DEPARTMENT OF ECONOMICS WORKING PAPER SERIES

Are the Washington Consensus Policies Sustainable? A Game Theoretical Assessment for the Case of Ecuador

Pedro Francisco Páez

Working Paper No: 2005-07

January 2005

University of Utah
Department of Economics
1645 East Central Campus Dr., Rm. 308
Salt Lake City, UT 84112-9300
Tel: (801) 581-7481
Fax: (801) 585-5649
http://www.econ.utah.edu

Are the Washington Consensus Policies Sustainable?
Game Theoretical Assessment for the Case of Ecuador

Pedro Francisco Páez
University of Utah
pedro_paez2004@yahoo.es

ABSTRACT

This paper presents an evaluation of the so-called Washington Consensus economic policies in the case of Ecuador during the eighties and the nineties in a game theoretical framework. In a multi-period game, in which it acts as *Stackelberg* leader, the government minimizes a quadratic loss function using stochastic dynamic control techniques. A system of simultaneous equations represents the private agents' aggregate best responses that result from the general equilibrium solutions to the different agents' optimization problems. Its dynamic features show a stable system by itself, isolated from the type of policies that the government chooses. However, the introduction of the specific "style" of neo-liberal policies typical of the Washington Consensus, econometrically captured as they were applied in Ecuador, generates an explosive dynamics in every state variable of the system, suggesting that these types of policies are intrinsically unsustainable.

Keywords: economic policy evaluation, poverty, sustainability, neoliberal reforms
JEL Classification: C5, C6, C7, E6, I3

1. INTRODUCTION

The last two decades have seen the increasing deepening of neo-liberal policies in Latin America. The stubborn evidence of continuous failures has barely defined a line of academic reflection and policy-makers' self-criticism inside the mainstream environments. Rather, with very isolated exceptions whose continuity is dubious, the general assessment of those failures can be grossly reduced to: "too little, too late", therefore, the recipe goes: "more of the same".

This paper presents a methodology to address different aspects of the economic policy evaluation, focusing on the stability of the historical stabilization policies in Ecuador. The crucial feature of this research is the theoretical and empirical consideration of poverty as a key factor in the definition of the macroeconomic performance. Combining game theory, general equilibrium models, econometric techniques, and optimal control, I propose a methodological framework to evaluate and design optimal policies with clear roots in behavioral specifications.

Like any other applied tool in economics, this model has several shortcomings. Perhaps the main limitations have their roots in the very nature of this model as a short-term application. Being focussed on the short run, the model is by itself an incomplete tool. It is important to stress this warning: the use of the model should be linked to other types of instruments for the study of the problems in the long run. Only an adequate horizon of reference in the design of the experiments and simulations will make the results of this model sensible. In this sense, the goals of this research are not oriented towards the proposal of new recipes, but are centered on the construction of a framework and the testing of a methodology.

We should have in mind, at least, two major considerations in this regard:

- The model does not deal with investment and assumes that in the short run supply is perfectly elastic. The large margin of idle capacity experienced in Ecuador all these years would provide for any demand-driven expansion. This assumption is fairly common among short run models, but require active awareness with respect to the possible interpretation of the results. A development strategy must include considerations about capital accumulation whose basic traits might become targets in an optimal control framework.
- Some of the key variables in this model are also relevant in any long run development option. If not directly -as in the case of the rates for tariffs and taxes-, derived variables such as the real exchange rate, the real wage rate and the real interest rate are pertinent in the design of long-term strategies. Hence, the definition of targets and preferences must be informed by these kinds of considerations. Moreover, the evaluation of optimal policies should include a criterion-filter based on a long- term horizon.

Next section presents some general considerations with respect to the type of economic policies and poverty evolution in Latin America. Section 3 sketches the theoretical foundations of the model. Section 4 presents the basic results from the econometric estimation. Section 5 explores how dependent are the results on the model specifications with a sensitivity analysis of the estimated model with parameter perturbation techniques, checking in particular the role given in the model to poverty. Section 6 examines the stability conditions of the model without the intervention of the historical economic policies. Section 7 shows that the "type" of economic policies applied in Ecuador under the pressure of the external debt crises and the auspices of the International Financial Institutions presented some intrinsic problems of instrumental instability, suggesting the lack of sustainability of the neo-liberal policies from its conception. Last section adventures some conclusions.

2. PRELIMINARY CONSIDERATIONS

Latin America is one of the world's most polarized regions and, in particular, Ecuador has one of the worst situations in income distribution among the continent's countries. A long history of external and internal asymmetric conditions shaped the current Ecuadorian social inequality. Modernization in the second half of the century, and especially since oil exportation began in the early seventies, had rapidly changed the productive and social structures of the country. However, poverty continues to be a major problem.

The external debt crisis at the beginning of the eighties and the subsequent dismantling of the still incipient import substitution industrialization process, opened a period characterized by recession and impoverishment. Then, during the early nineties, the international financial system's relatively favorable condition and the exports boom defined a milder scenario in terms of stabilization and poverty until the new downturn detonated by the Southeast Asian financial turmoil. The accumulation of tensions in the Ecuadorian economy led to one of the sharpest crisis in the country's history and to the resignation of the monetary sovereignty with the official dollarization imposed in January 2000[1]. This article presents the evaluation of those policies and shows their intrinsic instability.

These last decades have been a changing stage for the same play: different adjustment and stabilization programs have been attempted with partial and temporary success. Each attempt is a more ambitious and radical set of prescriptions from the same recipe: a painful but –in the end, it is said- rewarding accommodation of the economy to the globalization process. Typical measures such as devaluation, higher interest rates, cuts in real wages and in social expenditure have been insistently repeated. The scarce evidence suggests that those policies had important implications in terms of social inequality[2].

Besides the structural factors involved in the deep roots of inequality, it is possible to distinguish an important range of short-term effects that different policy measures have had on the level and intensity of poverty. Moreover, poor people not only have to deal with very precarious conditions of life and production, but they must also face high degrees of uncertainty, associated with both their particular set of circumstances and the overall performance of the economy.

The discourse associated to the policies applied in Ecuador and Latin America during all these years abrogates itself the notion of technically sound, with structural beneficial effects in the long run even if there are some "collateral

---

[1] For a detailed analysis of the process that ended in the 1998-99 financial crisis and to the destruction of the national currency, see Paez (2003).
[2] See Paez (2000a), Larrea et al (1997), Vos and Leon (2001) for different interpretations of that relationship.

damage" in the implementation, as opposite to the "populists" policies that allegedly sacrifice a lasting stability for the short run. Let us build now a rigorous framework of evaluation for these claims.

3. A GAME THEORETICAL FRAMEWORK

The basic setup of the model is a dynamic stochastic game that can be solved under a standard quadratic-linear tracking optimization algorithm with forward looking variables. The game has a leader, the policy maker, and a follower, the private sector as a collective. Acting *a la Stackelberg*, the government takes the private sector's best responses as given. The private sector's best responses are captured in a system of equations whose rationale can be traced to the diverse optimization problems that the multiple agents in this economy face[3].

The responses of the system of equations are assumed as exogenous for the government, who only has at hand a set of policy instruments that can be used as control variables to lead the state variables towards the desired trajectories. Each instrument has a respective cost for deviation from desired values. Hence, the government's objective function must include those costs, tracking the differences between the target trajectory of the controls and the optimal application of policies, weighted by the matrix Λ, that represents those costs of implementation[4].

---

[3] To see the complete picture, including the general equilibrium model, please refer to Paez (1999a and b).

[4] Those penalties could refer to institutional or technical difficulties in the implementation. For example, the decisions about taxes could require a Congress' approval, while the monetary

The targets and the matrices W and Λ characterize a "type" of leader, in the game-theoretical sense. Each type of leader represents a political coalition that has a specific profile of priorities and preferences that define her style of policy in response to the private sector behavior. The follower, the private sector, bases its policy expectations in the style of policy, derived from the type of policy-maker playing as the leader.

Therefore, we can express the government's problem as to choose the sequence of control variables, *u,* that solve:

$$\min\left\{ J = E\Big[\sum_{t=0}^{T} \; (x_t - x_t^*)' W (x_t - x_t^*) + (u_t - u_t^*)' \Lambda (u_t - u_t^*) \; \Big] \right\}$$

subject to the system of equations that represents the private sector best response:

$$x_{t+1} = A_t x_t + B_t u_t + D_t x_{t+2}^e + C_t z_t + \xi_{t+1}$$

where: E is the expectation operator; x is the vector of state variables; u is the vector of government control variables; z is the vector of exogenous variables; the superscripts ^{e} and * denote expected values of the future variables and targets, respectively; W is the matrix of priorities; Λ is the penalties for instruments, A, B, C and D are the matrices of coefficients, and ξ are the additive stochastic noises.

