Democracy, Economy, and Values: Estimating a Recursive System

Sean David Ehrlich, Robert J. Franzese Jr., and Ronald F. Inglehart

Department of Political Science, The University of Michigan, Ann Arbor

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With three waves of the World Value Survey (WVS) completed, covering about 15 years, we now have the beginnings of a time-series of data regarding the *values*[1] of citizens in a wide sample of countries. With similar series already available indicating the extent of political and civil liberties (*democracy*, from Freedom House)[2] and economic development (*real GNP-per-capita*, from the World Bank),[3] we can begin to address exciting questions of temporal, and hopefully thereby causal, priority in these important concepts. Do populations' values that conduce toward democracy precede the establishment of democratic institutions, or do democratic institutions foster such values? Does economic development foster democracy, or do democratic institutions facilitate economic growth? Does economic development precede the growth of self-expression values over survival values or do such values foster growth, perhaps by strengthening democracy? In short, these data offer exciting opportunities to begin to answer some important questions about what causes what, and by what route, among values, economy, and democracy.

Of course, severe limitations remain on what we will be able to do, given the available data, relative to what we might like, ideally, to do. First, fifteen years, while a wonderful start, remains a

[1] *Values* are national-average survival/self-expression scores, a composite index created by principle-component analysis of XXXX survey questions from the WVS. Inglehart (XXXX, pp. XX) provides a full description and substantive interpretation.
[2] *Democracy* is the sum of Freedom Houses political- and civil-liberties indices, each of which are scaled 1-7. We have reversed the Freedom House polarity of those measures, so that our democracy index is 2-14, low to high.
[3] Real GNP *per capita* is in constant XXXX US dollars, natural logged.

very short time-period, especially for variables like population values, which evolve so slowly. Second, even for these fifteen years, we have only three snapshots from the three waves of the WVS with which to measure popular values. Third, the set of countries for which these data are available, while expanding across the three waves, varies and begins rather small. Thus, for each country, we have at best three observations, irregularly spaced over only 15 years, and the full set contains a relatively large number of observations for which some of the democracy, economy, and values indicators are unavailable. Methodologically, therefore, even to begin to address our questions, we must first address, not only the more standard issues of (a) the likely joint causality of democracy, values, and economy and (b) the time-serial and (c) cross-sectional origination of these variables, but also (d) the damaging amount of missing data in the sample and (e) the irregular periodization of the observations. Our first cut at the analysis will take a simple approach to (a) and (b), apply King et al.'s (1999) approach to (d), and, for now, leave (c) and (e) to future improvements.[4]

Regarding (a) simultaneity and (b) temporal-dynamics, we can make the same simplifying assumption. Regressing each variable on one-period lags of the other two variables while controlling for its own one-period lag amounts to assuming that (i) temporal implies causal precedence and (ii) the dynamics of each variable follow a simple AR(1) process in their levels. Substantively, (i) amounts to saying that the relevant actors do not determine their current levels of, say, democracy by an expectation of what economic activity or values will be next period, or that the level of democracy last period sufficiently controls for the impacts of any such expectations. Especially since these periods are 6-9 years long, this may be a reasonable assumption, but it is nonetheless an assumption. Our results speak more definitively to temporal precedence; we leave to the reader how

[4] To address (c), we intend to employ estimates of the variance-covariance matrix of the coefficient estimates robust to panel-type heteroskedasticity and cross-sectional correlation within time (the PCSE's suggested by Beck and Katz 1997). Addressing (d) will be slightly more complicated; we intend to allow coefficients on independent variables (including the constant) to scale proportionately to the number of years between observations. This will require estimation of only one more coefficient if we can safely assume that factor of proportionality is the same across equations, variables, and time-periods but could involve as many as thirty-six if the evidence insists that this factor varies importantly along all three dimensions. We expect some intermediately binding assumption will prove safe to apply.

much causal precedence to infer therefrom. With this identifying assumption, we can safely estimate a simple system of three dynamic (specifically, linear-difference) equations:

Equations 1

$$DEM_t = \beta_{10} + \beta_{11}DEM_{t-1} + \beta_{12}GNP_{t-1} + \beta_{13}VAL_{t-1} + \varepsilon_{1t}$$
$$GNP_t = \beta_{20} + \beta_{21}DEM_{t-1} + \beta_{22}GNP_{t-1} + \beta_{23}VAL_{t-1} + \varepsilon_{2t}$$
$$VAL_t = \beta_{30} + \beta_{31}DEM_{t-1} + \beta_{32}GNP_{t-1} + \beta_{33}VAL_{t-1} + \varepsilon_{3t}$$

Controlling for the lagged value of the dependent variable is also crucial given the time-serial nature of the processes generating these data. Values, democracy, and economy all tend to change fairly slowly, so their past levels largely determine their current levels, even if 6-9 years separate those periods. Societal values, for example, likely evolve very slowly in Maslovian fashion from an emphasis on survival (safety, wealth, and health) to an emphasis on self-expression (tolerance, aesthetics, etc.) as prior needs are met. Economies also tend to develop gradually; a poor nation becomes wealthy only by experiencing growth over many years. Of the three core concepts, only democracy (especially as measured by Freedom House) is capable of large jumps less dependent on previous levels, and, even there, most democratic change is incremental.[5] Thus, past levels of all three variables critically affect current levels of these variables. Statistically, this implies that the three periods of data in each country are not each wholly new information. To fail to control for this temporal dependence of the observations would be to exaggerate the amount of information (i.e., degrees of freedom) we actually have with which to estimate the relationships about which we care. Moreover, our structural equations allow past levels of all three concepts to affect the others' current levels, suggesting that omitting the lagged dependent-variable would also produce omitted variable bias if it is correlated with the other lagged variables.

[5] The revolutions in Eastern Europe in 1989, e.g., brought sudden and dramatic pro-democratic changes in those countries, but in the past ten years most have slowly become even more democratic.

Pleasantly, the lagged-dependent-variable formulation is no mere atheoretical statistical fix; it also provides important substantive leverage on the interesting dynamics of system. Since all three concepts may affect each of the others (we expect some connections are stronger than others), we will want to track the responses in each variable to movements in each of the others. For example, should the discovery of a new natural resource or a new technological invention or process produce an additional 1% GNP annually, not only may democracy and values respond, but this may also, in turn, foster more GNP growth, producing further responses in democracy and values. Estimating the dynamic system in **Equations 1** will allow analysis of such situations, making maximal use of the available cross-sectional and cross-temporal evidence.

Furthermore, and again pleasantly, our hypothesis of causal relation among these concepts suggests not only that current levels of each depend on previous levels of all three, as the right-hand-sides of **Equations 1** show, but also that the unexplained parts of each, ε_{it}, are likely related as well. We can use this information–that the stochastic as well as systematic components of democracy, economy, and values are related–to gain extra leverage from the data on our substantive questions (i.e., increase the efficiency of our results) by estimating **Equations 1** jointly rather than in three separate equations. One technique for doing so, Seemingly Unrelated Regression (SUR) (Greene 1997: 674-88; Zellner 1972), is especially appropriate here because it adds only the assumptions that the residuals in the equations correlate, $Cov(\varepsilon_{it},\varepsilon_{jt}) \neq 0$, and that this correlation is the same for all observations in each pair of equations, $Cov(\varepsilon_{it},\varepsilon_{jt})=\rho_{ij}$. Technically, SUR performs ordinary-least-squares (OLS) regression separately on each equation to estimate the residuals, then transforms the data to incorporate the information from the correlations between **Equations 1** residuals and then re-estimates each equation by OLS using the transformed data. The more the residuals correlate across equations, the more efficiency gained by using that information (SUR) over failing to use it (OLS).[6]

[6] SUR provides no efficiency gains when the matrix of independent-variable values is the same in all equations or when

