility. The polarization dynamic for political regimes occurs in this framework simply through the degree of heterogeneity and the polarization of economic outcomes due to the resultant credibility capital accumulated necessary to pull off successful economic reform. This is of course only part of the story and I suggest how it is possible for a homogeneous selectorate to lead to a credible political elite. This politician could then prevent reform for fear of increasing heterogeneity if the status quo is desirable or encourage it if it is not. This framework provides no method of ascertaining that and an interesting next step in this line of research would be to provide a few case studies.

Running simulations of even a simple evolutionary model reminded us of the complexities that can arise in the evolutionary dynamic and that oscillations of strategy fitnesses are quite possible over time. All this when a specific payoff was imposed on the

game. It is of course perfectly plausible that a new strategy emerges and the game starts afresh. This game was played in retrospect based on (sound) theories that posit that economic reform provides for higher income for countries than those that remain unreformed. It therefore only provides a heuristic rule and not any serious predictive power, especially not in a system that has a different set of theories as its parameters. Predicting how many democracies will there be in the world thirty or hundred years from now must therefore take the state of our knowledge about politics and economics as a necessary constant.

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APPENDIX
An Application of Control Process Engineering Theory to the
Credible Polity Construct

1. Usage of Control Engineering

The typical use of control engineering – and its hallmark PID controllers – varies from designing robotic responses, fluid mechanics, industrial engineering, aerospace engineering, and so on. It is employed in designing and analyzing various sorts of systems that require carefully the monitoring and controlling of specific processes.¹

With respect to analyzing the credible polity construct, it suggests how a behavior as complex as a government’s movement from a theoretical ideal may be manipulated and controlled by providing a useful framework that, we will see, allows both quantitative rigor and qualitative insight. In order to understand the example below the assumption should be kept in mind that the fully perfect version of the credible polity is being discussed. The fully credible polity is a simpler construct to deal with, but the analysis can surely be expanded to more complicated cases. For instance, with indirect representation, we would have nested controllers. The population would be assumed to be interested only in movement of the party government to the party-defined finagle circles and thereafter the parties would be interested in controlling movement of the final government towards their finagle circle and *away* from the true finagle circle.

2. Control Engineering: The Credible Polity Example

In our example, the process is the distance the government moves away from the finagle circle and the distance itself is the variable that the population seeks to measure and control owing to its effect on aggregate welfare. The population’s controller is a threat instrument measured on some numeric scale (from the lower bound representing no threat to the upper bound representing maximum threat) and its function is to generate an output that moves the government’s position in the issue space. Adjusting the threat level determines the desired rate of adjustment. A higher threat level corresponds with a desired goal of faster adjustment.

A caveat is in order here to the statistically minded who will notice similarities of this setup to other econometric approaches such as VEqCM. It is important to bear in mind, however, that the control-engineering viewpoint is suggested here as a method to model a behavior *ex ante* while VEqCM might be a useful and complementary approach to take in testing the model *ex post*.

¹ While books and journals dealing with control theory abound, for more on PID control and a very detailed analysis of aspects of control theory Dean and Wellman (1991) is a good place to start.

3. Proportional Corrective

Suppose that at time t the threat level is $V(t)$ units and that this level is sufficient to allow the government to detract from the finagle circle by some $F(t)$ units. This process has a gain of $G_p = F(t)/V(t)$ which measures how much the process variable changes when the controller output changes.

So threat in the polity works through the process model

$$F(t) = G_p \cdot V(t) \quad \text{eq. 1}$$

But the threat instrument of the population also has a gain G_c that determines the controller's (the threat instrument's) output at time t according to

$$V(t) = G_c (F_{\max} - F(t)) \quad \text{eq. 2}$$

where F_{\max} is a constant that describes the maximum distance that the government can stray when the threat level that the population can exert is at its highest possible value. So the quantity $(F_{\max} - F(t))$ that enters the threat controller's calculus as an input gains strength by some factor G_c before it is outputted to the process as a control effort $V(t)$.

This controller equation can be rewritten as

$$V(t) = G_c (F_{\text{goal}} - F(t)) + V_B \quad \text{eq. 3}$$

where F_{goal} is the desired theoretical distance that the government is wanted from the finagle circle and is achieved when the distance itself equals the setpoint. $V_B = G_c (F_{\max} - F_{\text{goal}})$ is a constant called the bias. The threat instrument's bias represents threat level required to maintain the process variable $F(t)$ at its desired level in the absence of a load on the system (an exogenous shock).

Then equation 3 shows how the threat controller output might be computed as a result of the error between the process variable at the theoretical goal. It is called a proportional control system due to the gain coefficient. The greater the error the greater the threat effort and as long as error remains the threat instrument controller will continue to output a corrective level of threat.