The follower, the private sector, acts as a whole with responses that reflect different agent's optimizing programs, with the government's moves as given.

---

authority could change the money supply every day. For an intuitive explanation, see Turnovsky (1977). Also, they could be related to specific institutional arrangements that change the level of "endogeneity" and "controllability" of different policy variables, like money supply (both demand and supply led endogeneity), the nominal exchange rate (under flotation vs. other exchange rate regimes), the fiscal expenditure (level of discretionarity), etc.

General equilibrium solutions inspire the system of equations in a Johansen-type linear approximation.

In order to advance in the understanding of the role of poverty, the model investigates the specific pricing rule that predominates in an environment of shrinking markets with a clear polarization in income distribution. Mathematically, it is possible to show that mark-ups go up with the proportion of poor consumers. The basic idea is that the firms' strategy is mostly oriented to middle-high income consumers and try to compensate via prices their loses in sales volume due to the demand contraction that income polarization implies.

The composition and the level of economic activity, the rhythm of inflation and the variation of the key macroeconomic prices (mainly the minimum wage) affect the evolution of the labor market and the incidence of poverty.

In a departure from the Hecksher-Ohlin-Samuelson paradigm, efficiency wages and unemployment define a correspondence between macroeconomic policy, level of activity and income distribution. Devaluation and free trade reforms favor exports based on cheap labor but not necessarily improve earnings of unskilled workers as the conventional paradigm affirms. The dismantling of the protectionist scheme tends to affect more qualified workers and they feed the statistics of underemployment and unemployment in a "cascade effect" that crowds out hierarchically the lower echelons of skills in the labor market, transferring negative effects to less qualified workers. That explains the empirical evidence of income distribution deterioration during the process of free trade reforms.

With this set up, the repeated game model could be solved with the algorithms developed by Kendrick (1981 and 2002) for linear-quadratic optimization models and extended by Amman and Kendrick (1993, 1996, 1997b and c) for forward looking variables and learning[5].

4. Econometric Estimation of the Private Sector's Best Responses

4.1 The Model

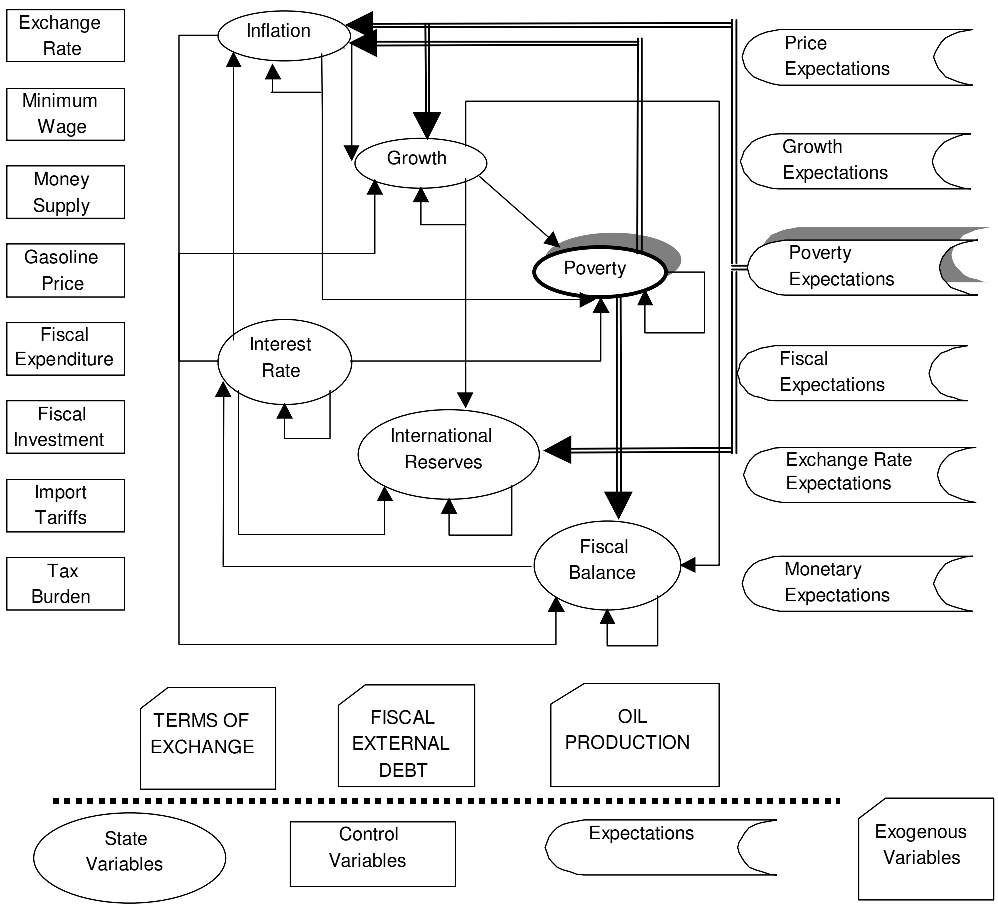
Despite several problems in data availability, a combination of neural networks, genetic algorithms and traditional simultaneous equations estimation, give a fairly robust model, under different statistical criteria. The estimated model for Ecuador, with quarterly data for the period 1986-98 is normalized in standard deviations of rates of change (z-scores) with respect to the trend. The main state variables of the system are: inflation, growth, poverty evolution, the interest rate, international reserves and fiscal balance. The control variables are: exchange rate, minimum wage, money supply, gasoline price, government expenditure, fiscal investment, tariffs and taxes.

Figure 1 shows a flowchart that captures the basic links of the system of equations, stressing the role of poverty in the chain of effects. The arrows only represent the basic relationships among endogenous variables (ovals) to give an idea of the feedback effects involved. The impacts of the control variables

[5] In game-theoretical terms, the solution concept achieved with these algorithms is a Sub-game Perfect Bayesian Equilibrium. The dynamic programming solution for the Ricatti matrices that define the optimal feedback rule guarantees the character of sub-game perfect (dynamically consistent because is solved by backward induction). The Bayesian updating of the system of equations is given through the Kalman filter.

(rectangles), the expectations (curved labels) and exogenous variables (trapezoids), were omitted to improve the readability of the chart. Nevertheless, the feedforward effects of the expectations on poverty are explicit to show the full impact of poverty evolution in the system. All the influences of poverty in the model are represented by a double-lined set of arrows, to reflect the pervasive presence of the phenomenon in the performance of the macroeconomic variables.

Figure 1: Importance of Poverty Incidence in the model



4.2 Specification, Identification and Problems in the Simultaneous Equations Estimation

Now we will go through the estimation procedure itself. First of all, we will concentrate in the specification of the model. The core of each equation is a Johansen-type linearization and a "partial adjustment" version of the equations from a simplified general equilibrium model developed for the Ecuadorian economy elsewhere[6], resulting in a simultaneous equation model in rates of change.

The theory binds the basic structure of the model, but the estimation includes some peculiar features of the Ecuadorian economy, like the roles of the public sector and of energy. Also, even if the main relationships were established, the lag structure had to be chosen based on statistical criteria. The final specification of each equation was selected from a series of separated estimations using instrumental variables, with the major criterion defined by the match of the expected signs of the coefficients and the best statistics achieved for each equation. However, the estimation must obey the Procrustean constraint in term of the size of the model for further tractability.

The results of this first stage were far from final, since the initial selection had to pass the effects of the so called "structural instability" of the estimates that appears in a simultaneous estimation[7]. Simultaneous equations model present some particular technical problems.

The joint determination and the feedback effects of the endogenous variables define correlations between the error terms and the explanatory variables, making the ordinary least squares estimates biased and inconsistent, attributing part of the effect of the additive disturbances to the explanatory variables[8].

---

[6] See Paez (1999a and b) for details.
[7] See Pindyck, R. and D. Rubinfeld (1998), p. 414.
[8] See Hamilton (1994), p. 234.

Instrumental variables yield also biased estimates, but this time, consistent ones. The bias is of the opposite sign of the OLS estimates and become more unbiased and efficient as the sample increases. However, instrumental estimation requires special attention in this case: if the fit of the instruments is poor or if the predetermined variables are highly correlated, the use of instrumental variables with small samples can be counterproductive.

Due to the sample size and considering the purposes of the model, the more appropriate technique available seems to be a joint estimation with iterative three stage least squares[9]. This technique assumes that the disturbances for each individual structural equation are spherical, with no serial correlation and with a constant contemporaneous variance- covariance matrix[10]. The correction for autocorrelation was introduced in the specification of the equations with a pseudo-differentiation including the respective ρ, therefore, the residuals can be taken as white noise. Other procedures like full information maximum likelihood (asymptotically more efficient in the presence of lagged endogenous variables) or generalized method of moments (that could control for any remaining heteroskedasticiy, for example) could be used, but there is evidence that three stage least squares has better small sample properties.