We gain further efficiency by using all available information regarding the missing values of the independent variables instead of simply deleting all observations with any variables missing. Missing data plague especially the variable, *values*, since not every country participated in all three WVS waves. Worse still, the likelihood that a country is absent from a WVS wave is related to its levels of the variables we are studying. Poorer, less democratic countries with lower survival/self-expression scores were more likely excluded from the earlier waves, and many Western European countries (wealthier, more democratic, and more self-expressive) declined the third wave. When the probability data is missing relates to the value of the missing data, not only does listwise deletion waste information (i.e., it's inefficient), but it also potentially biases the results (i.e., selection bias). To avoid this inefficiency and potential bias, we can use whatever correlation might exist among the independent variables to estimate the missing values of *independent* variables[7] using *EMis* and *Amelia*, the multiple-imputation procedure and associated computer algorithm, suggested by King et al. (1999). *EMis* essentially replaces missing data with the best predictions of them attainable from the data actually available for that observation. These imputed data, however, are only estimates, and so contain estimation error.[8] Distributions of those estimation errors can be calculated as in any other predictive equation, and *EMis* uses those to re-estimate the whole system repeatedly, redrawing the imputed values from their estimated distribution each time. The multiple-imputation procedure thus improves efficiency by using what information is actually available in an incomplete row of data, appropriately incorporating the uncertainty added by having had to estimate the completion of that row. While this procedure more than triples our usable *sample*, this corresponds to much less than a

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there is no residual correlation across equations. This former may seem to hold in **Equations 1**, but, because different observations are missing in the three equations, the matrix of independent variables differs. The differences are moderate in this case, so the efficiency gains from SUR are likewise moderate.

[7] King et al. (1999) suggest imputing values for dependent variables also. However, if we use information in $\boldsymbol{DEM_{t-1}}$, $\boldsymbol{GNP_{t-1}}$, and $\boldsymbol{VAL_{t-1}}$ to estimate the values of $\boldsymbol{DEM_t}$, $\boldsymbol{GNP_t}$, and $\boldsymbol{VAL_t}$, then, even if we add estimates of standard errors to those imputed values, we are still assuming the equations we wish to explore actually produced those missing values. That strikes us as assuming the conclusion. Imputing the independent data, contrarily, seems to us safe and advisable.

[8] This estimation error is not necessarily additional to whatever measurement error exists in the data since imputation, like instrumentation or factor-analysis data-reduction, may actually reduce that measurement error. If the latter effect

tripling of usable *information* since those extra observations contain some imputed data, which contains uncertainty in the form of estimation error. In plain terms, these extra observations are less reliable sources of information, and our reported uncertainty (e.g., standard errors) will reflect that. Finally, at least as important here is the side-product of imputing the missing data: reduction of the selection bias induced by the non-random inclusion and omission of countries in the WVS.

The irregular timing of WVS waves—1981, 1990, and 1996-7—raises another statistical challenge, one not yet addressed. Our regression treats the time between waves as equal even though the first two waves are 9 years apart and the second two are only 6-7 years apart, differing across countries.[9] We also do not yet address the potential for spatial correlation and heteroskedasticity raised by the cross-sectional nature of our data. We consider these far less central issues than those addressed above, but see note 4 for our plans/suggestions for redressing them.

Lastly, as stated above, the dynamic system of democracy, values, and the economy in **Equations 1** allows us to examine the propagation of each variable's effects on and through each other by tracing their estimated responses to hypothetical exogenous shocks. To obtain such estimated *response paths*, we simply solve the estimated system of linear-difference equations and compare those results to the same system plus whatever hypothetical we might like. Obtaining estimates of our uncertainty regarding these estimated response paths, i.e., their standard errors, is analytically onerous. To reduce the human-calculation intensity, we use a simple Monte Carlo simulation repeatedly to draw the set of coefficients from a multivariate normal distribution with means, variances, and covariances as estimated by the SUR of the system and use these to calculate the response paths repeatedly. The standard deviations of these many estimates of the nine response paths then emerge as our estimates of the standard errors of those paths.