4. Integral Corrective

The problem is that, in the presence of an exogenous shock or load to the system, the proportional corrective will likely leave a steady state error in the process variable of adjustment to the finagle circle. Suppose that the process gain G_p is 1 so that any threat level will cause an identical adjustment in the rate of distance detraction from the finagle circle. Suppose also that the threat instrument's gain is 1 and the threat instrument's bias is also 1. If the distance detraction rate goal requires F_{goal} to be 3 and the rate is only 2, there will be an error of $(F_{\text{goal}} - F(t)) = 1$. The threat instrument controller will amplify the

error to a threat level of 2 according to equation 3. However, since that threat level of 2 will, in turn, cause the government's rate of detraction from the finagle circle to remain at 2, the controller will make no further changes and the error in distance will remain at 1.

An integral corrective can solve this problem by generating a threat level corrective proportional not to the present error, but to the sum of all previous errors.

In the previous section the threat controller uses the threat instrument to control the distance the government moves from the finagle circle. Here too, the objective is to readjust the distance a government moves whenever a load or exogenous shock causes a significant change to its position. The process variable in this case is still $F(t)$ and it still measures the absolute level of the distance the government is away from the finagle circle and F_{goal} is again the desired distance from the finagle circle (theoretically 0).

Here

$$F(t) = \int G_p V(t) dt \quad \text{eq. 4}$$

which shows that the distance depends not only on the level of threat but also on the length of time the threat is applied and thus, in the sense of integral action, the threat controller's effect is not more effective. This threat controller will not generally permit a steady-state error.

Consider the situation where the government's distance from the finagle circle decreases until its desired value and the threat output ceases. If, however, the threat controller and the distance process follow a function such as equation 4 then the government's distance from the finagle circle would grow unboundedly as the steady-state error would explode.

5. Bang-Bang or Derivative Corrective

In combination, the PI controller – i.e. with the proportional and the integrative components – is effective but might take too long to compensate for an exogenous change that alters the system. Here the derivative corrective is useful since it generates a threat control proportional to the time derivative of the government error. Therefore, in a perturbed system, the derivative control would generate one large threat action (hence, bang-bang) to begin eliminating the government error immediately.

If, for instance, a surge in government error occurs at time, the time derivative function of the government error in distance from the finagle circle would demonstrate an even larger surge at t_1 since the derivative of a step-function is an even more pronounced impulse function.

6. PID Control and its Problems

The form of a PID controller then is

$$TC(t) = P \cdot e(t) + I \cdot \left(\int_0^t e(t) dt \right) + D \cdot \left(\frac{d}{dt} e(t) \right) \quad \text{eq. 5}$$

where $TC(t)$ is the threat control output at time t and P, I and D are known as the tuning constants. $e(t)$ is simply the difference between the setpoint and the process variable or $e(t) = (F_{goal} - F(t))$

The problem with bang-bang control is that it is crude and on its own (i.e. without integrative and proportional correctives) would make for a poor control instrument.

Integrative correctives are susceptible to the closed-loop problem that a large gain will allow aggressive threat control usage to transform the error into another large error in the opposite direction and the controller is then likely to cause the hunting problem of oscillating between maximum threat output and minimum threat output. Proportional correctives would be unlikely to cause this.

7. Bridging the Gap with Qualitative Analysis

Distance from the finagle circle as a process variable of such pivotal importance would be hard to digest for a researcher that is not comfortable with the multidimensional spatial voting model premise to begin with. To appears to specific and seems to neglect any case-specific information that in-depth analysis might be able to provide. In this section, I suggest how this divisive issue can be resolved by employing fuzzy-logic controllers.²

Consider this example. Assume that a controller with two inputs is what is deemed appropriate. Concretely, consider the following dynamic PI controller

$$\Delta v_r = \Theta_r \cdot \Delta f + \Theta_r \cdot \left(\frac{\Delta t}{T_i} \right) \cdot f \quad \text{eq. 6}$$

where f represents the variable to be controlled, v represents the control action variable and Θ is the gain of the process.

The qualitative researcher (or even perhaps the aggregate populace) can be seen as an expert tuner of controllers. Their intuition, honed through experience, is able to guide them as to what gains can be expected from a tuning coefficient and thus how to effectively package the total control effort in a given period. However, experts, having witnessed a government that has strayed some distance from the socially desired outcome are likely to suggest a level of threat effort based on current and past deviations of the government not in numeric terms but rather is linguistic ones. They might suggest “just a teeny bit” or a “nice healthy dose” of threat control.

This can be operationalized using fuzzy-logic control or FLC. Fuzzy logic is the superset of set theory. Rather than clean distinctions of set membership that Venn diagrams routinely portray, fuzzy sets are better seen as smudges such that the center of

² For more on this approach see Russo and Jain (2000) and Reznik and Reznik (1997)

the set indicates rather clear membership, but at the outer edges the probability of membership to that set diminishes. Specifically set membership is a function bounded by 0 and 1 and often takes the functional form of a trapezoid or an isosceles triangle.