---

[9] See Bowden, R. and D. Turnington (1984), ch. 4, for some theoretical results in small sample cases. Most of the literature stresses the results from Monte Carlo studies, that, briefly, say that if the predetermined variables are highly correlated, instrumental variables methods work better than maximum likelihood; if the correlation among disturbances is not very small, full information methods perform better than separated estimation and that in using them, errors of specification are harmful for the estimates but not for the prediction accuracy. See Chow (1983), ch. 5; Kennedy (1998), p. 165.

[10] I used the routines built in the software TSP.

Given the presence of autocorrelation and lagged endogenous variables, 3SLS estimates will not be consistent (neither the coefficients nor ρ, the autocorrelation term) and we need a consistent –even if not efficient- estimate of the autocorrelation term for FGLS[11]. Hence, iteration with 3SLS allows for an estimation of ρ from a consistent set of residuals in the next iteration.

I restricted the dynamic structure of each equation to only one period lag and only one period lead that would end up with an additional lag in consideration to take care of the autocorrelation correction.

Once I have restricted the size of the model, I had to check the order and rank conditions to overcome the problem of identification characteristic to simultaneous estimation[12].

Failing the identification conditions does not affect the predictive power of the model nor changes the reliability of the simulations. Notwithstanding, without identification, the estimates are linear combinations of the actual parameters, rendering the estimates theoretically meaningless.

A model must satisfy two basic conditions to be identified: order and rank. The order condition is a counting rule: the number of predetermined variables excluded from each equation must be larger than the number of endogenous in the system excluded from this equation. The order condition is necessary but not sufficient. The rank condition is necessary and sufficient for the whole model to be identified. The rule of thumb for the rank condition is that each equation (equal

---

[11] See Greene (1997), p.749.

[12] For a more detailed reference of these procedures, see Paez (2000b).

each endogenous variable) must have its own predetermined variable (exogenous variable)[13].

Identification refers to the property of consistency in the estimation. Getting consistent estimates is just necessary not sufficient condition for identification. Sufficiency is usually determined by the own viability of the 2SLS procedure[14].

That condition is indispensable for 2SLS and, therefore, without the rank condition, 3SLS are simply not feasible. If this is always true for linear models, however, for non-linear 3SLS, the software could compute results but the coefficients are just a combination of other coefficients, without real meaning. The algebra now could work because the derivatives taken in the linearization used to solve these models produce additional terms that increase the rank of the matrix of moments.

Table 1 shows the order condition and the variable that assures that all the equations are identified. By the order condition we can check that they are, indeed, overidentified. Hence, we can proceed with the estimation process.

---

13 Greene (1997), p. 729.

14 See Greene (1997), p. 750

Table 1: Identification of the Simultaneous Equations Model

EQUATION	Endogenous Variables Inclu.	Endogenous Variables Exclu.	Exogenous Variables Inclu.	Exogenous Variables Exclu.	Order Condition	# var. in the equation	Rank Condition
Inflation	2	14	12	26	24	14	mf
Growth	1	15	13	25	24	14	m-1
Poverty	3	13	10	28	25	13	po-1
Interest	1	15	7	31	30	8	ff
External	3	13	11	27	24	14	I-1
Fiscal	3	13	13	25	22	16	f-1
Tariffs	2	14	9	29	27	11	wtar
Taxes	1	15	8	30	29	9	wtax
Inflationary Expectations	0	16	2	36	36	2	p+1
Growth Expectations	0	16	2	36	36	2	y+1
Poverty Expectations	0	16	2	36	36	2	po+1
Fiscal Expectations	0	16	2	36	36	2	f+1
Exchange Expectations	0	16	2	36	36	2	e+1
Monetary Expectations	0	16	2	36	36	2	m+1
Terms of Exchange	0	16	6	32	32	6	ti-1
External Financing	0	16	6	32	32	6	gd-1
Oil Production	0	16	6	32	32	6	pe-1
Endogenous in the System	17						
Exogenous in the System	38						

4.3 Estimation

The mentioned constraints and the effects of the joint estimation define a set of parameter different from those yielded by the individual equations in the selection process. Some of the coefficients even showed the wrong sign. Other than the incorrect specification of the model, there exist several reasons to explain those incongruencies. After all, the data, when available and consistent, refer to a period full of what some econometrists could call "structural breaks". The sample period --just 49 observations--corresponds to a transition from an economy looking for a late industrialization by import substitution, to a "neoliberal" scheme with a sequence of each time more radical free-market reforms and stabilization packages. Not to mention two major earthquakes, one of which destroyed essential parts of the petroleum infrastructure; floods; droughts; El Nino; La Nina; the kidnapping of one President in office; the removal from office of a Vice-president by the Parliament in another administration and the overthrow of the following President by massive demonstrations; several general strikes that lasted several days each; a country-wide rebellion of the Indigenous Nations; a non-declared war against Peru; a Constitutional Assembly, etc.

Instead of filling the regression with dummies, I opted for a restricted estimation of all the theoretically-bound parameters. As tables 3.5 and 3.6 and Appendix 3.3 document, the restrictions do not seem to force too much the estimation if a comparison of the restricted results with those of an unrestricted model were relevant. Unfortunately, the restrictions transform the linear model in a nonlinear one and the comparison is not fully pertinent.

The initial estimates of this restricted model, with starting values derived from the individual regressions with the "right signs" under 2SLS, presented very poor statistics, most of them statistically zero.

Then I followed a long search for better results, keeping the original specification untouched and trying with different starting values. The strategy was inspired in the notion of the genetic algorithms[15]: from several runs, pick the best results from three different sources:

- the best results with a global criterion,
- the best results for each equation individually, and
- the best t-statistics for each parameters.

Within arbitrary boundaries, the vectors of starting values for subsequent runs were mixings of the selected estimates[16].

The global criterion was a combination of the value of the objective function, the Durbin's statistics and R-squares of each equation and the t-statistics of the more important parameters. The weights in this criterion function changed with the iterations as evidence of deterioration or irrelevant improvement of the statistics appeared. However, special care on autocorrelation symptoms was a constant.

Although the procedure does not guarantee convergence and the arbitrariness of the criterion does not allow for a high level of automation, the final result shows a very significant improvement with respect to the original

[15] Genetic algorithms (GA) have been used in a wide variety of non-linear optimization problems, and its use for searching a better vector of starting values seems natural. Our experiment, however, is a very primitive one, in which much of the randomness typical of the proper procedures is replaced with the arbitrariness used to qualify the degree of "fitness", in GA jargon. Also, given the specific needs of our exercise, we skip all the problem of representation and use the coefficient vectors directly instead of the binary transformation. For a formal introduction, see chapter 8 in Judd, K. (1998), and for a didactic application, see Bauer, R. (1994). A more detailed explanation of this procedure is in Paez (2000b).

[16] "Crossover" in the terminology of GA. The procedure reaches "convergence" in the GA sense, i.e., that the selection of coefficient vectors tends to look alike, but not in the sense that gets always better statistics.

regressions. By construction, the algorithm chooses the estimates with the thicker t-statistics possible, given the structure of the data and the selected specification, with important gains in efficiency, at least for the set of the more relevant parameters. Note, however, the risk of overestimation of the absolute value of each parameter implicit in the mechanism of selection based in t-statistics. The counterpart to this risk is the advantage of the joint estimation itself: it is not possible to push arbitrarily any parameter without changing the estimation of each and every equation and eventually spoiling the goodness to fit of the regressions.

Table 2 shows the basic statistics of the restricted model in comparison with two other versions: one without restrictions on signs but that uses the covariance matrix from the restricted estimation as weights for the third stage of the estimation, and the other "fully" unrestricted[17]. The value of the objective function is virtually the same and several statistics for the equations improve significantly, especially those related to symptoms of autocorrelation. In contrast with the unrestricted estimates, all the Durbin statistics of the restricted model are reliable within reasonable margins and the R-squared are in a range from .34 to .87 that is rather auspicious in dealing with equations in rates of change and not in levels.

However, the cost of the restriction appears in the degree of significance of the parameters. With the "fully" unrestricted model 53% of the 133 parameters are significant at 10% level, while with the restricted model, only 49%.

[17] Rigorously speaking, all models are restricted in some way, and most of the time, those restrictions are not explicit.