Table 1 summarizes the SUR system-estimation results both with and without imputing the

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were to dominate, that would actually suggest that all data should be instrumented in this way! We doubt this.

[9] Our 0th wave, which includes real FH and economic data and imputed cultural data, was set as 1972 so as to be equal to

missing data and each both for model ***B*** that controls for tertiary-education enrollment-rates and agriculture- and service-sector shares of GNP and for model ***A*** that does not.

Table 1: Estimation Results for the Recursive System of Democracy, Economy, and Values

	DEMOCRACY$_t$				**ECONOMY$_t$**				**VALUES$_t$**			
	Non-Imputed		***Imputed***		***Non-Imputed***		***Imputed***		***Non-Imputed***		***Imputed***	
Model	***A***	***B***	***A***	***B***	***A***	***B***	***A***	***B***	***A***	***B***	***A***	***B***
DEM$_{t-1}$	**0.301**	**0.269**	**0.510**	**0.493**	**0.041**	**0.063**	**0.055**	**0.054**	**0.069**	**0.050**	**0.096**	**0.078**
	0.106	*0.122*	*0.058*	*0.065*	*0.024*	*0.028*	*0.016*	*0.016*	*0.022*	*0.024*	*0.015*	*0.016*
GNP$_{t-1}$	**1.539**	**1.822**	**0.761**	**0.710**	**0.913**	**0.714**	**0.745**	**0.551**	**0.089**	**0.035**	**0.100**	**0.115**
	0.348	*0.537*	*0.197*	*0.260*	*0.079*	*0.124*	*0.048*	*0.057*	*0.076*	*0.111*	*0.053*	*0.065*
VAL$_{t-1}$	**-0.611**	**-1.074**	**0.142**	**0.073**	**-0.002**	**0.030**	**0.164**	**0.125**	**0.741**	**0.794**	**0.534**	**0.479**
	0.384	*0.447*	*0.286*	*0.309*	*0.088*	*0.103*	*0.069*	*0.066*	*0.091*	*0.097*	*0.072*	*0.075*
Edu$_{t-1}$	**-**	**0.010**	**-**	**-0.007**	**-**	**-0.002**	**-**	**0.005**	**-**	**-0.003**	**-**	**-0.006**
	-	*0.023*	*-*	*0.018*	*-*	*0.005*	*-*	*0.004*	*-*	*0.005*	*-*	*0.004*
Ag$_{t-1}$	**-**	**-0.005**	**-**	**-0.006**	**-**	**-0.014**	**-**	**-0.024**	**-**	**-0.008**	**-**	**0.002**
	-	*0.054*	*-*	*0.025*	*-*	*0.013*	*-*	*0.005*	*-*	*0.011*	*-*	*0.006*
Ser$_{t-1}$	**-**	**0.015**	**-**	**0.023**	**-**	**0.006**	**-**	**0.006**	**-**	**0.006**	**-**	**0.016**
	-	*0.040*	*-*	*0.027*	*-*	*0.009*	*-*	*0.006*	*-*	*0.008*	*-*	*0.006*
Const.	**0.363**	**0.949**	**-1.590**	**-1.389**	**0.729**	**1.840**	**0.683**	**2.459**	**0.852**	**0.963**	**2.146**	**1.923**
	2.205	*3.837*	*1.572*	*2.332*	*0.506*	*0.883*	*0.372*	*0.492*	*0.510*	*0.831*	*0.418*	*0.562*
N	***53***	***48***	***183***	***183***	***52***	***48***	***145***	***145***	***44***	***41***	***114***	***114***
Adj. R2	***0.67***	***0.70***	***0.74***	***0.74***	***0.92***	***0.91***	***0.90***	***0.91***	***0.88***	***0.89***	***0.61***	***0.63***
S.E.R.	***1.58***	***1.56***	***0.35***	***0.35***	***0.36***	***0.36***	***0.44***	***0.42***	***0.33***	***0.31***	***0.43***	***0.43***
DW	***1.32***	***1.02***	***2.25***	***2.24***	***1.78***	***1.57***	***2.13***	***2.02***	***1.62***	***1.13***	***0.94***	***1.02***

NOTES: Models *A* without and *B* with additional control variables estimated by seemingly unrelated regression with and without multiple imputation. Coefficients in bold; standard errors in italics; summary statistics in bold-italics.