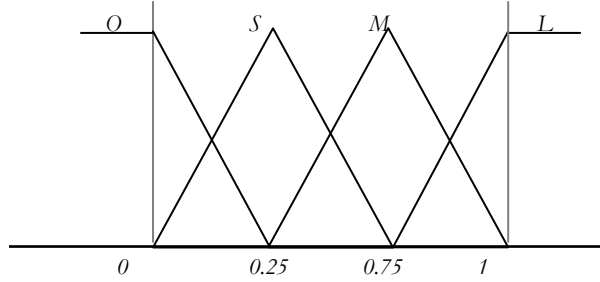


Figure One: Normalized Isosceles Membership Functions

Both inputs of the PI controller in eq. 6 are then normalized such that they can be represented on the same scale when *fuzzified* into categories such as Zero (O), Small (S), Medium (M) and Large (L) as shown in figure one. Then a control algorithm such as the one shown in figure two is devised that relates the control action to inputs. This control algorithm takes the form of a matrix, which is why FLC would dictate a rather complicated 3-D control algorithm matrix for a PID controller. The control algorithm would of course have to be based on rich and contextual information from experts. Thereafter group membership rules would have to be devised for the control action such that it follows a fuzzy-set logic or

$$\begin{aligned} \Psi_{A \cap B}(y) &= \Psi_A(y) \cap \Psi_B(y) && \text{MIN} \\ \Psi_{A \cup B}(y) &= \Psi_A(y) \cup \Psi_B(y) && \text{MAX} \end{aligned} \quad \text{eqs. 7}$$

where Ψ is the membership function bounded by 0 and 1 such as a cdf appropriately stretched according to the level of certainty of the expert. This weight can be determined in the next step and initialized at some reasonable seed value.

		<i>Proportional Control</i>			
		O	S	M	L
<i>Integrative Control</i>	O	O	S	S	M
	S	S	S	S	M
	M	S	S	M	M
	L	M	M	M	L

Figure Two: A Possible Two-Input PI Control Algorithm

Now, obviously a step needs to be undertaken back from the linguistic to the quantitative, which is known, rather gracelessly, as defuzzification. While various ways exists of doing this, I will suggest here the most common and straightforward one. Assume we have some values for the I and P control inputs such as 0.1 and 0.5. This would

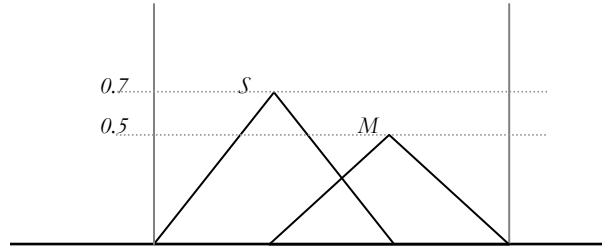
suggest that Integrative control belongs either to O or to S and the Proportional Control belongs to either S or M, and, from their membership functions, this would then imply

$$\begin{aligned}\psi_o(f) &= 0.9 & \psi_s(f) &= 0.1 \\ \psi_m(\Delta f) &= 0.5 & \psi_s(\Delta f) &= 0.5\end{aligned}\quad \text{eqs. 8}$$

The ultimate objective is of course to quantify the control action output increment that equation 6 instantiates. To do this we use a simple rule devised from equation 7

$$\begin{aligned}f \leftrightarrow \Delta f : \Delta v_o &= S = \text{MIN}[\psi_o(f), \psi_s(\Delta f)] = 0.5 \\ f \leftrightarrow \Delta f : \Delta v_o &= M = \text{MIN}[\psi_o(f), \psi_m(\Delta f)] = 0.5 \\ f \leftrightarrow \Delta f : \Delta v_s &= S = \text{MIN}[\psi_s(f), \psi_m(\Delta f)] = 0.1 \\ f \leftrightarrow \Delta f : \Delta v_s &= S = \text{MIN}[\psi_s(f), \psi_s(\Delta f)] = 0.1\end{aligned}\quad \text{eqs. 9}$$

which suggests that the control system would employ small and medium sized fuzzy-logic correctives alone with magnitudes of 0.7 and 0.5. However, we still require an estimate for the gain Θ for the two inputs which then gives us the desired control action output. This is done by finding the center of gravity of the now adjusted figure obtained from the relevant membership functions



and the calculation provides the control action increment

$$\Delta v = \frac{0.25 \times 0.7 + 0.75 \times 0.5}{0.7 + 0.5} = 0.46$$

8. Econometric Foundations

PID Control Theory is not without parallel in the econometric literature. Error-correction models (ECM) are their closest counterparts. In two variables an ECM is specified as

$$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + (\beta_3 - 1)(y_{t-1} - x_{t-1}) + \varepsilon_t$$

where Δy_t is the incremental control 'action' and $y^* - x^* = \bar{c}$ describes a long-term equilibrium condition. For an ECM to work correctly we would also need to ensure that the variable $(y_t - x_t)$ is $I(0)$ and that $\beta_3 < 1$. The proportional and integrative corrective elements of the ECM are evident even in this attenuated lag-structure specification.