Table 2: Comparison among restricted and unrestricted estimations

	RESTRICTED		VAR. REST.		UNRESTRICTED	
EQUATIONS	R-SQUARE	DW	R-SQUARE	DW	R-SQUARE	DW
INFLATION	0.88	1.93	0.85	1.75	0.85	1.75
GROWTH	0.84	2.01	0.87	2.09	0.87	2.09
POVERTY	0.66	1.99	0.70	2.18	0.70	2.17
INTEREST	0.85	2.19	0.99	2.72	0.99	2.72
INTERNATIONAL RESERVES	0.34	1.86	0.37	1.80	0.37	1.80
FISCAL	0.43	1.99	0.30	2.24	0.30	2.23
TARIFFS	0.48	1.87	0.47	1.71	0.47	1.71
TAXES	0.44	2.10	0.41	2.28	0.41	2.28
INFLATIONARY EXPECTATION	0.98	1.91	0.98	1.98	0.98	1.98
GROWTH EXPECTATION	0.96	1.84	0.96	1.75	0.96	1.75
POVERTY EXPECTATION	0.89	1.89	0.91	1.74	0.91	1.74
FISCALEXPECTATIONS	0.96	1.91	0.96	1.56	0.96	1.56
EXCHANGE EXPECTATION	0.96	1.96	0.96	1.57	0.96	1.57
MONETARY EXPECTATION	0.93	1.94	0.93	2.01	0.93	2.01
TERMS OF EXCHANGE	0.82	2.11	0.99	1.62	0.99	1.62
EXTERNAL FINANCING	0.98	1.83	0.96	0.24	0.96	0.23
OIL PRODUCTION	0.95	2.03	0.99	1.18	0.99	1.19
OBJECTIVE FUNCTION	765		764.992		764.998	

No conclusive test can certify the adequacy of this estimation, but, to further explore the costs of the restriction, we can see in Table 3 the results of McKinnon and Davidson J-test.

Basically, these tests are the p-values for the statistic significance of the coefficient in the regression of the residuals of each regression against the differences between the estimates of the tested model and an alternative. The higher the value, the more probable that the coefficient is different from zero and, therefore, the alternative model explains some movements in the variables that the tested model does not. Unfortunately, two caveats appear in the application of this test to our model: one, it is designed for individual regressions, not for joint estimations, and two, the results are asymptotic, and we have a small sample. Additional problems arise when testing the alternative model, if the results are not confirmatory or ambiguous, and there is no clear cut theory to this respect[18]. However, to have an idea of the losses incurred in the estimation with the restrictions, let us assume an arbitrary criterion for "dominance" of one model over the other: if the p-value is higher than 50% and the other is lower, or if the ratio between both p-values is higher than 100, the tested model "dominates" the alternative; if both are lower than 30%, no one would have advantage over the other.

However, we can see in the table that, even if non-conclusive, we have some favorable evidence for our restrictions. In 8 out of 17 cases, the restricted model has some advantage and only in 3 the unrestricted one has it. Considering only the 6 core equations, though, things are less clear: 2 equations with enough advantage for each specification. Nevertheless, let us recall that the equations in which the unrestricted version has certain "dominance" are those in which the restricted model has very high goodness to fit (R-squares of 0.84 and 0.85 for growth and interests, respectively) and, in the case of the interest rate equation, there are important signals of uncorrected autocorrelation in the unrestricted model (DW=2.7).

---

[18] As reference survey, see McAleer, M. "Sherlock Holmes and the Search for Truth: A diagnostic Tale" in Oxley, L. et al. (1995) "Surveys in Econometrics" Basil Blackwell. Zheng, J. (1996) "A Consistent Test of Functional Form Via Non-Parametric Estimation Techniques", Journal of Econometrics 75, p. 263-289, proposes a much more general specification test against all possible departures from the tested model, using non-parametric alternatives. However, that is still an individual equation option with the typical sample size requirement in kernel estimations (in the reported small-sample simulations, n=100).

Table 3. Comparison between Restricted and Unrestricted Models

J-TEST			
Equation	A	B	Dominance
INFLATION	0.470	0.002	Restricted
GROWTH	0.001	0.989	Unrestricted
POVERTY	0.002	0.017	None
INTEREST	0.000	0.905	Unrestricted
EXTERNAL	0.058	0.217	None
FISCAL	0.782	0.000	Restricted
TARIFFS	0.583	0.114	Restricted
TAXES	0.556	0.203	Restricted
INFLATIONARY EXPECTATIONS	0.217	0.577	Unrestricted
GROWTH EXPECTATION	0.841	0.401	Restricted
POVERTY EXPECTATIONS	0.025	0.954	Unrestricted
FISCAL EXPECTATIONS	0.661	0.039	Restricted
EXCHANGE EXPECTATIONS	0.507	0.030	Restricted
MONETARY EXPECTATIONS	0.764	0.307	Restricted
TERMS OF EXCHANGE	0.000	0.000	None
EXTERNAL FINANCING	0.000	0.000	None
OIL PRODUCTION	0.000	0.000	None

a: p-value =unrestricted-restricted explains restricted's residuals
b: p-value =unrestricted-restricted explains unrestricted's residuals
Dominance:if p-value>.5 and other is < .5 or ratio > 100
None: if both p-values <.3

We will finish our discussion of the statistical properties of the estimation, referring to the predictive accuracy, with a brief reference to some of the Theil's indices for the core of the model. Using Theil's decomposition of the mean square error, we can see the sources of the mismatch between actual and estimated values, the so-called bias, regression, and disturbance variance proportions[19]. The

[19] I am following here Kennedy (2003), ch. 18 and Granger and Newbold, ch. 9.

disturbance component represents the unsystematic source of error and it is desirable to have values close to 1. The bias proportion measures systematic error as a deviation of the average estimate from the actual average of the variable; if it is not close to zero, the model should be checked. The regression proportion of the inequality measures other sources of systematic error derived from the fact that the coefficient of the regression of the actual on the fitted values is different from one, and if this component is too large then the model has signs of trouble. We do not have a test for the whole model, but we can have an idea of the potential and the limitations of the estimations in a brief analysis equation by equation. In all of the equations, the part of the error due to a bias in the estimation is irrelevant and that the more important part is explained by the disturbances proportion. Except in the case of the equation for the interest rate, the non-systematic part of the mean square error is more than 92%, suggesting an auspicious estimation[20]. The last column shows the Theil (1961) inequality coefficient (the unbounded version), whose values closer to zero are indication of a perfect fit[21].

[20] Pindyck R. and D. Rubinfeld (1998),p. 385, present another Theil's decomposition in bias, variance and covariance. The interpretation of this decomposition is very controversial. Granger, C. and P. Newbold (1986), p. 286 argue that the interpretation is merely impossible because the shares depend (especially the last two) on the inherent features of the series involved. Clemens, M. and Hendry, D. (1998), attribute this impossibility to the non-monotonicity of these indices with respect to the mean square error.

[21] See Greene (1997), p. 373. This version is preferred because it depends monotonically on the mean square error, see Clements and Hendry (1998), p. 65.

Table 4: Decomposition of Mean Square Error

THEIL DECOMPOSITION	Bias Proportion	Regression Proportion	Disturbance Proportion	Theil's Inequality	Correlation Coefficient
INFLATION	0.0001954	0.0021904	0.99761	0.18387	0.93571
GROWTH	0.0000548	0.073816	0.92613	0.20485	0.91648
POVERTY	0.0002656	0.0045391	0.9952	0.32961	0.81157
INTEREST	0.0020766	0.38855	0.60938	0.31028	0.92085
INTERNATIONAL RESERVE	0.0012851	0.0074332	0.99128	0.49278	0.58228
FISCAL	0.0002749	0.024142	0.97558	0.431	0.65511

Another aspect to be considered in the evaluation of a model is its ability to capture the turning points of the series. That type of information cannot be inferred from the usual statistics. We will apply the Theil's indices to the differences of the actual and the predicted variables to measure the coincidence of the direction of the variables' movements. In this case, Table 5 refers to the second differences of the logarithms of the variables, and, in general, they are pretty well tracked by the estimations. With the exception of inflation, and international reserves, the correlations are rather high, the inequality index reflects a low level of mean square error. Moreover, except –again- in the case of inflation, in all the rest, the disturbance proportion, the non-systematic source, explains more than 60% of the mean square error. In addition, the bias component is virtually zero in all the cases. All this suggests that the model could capture most of the quantitative and qualitative movement of the variables.