Notice, first, that almost none of the controls in ***B*** are significant in any of the equations, with or without imputation. The two exceptions occur in equations with imputation: the coefficient on agriculture-sector share of GNP, which may retard growth, and the coefficient on service-sector share of GNP, which may increase self-expressive values. Inclusion of these controls noticeably alters a substantive conclusion regarding our three key variables in only one case; the coefficient on GNP in the non-imputed values equation is smaller and more-highly insignificant in model ***B***. Thus, the results for our variables of interest are quite robust to the inclusion or exclusion of these controls while the latter seem generally unimportant controlling for our three key variables.

Next, the coefficient estimates with the imputed data are also broadly similar to those using

the difference between the first and second waves.

only non-imputed data, though two switch sign and three change substantive magnitude appreciably. The coefficients on values in the economy and democracy equations change sign; the coefficients on democracy in its own and the values equation each increased by about half; and the coefficient on GNP in the democracy equation reduced by about half with imputation. King et al.'s (1999) concerns with listwise deletion seem well founded here; listwise deletion may have biased the estimated impacts of democracy and values downward and of the economy (less consistently) upward. Listwise deletion would create such selection bias if, as in this case, which observations were missing correlated with the dependent variables.

Note, finally, the tremendous efficiency gain from imputation; standard errors in imputed equations are radically reduced by the large increase in the effective sample size. However, these standard errors usually decreased by a factor much less than the square root of three, which is what a full tripling of the sample size would likely have produced. I.e., imputation is adding a lot of information, but not as much as actually having the missing data would add. This, too, is comforting, suggesting that *EMis* and *Amelia* are accurately reflecting rather than exaggerating the true increase in information from multiple imputation.

For these three reasons, we conclude that the imputed-***A*** model provides the best estimates from the available evidence of the substantive relationships about which we care.

More substantively, then, note first that almost all the coefficients of interest in the imputed model ***A*** are strongly significant. Democracy, economy, and values nearly all *Granger-cause* each other; they each retain explanatory power for all of the others, even controlling for those others' lags, including their own. The only exception is values' *direct* effect on democracy, which is positive but substantively small and statistically insignificant. Aside from this, all of the variables of interest positively impact each other directly. Higher past levels of democracy produce more democracy, higher GNP, and more self-expressive values in the present, with the analogous results for higher

GNP and more self-expressive values in the past for current values of all three, though, as noted, the *direct* link from values to democracy is weak.

Moreover, even to conclude from these coefficients that value changes have no effect on democracy would be incorrect. The estimated coefficients represent only the direct effects of last period's levels of each independent variable on this period's level of the dependent variable, controlling for last period's levels of all variables. All three variables are inter-related, so, e.g., past democratic advances spur present democratic, economic, and self-expressive-values advances. All but one permutation of that causal chain holds, so each variable also has indirect effects on *all* the others, without exception. Values do have a strong effect on democracy, albeit indirectly: past advances in self-expressive values increase present economic development, which produces pro-democratic developments. The other variables have both direct and indirect effects on each other.

We can follow these direct and indirect effects through **Table 1** thus. Consider an exogenous one-point increase in the democracy index–say a foreign power imposes an increase in domestic civil liberties. One period (6-to-9 years) later, the pro-democratic momentum would accumulate another .5± increase in the democracy index and also a 5.5±% increase in wealth and a .1 increase in the values index toward more self-expression. In the following period, all three variables are now higher, and so all three concepts start jointly conspiring to raise each other. Over time, the rate of accumulation decreases exponentially, so democracy, wealth, and self-expression all asymptotically approach new, higher levels in response to this single, permanent, exogenous, one-point increase in democracy.[10] Such dynamic systems are best presented graphically.