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ⁱ In the 1950s the neo-classical growth model attributed to Solow, Koopmans and Cass presented an exogenous view of economic growth that had, as one of its key insights, a dynamic for cross-sectional convergence in income. The exogenous growth model can be augmented in the manner of more recent endogenous growth models that derive growth in income from explicitly modeled agents making decisions each period on education, fertility, consumption, etc. Mankiw, Romer and Weil (1992), Barro (1991), Barro and Sala-i-Martin (1992) and Sala-i-Martin (1996) are pioneering studies that demonstrate convergence as a natural predicted outcome of the neo-classical growth model in economics

ⁱⁱ See Przeworski and Limongi (1997)

ⁱⁱⁱ The idea of the end of history, convergence in regimes to democracy or democracy emerging as a natural outcome among other forms of politics can be found in some influential contributions to political science such as Fukuyama (1989), Starr (1991), Mueller (1992). Interesting exceptions include Goldgeier and McFaul (1992)

^{iv} See Quah (1993, 1994 and 1996) and Bernard and Durlauf (1995)

^v Goorha (2002) is a useful summary of the methodology of convergence analysis, identified problems with the methodology, and proposed alternatives.

^{vi} For a convenient summary of evolutionary game theory and its applications I refer the reader to the Spring 2002 edition of the Journal of Economic Perspectives, which features a special symposium on evolutionary game theory.

^{vii} This observation refers to the central finding in Przeworski et. al. (2000)

^{viii} The presentation in the next section is meant as an illustration of the evolutionary approach and should not be taken to be an explanation in and of itself.

^{ix} Evaluated, as inferior of course in normative terms and not strict Pareto criteria.

^x While the manner in which I phrase this appears to betray my preference for a top-down approach, the evolutionary game itself neatly links decisions by the political-elite subgroup to other subgroups as well.

^{xi} This can be seen as a threat point for revolt or impeachment.

^{xii} There is a well established literature on this issue. See Calvo (1989), Dixit (1992, 1993), Dornbusch (1990, 1993). Rodrik (1992) even suggests how credible governments can reform and bring their countries onto a virtuous circle of economic growth and “incredible” governments can cause their countries to be stuck in a vicious circle of pathetic economic performance.

^{xiii} However, note that this result would allow negative values. So imagine an income low enough relative to the total amount of public good provision, a very intolerant constituency, or some combination thereof. It is conceivable that this can lead to a change in the marginal utility of the politician from a change in the constituents’ utility, given the politician is maximizing his own utility, which is actually negative. The Kuhn–Tucker conditions in such problems disallow this ‘perverse’ result and by imposing the strict inequality restrictions on the maximization problem, we get the results that

$$G > \frac{Y}{Y + r'(t)} \quad \text{and} \quad r'(t) < Y/G$$

^{xiv} Issue space in this paper is taken to define the utility space of the entire selectorate.

^{xv} Although this has only been shown for symmetrical distributions of ideal points.

^{xvi} See Krugman (1991) for a representative example and also Jacobs (1984) for a more general assessment.

^{xvii} The weightless economy is a collection of ‘weightless’ (in a rather literal sense of the word) knowledge products such as software, the Internet and electronic databases and the continual expansion of its share in total output generated by many advanced economies of the world demonstrates how intensive the role of knowledge capital has gradually become.

^{xviii} While to embarrass is certainly not the purpose of their article, see Przeworski and Limongi (1993) for elaboration on this point.

^{xix} An exhaustive list of all its features would take much more space than an article provides and would add little value to the discussion here.

^{xx} Note that obtaining a Coase theorem for political science from this premise is easy. The distribution of political control power between the ruler and the ruled is invariant in the fully perfect credible polity, which has a zero transactions cost of recall.

^{xxi} Essentially because of the easy parallel between the credible polity construct as I have laid it out here and the typology of market competition in standard microeconomic theory.

^{xxii} Infiltration in the sense of the degree of representation or enfranchisement of the population. Note that it is much simpler to assume a homogenous population to grasp the intuition behind the basic results.