Table 5: Turning Points Tests

THEIL DECOMPOSITION	Bias Proportion	Regression Proportion	Disturbance Proportion	Theil's Inequality	Correlation Coefficient
INFLATION	0.0018363	0.58531	0.41285	0.66327	0.1407
GROWTH	0.0005399	0.11369	0.88577	0.5235	0.47201
POVERTY	0.0000003	0.28182	0.71818	0.47126	0.81432
INTEREST	0.0001541	0.28966	0.71019	0.50435	0.79896
INTERNATIONAL RESERVE	0.0054727	0.15155	0.84297	0.67672	0.16482
FISCAL	0.0000956	0.39568	0.60423	0.44523	0.86371

The econometric results suggest that empirical evidence supports the theoretical hypotheses presented in the section about the theoretical background. Figure 2 shows the goodness to fit for the six more important variables in this system of simultaneous equations. Among 17 equations and 133 parameters, the more important estimates are[22]:

For inflation: R^2=0.88 DW=1.9 ρ=0.135

$$p_t = -.02 + .76 p_{t-1} + .29 po_t + .2 po^e_{t+1} + .18 e_t + .11 m_t + .09 gas_t + .05 w_t$$
$$+ .05 tar_t + .05 tax_t + .03 r_t + .02 m^e_{t+1} + .002 e_{t-1}$$

For growth: R^2=0.84 DW=2.01 ρ=-0.61

$$y_t = -.02 + .92 pe_t + .25 m_{t-1} + .13 e_t + .09 ti_t + .08 g_t + .07 ig_t - .07 p_t - .04 tax_t$$
$$- .04 po^e_{t+1} + .03 y_{t-1} - .01 r_{t-1} - .003 gas_t$$

For poverty: R^2=0.66 DW=1.99 ρ=-0.402

22 A more detailed presentation of the econometric results for the Private Sector's Best responses Model is in Appendix A.

$$po_t = .07 + .41e_t - .25w_t + .25\Delta p_t^e + .25r_t + .16po_{t-1} - .12y_{t-1} - .1w_{t-1}$$
$$- .04y_t - .03g_{t-1} - .01ig_{t-1}$$

For interest rates: R^2=0.85 DW=2.19 ρ=0.505

$$r_t = .17p_{t+1}^e - .12m_t + .1e_{t+1}^e - .09f_{t+1}^e + .07y_{t+1}^e - .07f_t + .01r_{t-1}$$

For international reserves: R^2=0.34 DW=1.86

$$i_t = .04 + .33pe_t + .26gas_t + .24e_t - .22e_{t+1}^e + .22ri_{t-1} - .2y_t + .18ti_t - .12w_t$$
$$+ .06gd_t - .04po_{t+1}^e - .03p_t + .02r_t + .02tar_t$$

For fiscal balance: R^2=0.43 DW=1.99 ρ=-0.303

$$f_t = .01 + .32f_{t-1} - .28g_t - .27w_t + .19ti_t + .13tar_t - .11ig_t + .1gas_t - .1po_t$$
$$+ .09gd_t - .08p_t + .05e_t + .05y_t + .02pe_t + .02tax_t$$

Notation:

p is the rate of inflation,

y is per capita income growth,

po is poverty evolution,

r is the evolution of the rate of interest,

i is the evolution of the international reserves,

f is the evolution of the fiscal deficit,

e is the rate of devaluation,

w is the evolution of the legal minimum wage,

m is the rate of change of money supply (M1),

gas is the rate of change of the price of gasoline,

g is per capita real fiscal expenditure evolution,

ig is per capita real government investment evolution,

tar is the rate of change of the ratio tariff/imports,

tax is the rate of change of the ratio tax burden/GDP,

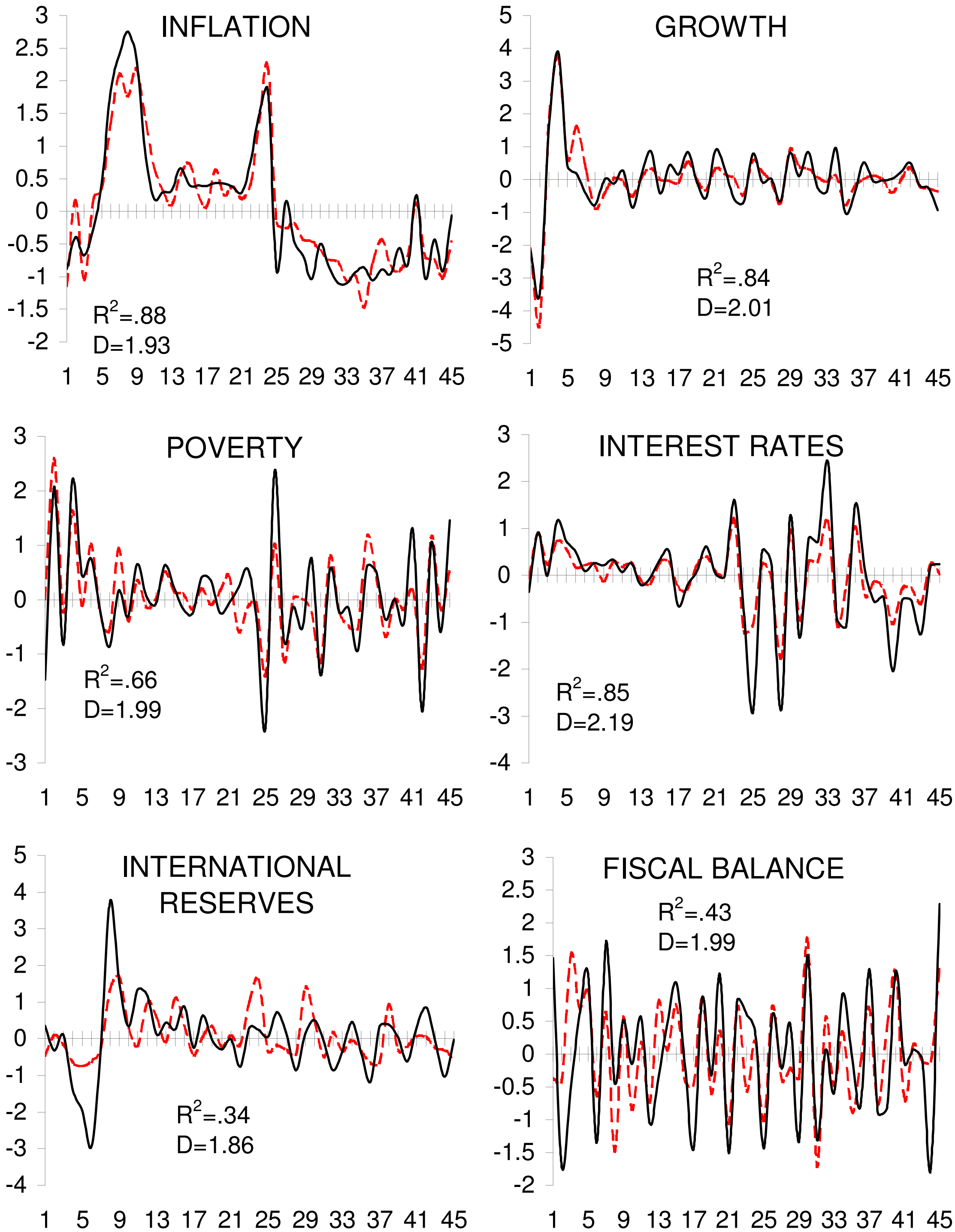
ti is international terms of exchange evolution,

gd is net external fiscal financing evolution,

pe is the rate of change of oil production, and

^{e} denote expectation

Figure 2: Goodness of Fit for the Main State Variables



5. SENSITIVITY ANALYSIS: HOW RELIABLE IS THE ROLE ASSIGNED TO POVERTY IN THE MODEL?

In this section I will check the robustness of the model to some changes in specification. The first sensitivity analysis is impicit in the encompassing exam performed during the estimation process and the above presented information jointly with the model's godness-to-fit with respect to the main variables show a significant level of reliability. However, I present here additional arguments, focussing in the role assigned to poverty in the model, a no very common feature in macroeconomic models.

The experiment consist in hitting one of the more sensitive parameters of the model: the elasticity of inflation with respect to poverty. The baseline scenario is the anticipated step input of one permanent standard deviation devaluation during twelve periods, with the shock starting in the fifth. The first column of numbers in Table 6 presents the averages of the deterministic simulation, with heavy weights for the control variables and very light on the state variables.

Table 6: Perturbations of the elasticity of inflation with respect to poverty[23]

[23] All numbers appear rounded to three decimals. No variance is actually zero.

SENSITIVITY ANALYSIS

	Deter-ministic	Perturbation CV=1		
		Average	Variance	t-statistic
Inflation	0.79	0.793	0.08	0.011
Growth	0.049	0.049	0	-0.009
Poverty	0.533	0.535	0.015	0.016
Interest	0.247	0.253	0.008	0.067
External	-0.063	-0.062	0.005	0.004
Fiscal	-0.092	-0.093	0.001	-0.021
	Deter-ministic	**Perturbation CV=2**		
		Average	**Variance**	**t-statistic**
Inflation	0.79	0.789	0.082	-0.002
Growth	0.049	0.05	0	0.081
Poverty	0.533	0.519	0.014	-0.12
Interest	0.247	0.198	0.006	-0.653
External	-0.063	-0.063	0.005	-0.004
Fiscal	-0.092	-0.09	0.001	0.053
	Deter-ministic	**Perturbation CV=3**		
		Average	**Variance**	**t-statistic**
Inflation	0.79	0.788	0.082	-0.006
Growth	0.049	0.05	0	0.04
Poverty	0.533	0.519	0.014	-0.125
Interest	0.247	0.194	0.006	-0.691
External	-0.063	-0.062	0.005	0.015
Fiscal	-0.092	-0.091	0.002	0.049

I ran three types of Monte Carlo simulations assuming coefficients of variation of one, two and three, respectively. This level of perturbation means a fairly large range of variation, just to extreme the refutation possibility. As the generation of random numbers uses normal distributions, a coefficient of variation of one implies that in 16% of the cases the parameter would change sign; a coefficient of variation of two implies a probability of 31% of the cases with the opposite sign, and a coefficient of variation of three, a probability of 37% cases with different sign. Each simulation consisted of 100 Monte Carlo replications.