[10] For some levels of the matrix of cross-effects involved, this could even be explosive, with democracy, wealth, and self-expression rocketing off to infinity, but the estimates drawn from the available evidence produces decaying accumulation of the effects of any such exogenous shock to any of the variables.

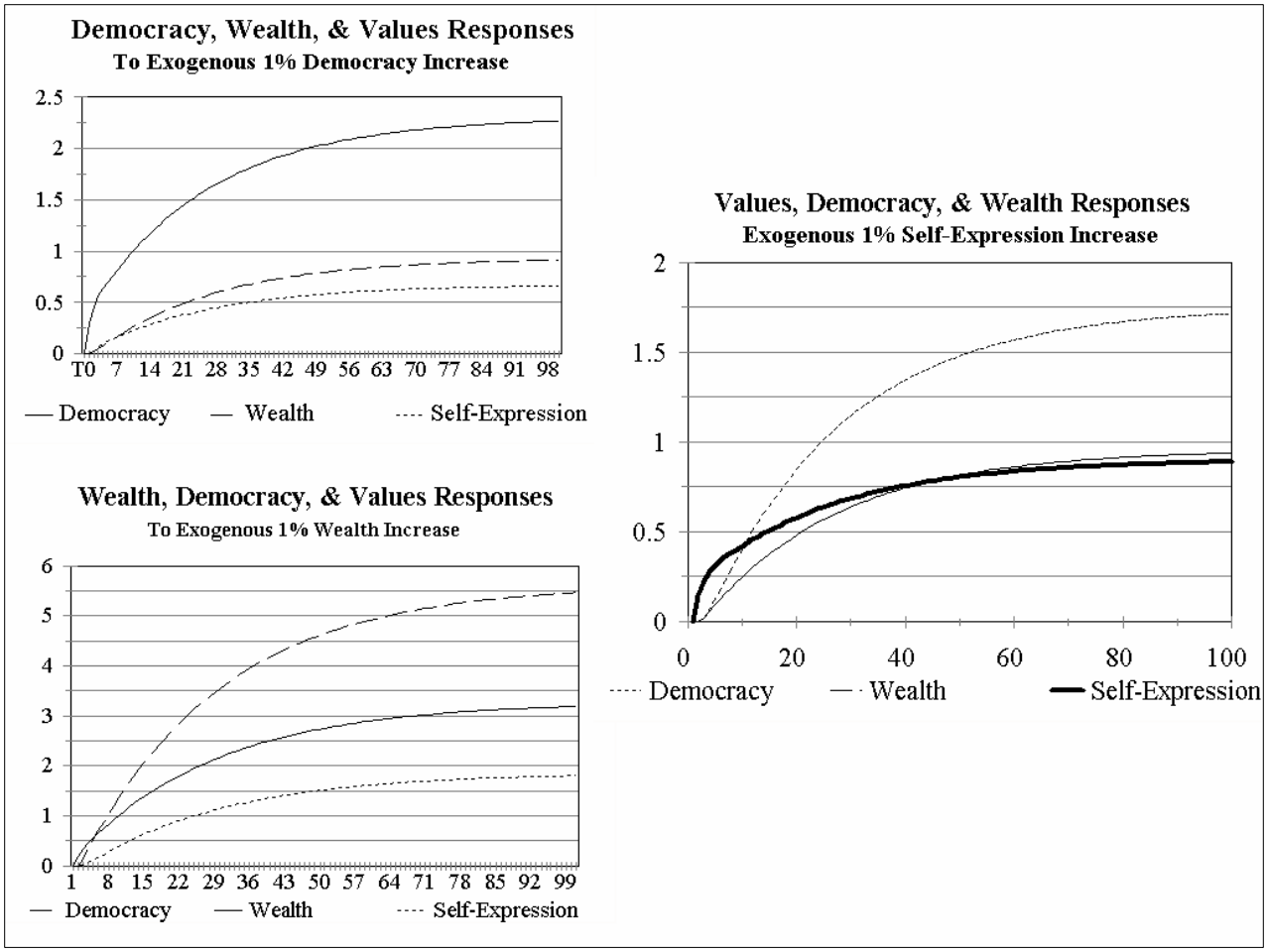

Figure 1: Estimated Responses of Democracy, Wealth, and Values to 1% Exogenous Shocks in Each