^{xxiii} In development economics, some examples include Dixit (1989), Rodrik (1989), and also Dornbusch (1993). Franzese (1998) is an example from comparative politics

APPENDIX OF FIGURES

FIGURE A: HISTOGRAMS OF INSTITUTIONAL DEMOCRACY FROM THE POLITY DATASET

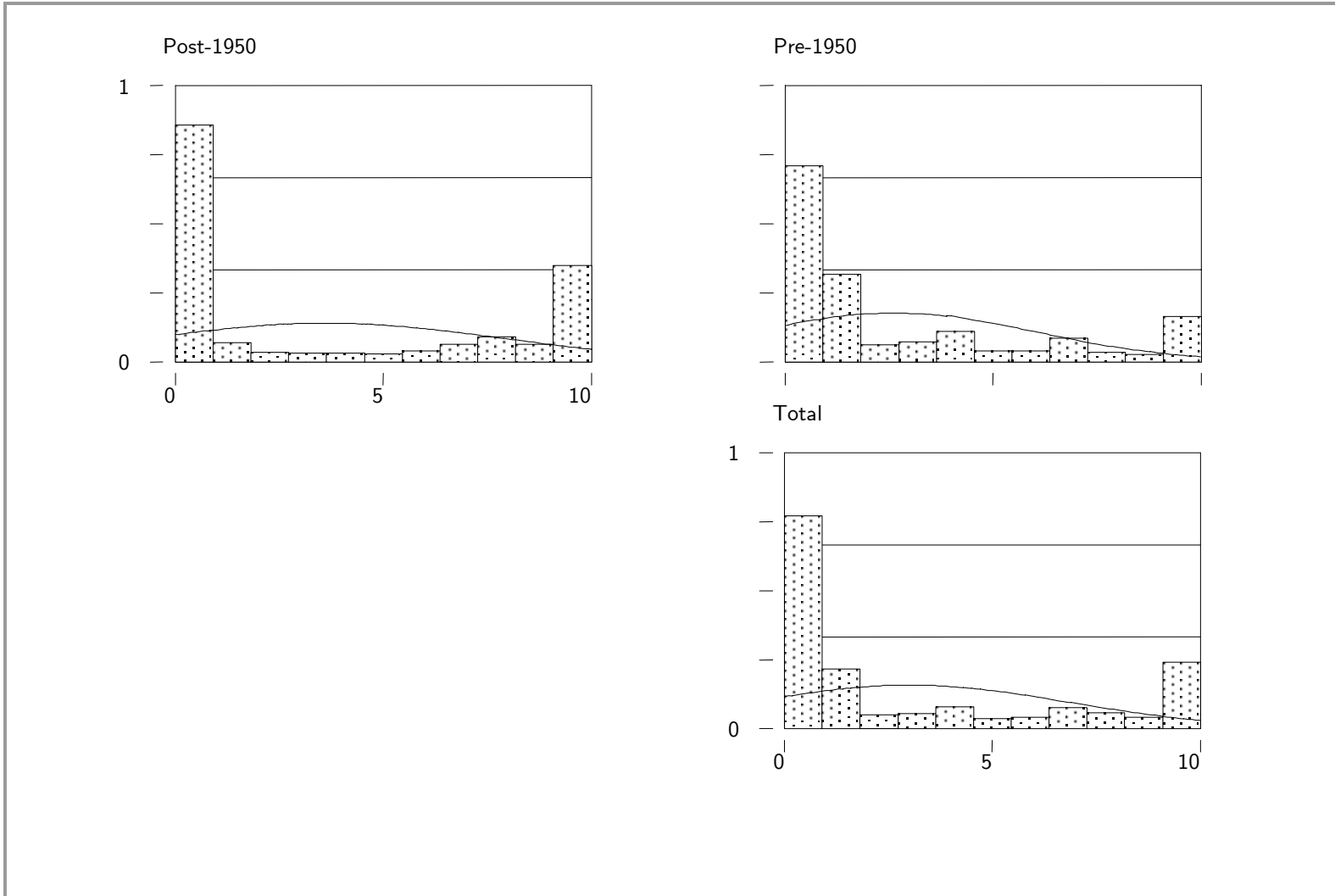


TABLE ONE: TRANSITION PROBABILITIES FOR POLITIES

	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>
<i>0</i>	98.51	0.46	0.20	0.05	0.20	0.10	0.19	0.03	0.15	0.05	0.05
<i>1</i>	1.62	96.52	0.30	0.66	0.30	0.12	0.24	0.18	0.06	0.00	0.00
<i>2</i>	3.85	0.77	92.31	1.28	0.00	0.00	0.26	0.26	0.26	0.77	0.26
<i>3</i>	1.87	1.17	1.17	91.80	1.17	0.70	0.23	0.23	0.94	0.00	0.70
<i>4</i>	1.81	0.82	0.16	0.82	94.08	1.15	0.82	0.00	0.33	0.00	0.00
<i>5</i>	2.88	0.36	0.72	1.44	1.08	91.01	1.44	0.36	0.36	0.36	0.00
<i>6</i>	2.98	0.99	0.00	0.33	1.32	0.99	91.39	1.66	0.33	0.00	0.00
<i>7</i>	0.34	0.00	0.17	0.00	0.00	0.00	0.51	95.62	2.02	0.67	0.67
<i>8</i>	2.63	0.48	0.72	0.00	0.00	0.00	0.00	0.24	91.63	2.39	1.91
<i>9</i>	0.61	0.00	0.61	0.00	0.00	0.00	0.00	0.31	2.76	92.02	3.68
<i>10</i>	0.16	0.00	0.00	0.05	0.05	0.00	0.05	0.11	0.16	0.27	99.13