For each simulation, DUALI computes the mean and the variance across Monte Carlo runs[24] and we test the results against the null hypothesis that they are equal to the mean of the deterministic simulation. As we can appreciate, none of the t-statistics suggests that the parameter perturbations yield results statistically distinct than the deterministic simulation, with fixed coefficients. This sensitivity analysis, then, indicates that the loss of information for a possible misestimation of the parameter or due to the imposition of stability of the coefficient's mean is negligible.

6. Stability of the Model Isolated from the Historical Economic Policies

The conditions of stability define the dynamic characteristics of the model, i.e. the way in which each variable behaves in relation to others over time. The permanency of the system requires that their paths follow non-explosive trajectories with respect to each other[25]. The perspective of this analysis is not related to the whole model as a game, but only to the best responses of the second player, the private sector.

---

[24] These appear in the DUALI output as AvgAvgXsCe and VarAvgXsCe, respectively.

[25] Even if some variables of the system are not stable, the model could still be useful for forecasting, simulation, and control. The real test should refer to the approximated replication of the actual series, although the degree of instability and the temporal horizon of the simulation would define the limits and the interpretation of the results. See, for instance, Pindyck and Rubinfeld (1998), ch. 14.

The characteristic values of the coefficients' matrix in the system of equations give information about those behaviors, expressing stability, instability or saddle-path stability[26].

For the model as a whole, the largest or dominant characteristic root establishes the condition of stability[27]. However, the analysis can go deeper, equation by equation.

For being globally stable, i.e. to converge towards the steady state from any initial condition, a system of equations must have characteristic values whose magnitude is inside the unitary circle. That means that the absolute values of the eigenvalues or their modulus --if they are complex numbers--should be lower than one[28]. If the imaginary part is zero, the system converges without oscillations.

To the contrary, the model is unstable if its eigenvalues lie outside the unit circle, which means that unless it starts from the steady-state itself, it will diverge from it for any other initial conditions. If the coefficients of the imaginary parts are different from zero, the system diverges from the steady state with oscillations.

A combination of eigenvectors with both kind of properties indicated above defines a saddle point stable system The system will converge towards the steady-state from some initial conditions, and will diverge from other ones. Purely imaginary characteristic roots define an asymptotically unstable system, i.e. a

---

26 See Mercado, P. R. and D. Kendrick (1998a and b).

27 See Greene (1997), p.768. The author suggests taking care only of the autoregressive part of the coefficient matrix p. 770.

28 Then, as the temporal horizon goes to infinite, the effect goes to zero. That would characterize the matrix A as *nilpotent*, Greene (1997), p. 60.

system that orbits around the steady state without convergence, but only if the initial conditions are in this orbit.

For this model, despite the twenty-eight state variables in the augmented matrix, we have only twelve non-zero characteristic vectors, and only the first six refer to the current variables of the core. For the variables of relevance, the eigenvalues are:

Table 7: Eigenvalues from the matrix of endogenous coefficients

For Inflation Equation	= -0.60876
For Growth Equation	= 0.71999
For Poverty Equation	= 0.51804
For Interest Rates Equation	= -0.40212
For External Balance Equation	= -0.30200
For Fiscal Balance Equation	= 0.32399

None of the characteristic roots is outside the unit circle and there are no imaginary roots, which means that the model is stable and without oscillations. Nevertheless, the negative roots (related to inflation, poverty, and reserves in foreign currency) add a damped sawtooth term to the system[29]. The positive roots will define a damped exponential trajectory of adjustment. The closer to zero the real parts of the eigenvalues are, the faster the adjustment will be. The first two eingenvalues are closer to one, related to the dynamics of prices and growth. That implies a very slow adjustment towards the long-term position. Moreover, if we

[29] Greene (1997), p. 772.

take into account the eigenvalue related to the interest rates dynamics, the analysis confirms a relatively strong evidence of inertia in this economy.

7. TESTING THE SUSTAINABILITY OF THE WASHINGTON CONSENSUS POLICIES

In this section, we will use this framework as a whole, attempting an evaluation of the economic policies implemented in Ecuador between 1986 and 1998, i.e., during the sample period of the econometric estimation. The idea is to test the responses of the estimated system of equations to the predominant style of policies, as captured by the econometric estimation of the feedback rule:

$$u_t = g + Gx_t + \varepsilon_t$$

Where *u* and *x* are the augmented matrices of controls and state variables as defined before, *g* and *G* are assumed constant for the period, and ε represents the deviations with respect to the average type of policies due to political shocks, basically[30].

The econometric estimation with a vector autoregressive model yields the estimates for *g* and *G*. If these estimated matrices g and G are a close approximation to the actual type of priorities and preferences involved in the policy design of the last years, we could have enough elements for an appraisal of the economic policies as responses of both players to the exogenous shocks during the period[31]. Note, however, that this is just a rough approximation to

[30] This problem is treated in the literature as the "inverse" problem and it could be handled in different alternative ways. See, for instance Bray, J. (1981) for a political reading of this problem and Chow, G. (1975 and 1983) for a more technical approach.
[31] Appendix B contains the basic results of the estimation.

characterize the type of problems that, in general, the style of policy design could have. It would not be fair to infer from this "forced average" of the feedback rule a categoric judgement about the type of policies.

Taken the model as a whole, the repeated game between the policy makers and the private sector would have dynamics given by the private sector's system of equations and the government's feedback rule. Replacing the "average" feedback rule in the system of equations, we could have an approximation of the reduced form of the game as a whole:

$$
\begin{aligned}
&x_{t+1} = Ax_t + Bu_t + Dx^e_{t+2} + Cz_t + \xi_{t+1} \\
&= Ax_t + B(g + Gx_t + \varepsilon_t) + Dx^e_{t+2} + Cz_t + \xi_{t+1} \\
&= (A + BG)x_t + Dx^e_{t+2} + Cz_t + Bg + B\varepsilon_t + \xi_{t+1}
\end{aligned}
$$

This expression is a constrained structural vector autoregressive model whose properties come from the matrix *(A+BG)* . Table 7 presents the eigenvalues of this new, augmented matrix:

Table 8: Eigenvalues of the joint matrix (A+BG)

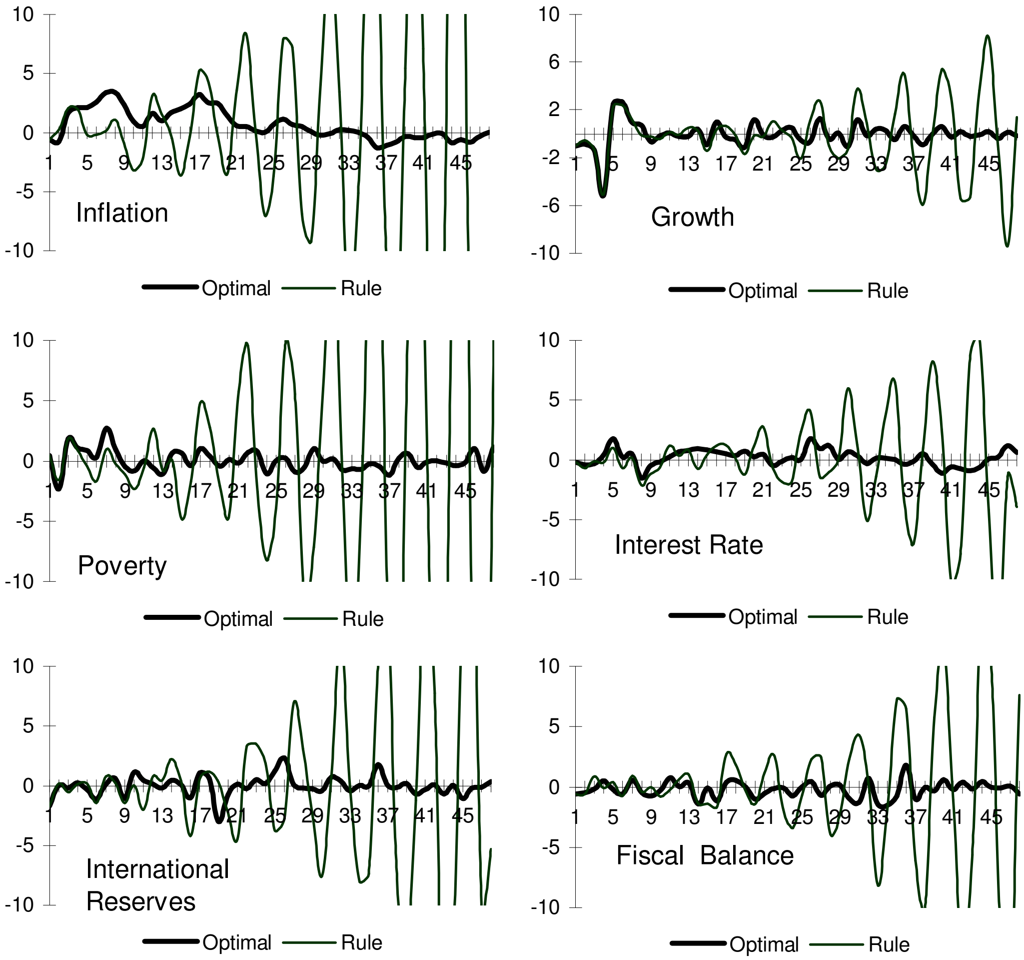
	(A+BG) Eigenvalues		
	Real	**Imaginary**	**Modulus**
Inflation	-1.135	0.000	1.287
Growth	0.205	1.132	1.323
Poverty	0.205	-1.132	1.323
Interest	0.973	0.404	1.111
External	0.973	-0.404	1.111
Fiscal	-0.642	0.448	0.613