Figure 1 plots the effects of an exogenous 1% per-year increase in each variable from its estimated equilibrium on all three dependent variables in the system. These graphs were obtained by entering the system of equations as estimated into a spreadsheet and allowing it to evolve over a large number of periods, starting from the estimated constants until the equilibrium level for each dependent variable is reached. Starting from these equilibria, the hypothetical 1% exogenous shock is added to one of the variables and the system is allowed to equilibrate again. The effects of the shock are determined by subtracting the original equilibrium levels from the new levels of the dependent variables as they evolve to the new equilibrium levels. As shown, increasing democracy by 1%-per-year in this way, eventually leads to a long-run-equilibrium increase in the Freedom House index of democracy, which ranges 2-14, of about two points. The cumulative effect of this

evolution to greater democracy is to increase long-run real GNP per capita by about 1% and to shift values toward more self-expression by about .6, over one quarter of the sample range. Increasing real GNP per capita by 1%-per-year produces even more dramatic effects: democracy increases by over five points (almost half the range), wealth increases over 3%, and self-expressive values increase by 1.8 (three-quarters of its range). Finally, a 1%-per-year increase in self-expressive values indirectly produces a long-run 1.7 point increase in democracy and directly and indirectly produces a just under 1% increases in wealth. Thus, insofar as +1% innovations in democracy, wealth, and values are comparable, the evidence does seem to suggest that economic development is the more powerful impetus among these three.

[XXXX GENERATE THE STANDARD ERRORS XXXX]

These results have very interesting theoretical and practical implications for social science and policymaking. Economic development and movements toward democracy and self-expressive citizen-values each tend to reinforce the others, supporting a theory that posits these three processes as the main elements of a larger syndrome: the modernization process (Inglehart XXXX). Rather than any strong conclusions about causal priority among these processes, the evidence strongly suggests that each variable Granger-causes the others, at least indirectly. Perhaps, the short time span covered by the data and other weak aspects of the available data hindered our attempts to uncover strong causal priorities. We remain, for example, unable to consider dynamic processes more complex than AR(1) with 6-to-9-year periodicity, and our sample covers only 15 years, both of which are likely especially problematic in studying values change, a long-lasting phenomenon whose changes over the 6-9 years that comprise our sample may be highly idiosyncratic (non-systematic).

For all their inherent limitations, the results presented here strongly support two important contentions: (a) that modernization is a coherent concept composed of the interrelated processes of economic, democratic, and self-expressive-values development and (b) that advances along each

dimension are capable of producing advances in each of the others. The former may have theoretical importance to social scientists; the latter has definite practical implications for policymakers. It suggests that, if they are interested in advancing these three developments, any progress that can be made on any of the fronts will have positive feedback on all of the fronts. Conversely, if some policymakers are for some reason interested in retarding any one of these developments, they must know that this will have negative feedback on the others, which they may less desire to hinder.

We conclude by re-emphasizing that we fully recognize and publicly acknowledge myriad limitations on what any analysis, however careful, can legitimately claim from three snapshots of a limited array of quite disparate countries oddly spaced over 15 years. Yet we also wish to re-emphasize that the inter-connections and causal ordering of the democratic, economic, and societal-value dynamic processes are, at broadest level, the central questions of social science. How do societies govern themselves, how do they develop economically, what values do they hold, and how do these things relate and evolve over time? The extension of the WVS to three waves covering 15 years offered an opportunity to provide some answers, however preliminary and circumspect, to these core chicken-or-egg questions. We could not forego that chance, but we also look forward anxiously to the continued expansion of available data and to future analyses that will improve the types of answers we can give to these fundamental questions.