Rows Represent Initial Polity Score and Columns Represent Final Polity Score

TABLE TWO: LONG-TERM DYNAMICS OF REGIME TRANSITION

	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	2	4	5	6	7	8	9	10
-10	94.12	3.53	0.00	1.18	1.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-9	0.72	93.48	2.17	0.72	0.00	0.72	0.72	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00
-8	1.59	3.17	87.30	3.17	0.00	0.00	0.00	0.00	1.59	0.00	0.00	0.00	0.00	1.59	0.00	0.00	1.59	0.00	0.00
-7	0.00	0.00	0.49	94.66	2.43	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.49	0.49	0.49
-6	0.00	0.00	0.00	2.04	87.76	2.04	0.00	2.04	0.00	2.04	0.00	0.00	2.04	0.00	0.00	0.00	2.04	0.00	0.00
-5	0.00	1.56	1.56	4.69	0.00	85.94	1.56	0.00	0.00	1.56	0.00	0.00	0.00	0.00	0.00	1.56	0.00	1.56	0.00
-4	0.00	0.00	0.00	6.67	0.00	6.67	80.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3	0.00	0.00	0.00	2.33	0.00	2.33	0.00	90.70	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.33	0.00
-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	82.35	5.88	0.00	0.00	0.00	0.00	0.00	0.00	5.88	5.88	0.00
-1	0.00	4.55	0.00	0.00	4.55	0.00	0.00	0.00	0.00	81.82	0.00	0.00	0.00	0.00	4.55	0.00	0.00	4.55	0.00
0	0.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00	0.00	0.00	71.43	0.00	0.00	0.00	0.00	0.00	14.29	0.00	0.00
2	6.25	0.00	0.00	6.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00	0.00	12.50	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.14	7.14	78.57	7.14	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.71	5.71	2.86	2.86	0.00	0.00
6	0.00	4.35	0.00	4.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	91.30	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.70	83.78	13.51	0.00	0.00
8	0.00	0.00	0.00	2.15	0.00	0.00	0.00	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	89.25	5.38	2.15
9	0.00	0.00	0.00	0.00	0.00	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.76	89.29	3.57
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.21	0.00	0.00	0.00	0.41	99.17

Table is based on 44 countries with series longer than 140 years. Row values indicate initial level of composite democracy scores and column values indicate final levels.