In contrast with the stability properties of the endogenous coefficient matrix, *A*, i.e. the system alone, without the historical economic policies, the composite matrix *A+BG* is unstable. Modulus of the complex characteristic roots are all larger than one, except that related to the fiscal situation. Since the eigenvalues are larger than one in absolute terms, the system, taken as a complete game, explodes. The dominant roots are related both to growth and poverty. The system explodes with oscillations because the imaginary parts are different from zero, except in the case of inflation.

Figure 3 shows the simulation of the "average policy" against the baseline[32], facing the historic perturbations as captured by the residuals of the econometric estimation. The exercise is extrapolated for the long run (47 quarters), that is the sample period, with the purpose of studing the stability properties of the integrated game.

Figure 3: Instrumental instability

[32] The baseline is the results of the model with the historic initial values, exogenous variables, and additive noises (resultant from the econometric estimation) for the 47 periods of the sample.



These features coincide with the so-called *instrumental instability*[33]. The stability analysis suggests that the style of policies implemented in Ecuador during the last years is unsustainable. Obviously the statement is relative to the temporal horizon and the specific exogenous shocks that the system would face.

This result about the long term unsustainability of the style of economic policy could be corroborated by the historic evidence of regular interruptions of

[33] See Turnovsky, S. (1977), Aoki, M. (1976).

the stabilization programs and its substitution for a new adjustment package, even within the period of the same administration[34].

In most of the cases, the policies seem to be fairly stable for the first three or four years, but then the series start to explode with oscillations. The case of inflation is very interesting because it is the only one in which the handcrafted feedback rule seems to have some advantage with respect to the baseline of historic simulation during the first quarters. However, the volatility in inflation is much earlier than in the rest of the exercises (exploding oscillations start at the second year).

8. CONCLUSIONS

With this game-theoretical framework for the analysis of economic policies, we have presented evidence of the lack of viability of neoliberal policies in the case of Ecuador.

In a multi-period game, in which it acts as *Stackelberg* leader, the government minimizes a quadratic loss function using stochastic dynamic control techniques. A system of simultaneous equations represents the private agents' aggregate best responses, inspired in the Johansen's linear approximation of the general equilibrium solution to the different agents' optimization problems.

[34] Those interruptions have been frequently presented as mere adjustments to the policies and not as new adjustment packages, even if they include dramatic policy measures.

Finally, stochastic disturbances affect, period after period, the system of equations.

The application of the model suggests that historical Ecuadorian economic policy presented serious problems of instrumental instability during the last two decades, when they were inspired by the spirit of what was called at the beginning of the nineties the Washington Consensus, even if its rationale informed the adjustment packages in all Latin America long ago.

BIBLIOGRAPHICAL REFERENCES

Aoki, M. 1976 . Optimal Control and System Theory in Dynamic Economic Analysis. North Holland Publishing Co., NewYork.

Aoki, M. 1981. Dynamic Analysis of Open Economies. Academic Press. New York

Amman, H. and D. Kendrick 1993. Forward looking behavior and learning in stochastic control , in The International Journal of Supercomputer Applications 7(3), 201-211.

Amman, H. and D. Kendrick 1997a. Linear –quadratic optimization for models with rational expectations and learning. Research Memorandum, University of Amsterdam

Amman, H. and D. Kendrick 1997b. The DUALI/DUALPC software for optimal control models, in Amman, H. et al. (ed.) Computational Approaches to Economic Problems. Kluwer Academic Publishers. Netherlands.

Amman, H. and D. Kendrick 1999. Should Macroeconomic Policy Makers Consider Parameter Covariances? Forthcoming in Computational Economics.

Azariadis, C. 1993. Intertemporal Macroeconomics. Basil Blackwell. Cambridge, MA.

Banerjee, A. and D. Hendry 1997. The Econometrics of Economic Policy, Blackwell Publishers, Oxford, UK.

Banco Central del Ecuador 1999a. Encuestas de Coyuntura de la Manufactura. Quito.

Banco Central del Ecuador 1999b. Cuentas Nacionales Trimestrales. Quito.

Bray, J. 1982. Production, Purpose and Structure. Towards a Socialist Theory of Production. Frances Printer Publishers. London.

Chow, G. C. 1975. Analysis and Control of Dynamic Economic Systems. John Wiley & Sons., Inc.

Chow, G. C. 1982. Analysing Econometric Models by Control Methods, in Chow, G. C. and P. Corsi, 1982. Evaluating the Reliability of Macroeconomic Models. John Wiley & Sons, Manchester, UK.

Chow, G. C. 1983. Econometrics. McGraw Hill, New York.

Clements, M. P. and D. F. Hendry. 1998. Forecasting Economic Time Series. Cambridge University Press, Cambridge, UK.

Currie, D. and P. Levine, 1993. Rules, reputation and macroeconomic policy coordination. Cambridge University Press, Cambridge, MA.

De Janvry, A., E. Sadoulet an A. Fargeix 1991. Adjustment and Equity in Ecuador. OECD. Paris.

Dervis, K., J. de Melo and S. Robinson 1982. General Equilibrium Models for Developing Countries. Cambridge University Press, New York.

Enders, W. 1995. Applied Econometric Time Series. John Wiley & Sons, New York.

Ganuza, E., L. Taylor and S. Morley 1998. Politica Macroeconomica y Pobreza en America Latina y el Caribe. PNUD. Ediciones Mundi-Prensa. Madrid.

Hamilton, J. 1994. Time Series Analysis. Princeton University Press. New Jersey.

Holly, S. and A. Hughes Hallet, 1989. Optimal Control, expectations and uncertainty. Cambridge University Press, Cambridge, UK.

Jácome L., C. Larrea and R. Vos 1997. Políticas Macroeconómicas, distribución y pobreza en el Ecuador, CORDES, Quito.

Kendrick, D. 2003. Stochastic Control for Economic Models. Electronic edition: http://www.eco.utexas.edu/faculty/Kendrick/papers/kendbook.pdf

Kendrick, D. 1990. Models for Analyzing Comparative Advantage. Kluwer Academic Publishers. Holland.

Kennedy, P. 2003. *A Guide to Econometrics*. 5th. ed. The MIT Press, Cambridge, MA.

Leon, M. and R. Vos 1999. Pobreza y Distribucion en Ecuador. FISE, Quito.

Páez, P. 1992. Un Modelo de Equilibrio General Computable para Ecuador 1990. Master's Dissertation. Facultad Latinoamericana de Ciencias Sociales FLACSO. Quito

Páez, P. 1999a. An Optimal Control Framework for Alternative Economic Policies in Ecuador. PhD. Dissertation. University of Texas at Austin.

Páez, P. 1999b. *Poverty and Alternative Stabilization Policies*, Paper presented to the 17th. World Congress of the ATWS, Association of Third World Studies, San José de Costa Rica, Novembre 1999

Páez, P. 2000a *Redes Neuronales para la estimación de la Pobreza Urbana en Ecuador*, in Cuestiones Económicas v. 16, n. 1, Banco Central del Ecuador.

Páez, P. 2000b *Democracia, lucha contra la pobreza y políticas alternativas de estabilización*, in Cuestiones Económicas v. 16, n. 2, Banco Central del Ecuador.