FIGURE B: TIME PLOTS OF GLOBAL LEVELS OF INSTITUTIONAL DEMOCRACY AND AUTOCRACY

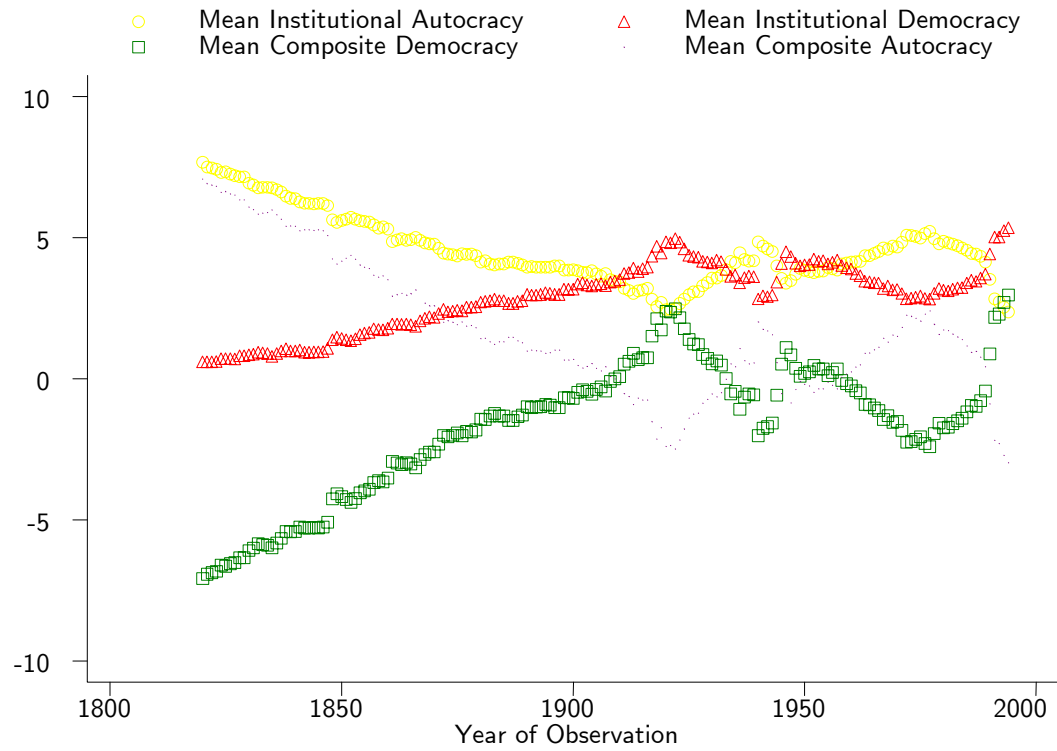


Figure 1: Evolution of Politician and Population Fitness
with identical initial fitness and equal distribution across strategies

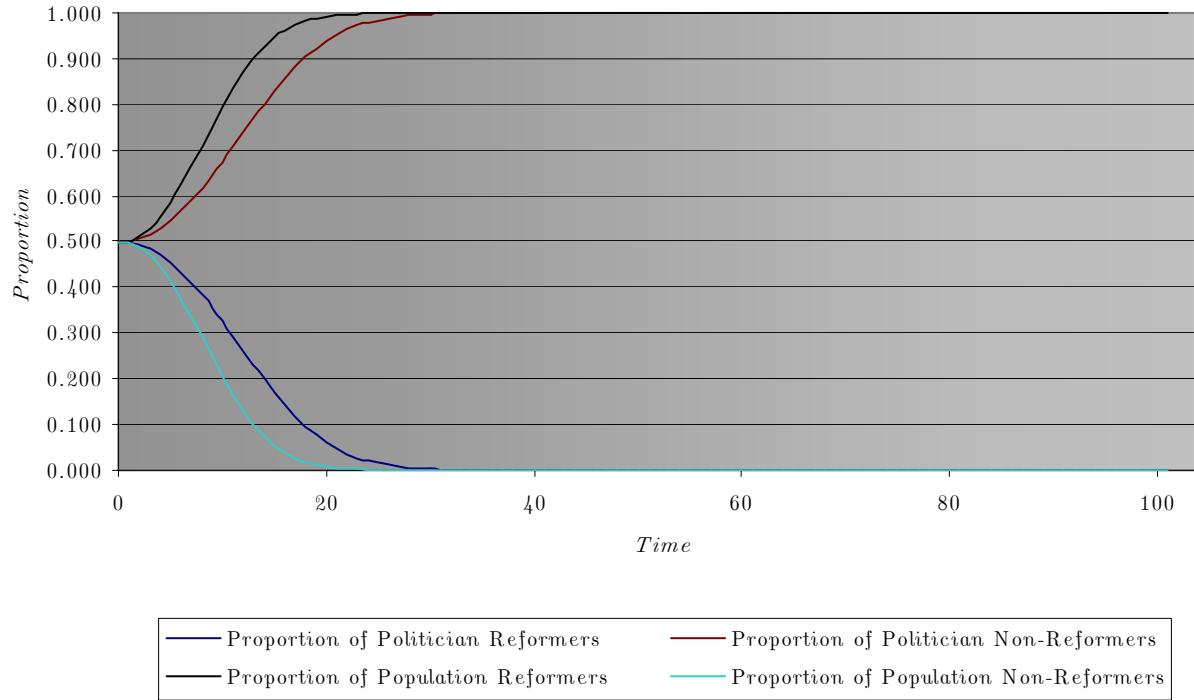


Figure 2: Evolution of Politician and Population Fitness
with reform strategy starting fitness for politicians 50% higher than the no reform strategy
and vice versa for the population

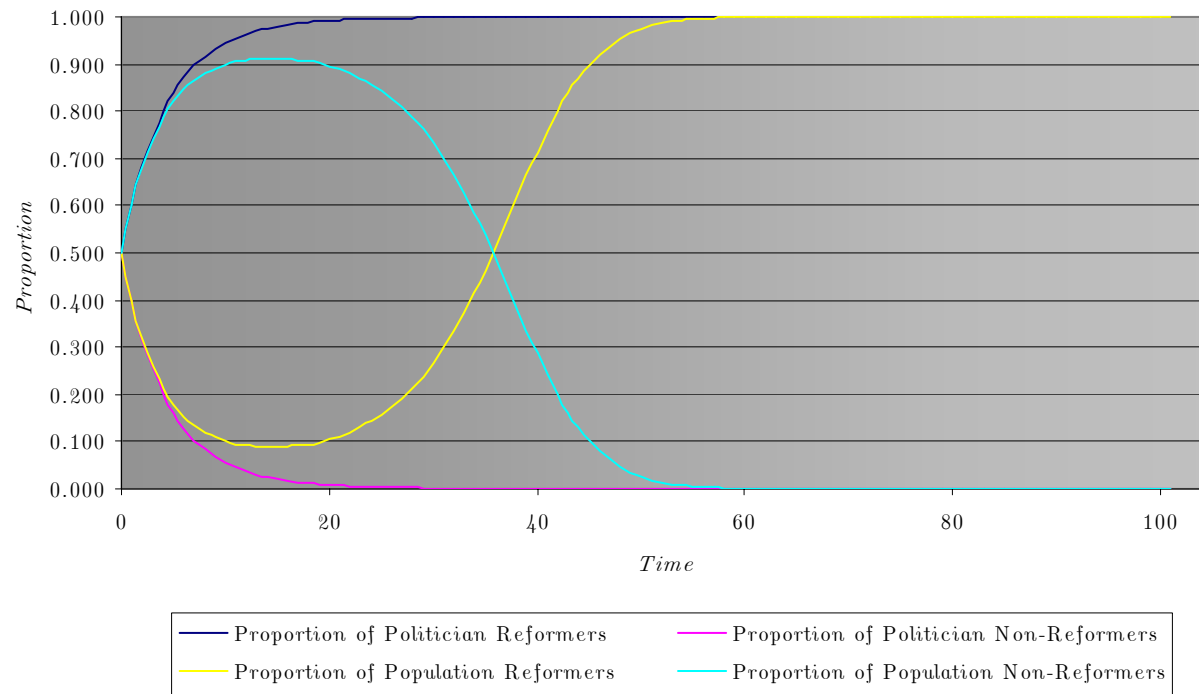


Figure 3: Evolution of Politician and Population Fitness
with reform strategy starting fitness for politicians 25% higher than no reform strategy
and no reform strategy starting fitness for population at 125% more than reform strategy

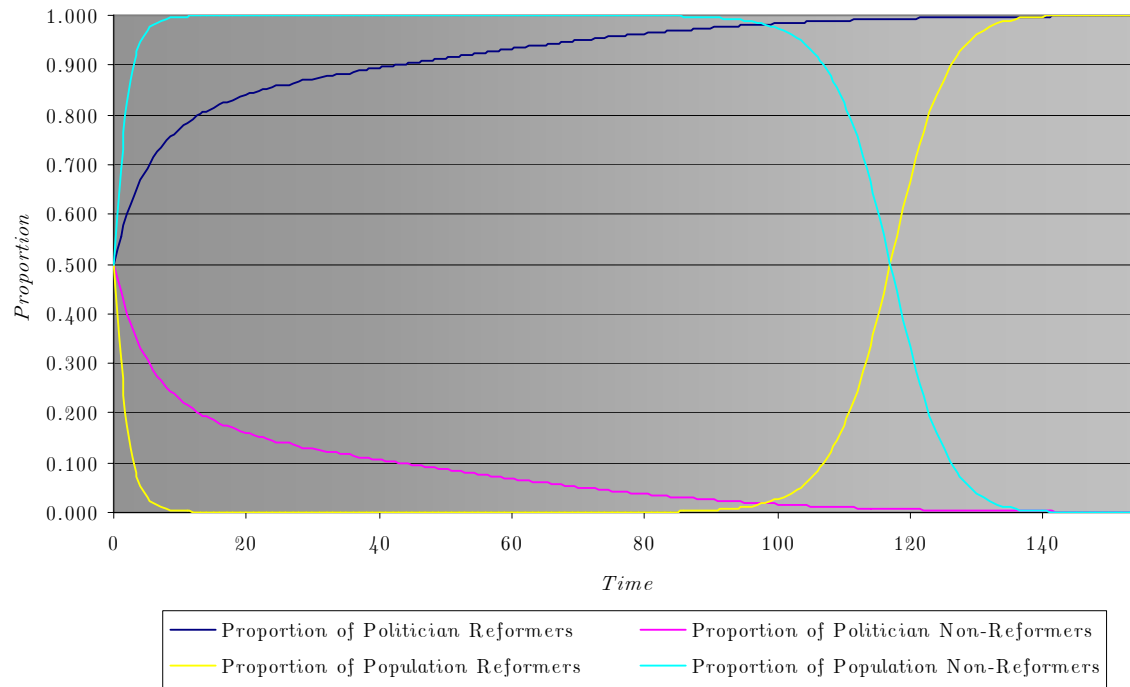


Figure 4: Evolution of Politician and Population Fitness
same as in figure 3 with initial proportion of Politicians playing reform only 16%