Páez, P. 2000c *Algoritmos genéticos en la estimación de un modelo macroeconométrico para Ecuador*, in Cuestiones Económicas v. 16, n. 3, Banco Central del Ecuador.

Páez, P. 2003 *Financial Liberalization, Crisis and National Currency Destruction in Ecuador*, in Pierre van der Haegen and José Viñals (eds.) "Regional Integration in Europe and Latin America: Monetary and Financial Aspects", Ashgate Publishing, c. 13, ps. 447-500.

Petit, M. L. 1990. Control theory and dynamic games in economic policy analysis. Cambridge University Press.

Sargent, T. 1993. Bounded Rationality in Macroeconomics. Clarendon Press, Oxford, UK.

Turnovsky, S. J. 1977. Macroeconomic analysis and stabilization policy. Cambridge University Press (Reprinted 1985) Cambridge, MA.

APPENDIX A: Econometric Results

Table A.1: Econometric results for Inflation

INFLATION EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
LAGGED INFLATION	0.763	0.063	12.145
POVERTY	0.288	0.053	5.441
EXPECTED POVERTY	-0.197	0.050	-3.963
DEVALUATION	0.176	0.055	3.191
MONEY	0.108	0.046	2.354
GAS	0.090	0.046	1.956
WAGE	0.053	0.047	1.125
TARIFF	0.049	0.044	1.113
TAX	0.048	0.040	1.193
INTEREST	0.031	0.047	0.663
EXPECTED MONEY	0.017	0.046	0.366
LAGGED DEVALUATION	0.002	0.005	0.408
CONSTANT	-0.023	0.047	-0.478
AUTOCORRELATION	0.135	0.130	1.042

Table A.2: Econometric results for Growth

GROWTH EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
OIL	0.923	0.050	18.509
LAGGED MONEY	0.248	0.053	4.720
DEVALUATION	0.129	0.048	2.659
TERMS TRADE	0.086	0.045	1.908
FISCAL EXPENDITURE	0.081	0.058	1.405
PUBLIC INVESTMENT	0.067	0.046	1.450
INFLATION	-0.066	0.047	-1.389
TAX	-0.042	0.059	-0.714
EXPECTED POVERTY	-0.037	0.055	-0.669
LAGGED GROWTH	0.026	0.014	1.891
LAGGED INTEREST	-0.011	0.049	-0.221
GAS	-0.003	0.037	-0.068
CONSTANT	-0.016	0.034	-0.472
AUTOCORRELATION	-0.610	0.090	-6.774

Table A.3: Econometric results for Poverty

POVERTY EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
DEVALUATION	0.407	0.087	4.662
WAGE	-0.251	0.076	-3.321
INFLATION	0.248	0.617	0.401
LAGGED INFLATION	-0.248	0.617	-0.401
INTEREST	0.246	0.076	3.254
LAGGED POVERTY	0.161	0.142	1.134
LAGGED GROWTH	-0.118	0.088	-1.347
LAGGED WAGE	-0.097	0.078	-1.249
GROWTH	-0.044	0.078	-0.562
LAGGED FISCAL EXPENDITUR	-0.034	0.104	-0.331
LAGGED PUBLIC INVESTMENT	-0.013	0.070	-0.186
CONSTANT	0.065	0.058	1.125
AUTOCORRELATION	-0.402	0.208	-1.934

Table A.4: Econometric results for Interest Rate

INTEREST EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
EXPECTED INFLATION	0.168	0.119	1.411
MONEY	-0.117	0.060	-1.959
EXPECTED DEVALUATION	0.102	0.088	1.161
EXPECTED FISCAL BALANCE	-0.088	0.084	-1.043
EXPECTED GROWTH	0.072	0.081	0.884
FISCAL BALANCE	-0.069	0.077	-0.893
LAGGED INTEREST	0.011	0.014	0.837
CONSTANT	0.000	0.151	0.000
AUTOCORRELATION	0.505	0.074	6.849

Table A.5: Econometric Results for International Reserves

INTERNATIONAL RESERVES EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
OIL	0.333	0.180	1.849
GAS	0.258	0.136	1.896
LAGGED DEVALUATION	0.237	0.121	1.953
EXPECTED DEVALUATION	-0.225	0.110	-2.049
LAGGED INTERNATIONAL RESERVES	0.223	0.137	1.628
GROWTH	-0.200	0.174	-1.152
TERMS TRADE	0.182	0.107	1.706
WAGE	-0.125	0.106	-1.179
DEBT	0.061	0.091	0.674
EXPECTED POVERTY	-0.042	0.127	-0.329
INFLATION	-0.029	0.134	-0.220
INTEREST	0.022	0.104	0.214
TARIFF	0.016	0.109	0.144
CONSTANT	0.044	0.107	0.409
AUTOCORRELATION	0.000	0.178	0.000

Table A.6: Econometric results for Fiscal Balance

FISCAL BALANCE EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
LAGGED FISCAL BALANCE	0.321	0.243	1.324
FISCAL EXPENDITURE	-0.276	0.128	-2.150
WAGE	-0.265	0.140	-1.900
TERMS TRADE	0.187	0.120	1.566
TARIFF	0.131	0.145	0.901
PUBLIC INVESTMENT	-0.111	0.119	-0.931
GAS	0.097	0.134	0.720
POVERTY	-0.095	0.176	-0.540
DEBT	0.093	0.129	0.721
INFLATION	-0.083	0.106	-0.780
DEVALUATION	0.052	0.053	0.987
GROWTH	0.046	0.244	0.187
OIL	0.023	0.262	0.087
TAX	0.021	0.150	0.137
CONSTANT	0.011	0.082	0.135
AUTOCORRELATION	-0.302	0.250	-1.207

Table A.7: Econometric results for Tariffs

TARIFF EQUATION			
		STANDARD	
VARIABLES	PARAMETER	ERROR	T-STATISTIC
LAGGED TARIFF	-0.529	0.102	-5.170
LAGGED INTERNATIONAL RESERVES	0.353	0.102	3.450
GROWTH	-0.311	0.096	-3.228
LAGGED DEVALUATION	0.287	0.108	2.647
LEGAL TARIFF	0.205	0.109	1.878
FISCAL EXPENDITURE	0.169	0.091	1.865
LAGGED INTEREST	0.095	0.087	1.084
INFLATION	-0.088	0.106	-0.826
PUBLIC INVESTMENT	0.045	0.095	0.472
CONSTANT	0.075	0.095	0.794
AUTOCORRELATION	-0.018	0.153	-0.120

Table A.8: Econometric results for Taxes

TAX EQUATION			
		STANDARD	
VARIABLES	PARAMETER	ERROR	T-STATISTIC
LAGGED TAX	-0.344	0.301	-1.143
LAGGED FISCAL EXPENDITURE	0.220	0.128	1.711
LAGGED INTEREST	-0.202	0.116	-1.751
LEGAL TAX	0.107	0.102	1.048
LAGGED WAGE	0.100	0.111	0.904
LAGGED DEVALUATION	-0.080	0.105	-0.765
INFLATION	-0.053	0.099	-0.537
CONSTANT	0.002	0.073	0.023
AUTOCORRELATION	-0.560	0.269	-2.078

Table A.9: Econometric results for expectations

EXPECTATIONS EQUATIONS			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
EXPECTED INFLATION	1.028	0.014	72.490
AUTOCORRELATION	-0.052	0.114	-0.457
EXPECTED GROWTH	1.007	0.023	44.484
AUTOCORRELATION	-0.428	0.110	-3.906
EXPECTED POVERTY	1.100	0.064	17.234
AUTOCORRELATION	-0.089	0.174	-0.513
EXPECTED FISCAL BALANCE	1.009	0.055	18.248
AUTOCORRELATION	-0.298	0.236	-1.265
EXCHANGE EXPECTATION	1.006	0.034	29.917
AUTOCORRELATION	-0.136	0.173	-0.784

Table A.10: Econometric results for Exogenous shocks

TERMS TRADE EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
CONSTANT	-0.10426	1.08495	-0.09610
LINEAR TREND	0.00000	0.16027	0.00000
QUADRATIC TREND	0.00003	0.00669	0.00378
CUBIC TREND	-0.00001	0.00008	-0.10351
LAGGED TERMS TRADE	0.09060	0.07480	1.21129
AUTOCORRELATION	0.40460	0.07938	5.09718

EXTERNAL DEBT EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
CONSTANT	1.43315	0.76264	1.87919
LINEAR TREND	-0.05499	0.02083	-2.63963
QUADRATIC TREND	0.01690	0.00618	2.73254
CUBIC TREND	-0.00019	0.00007	-2.82519
LAGGED DEBT	0.10090	0.02577	3.91510
AUTOCORRELATION	0.77811	0.02746	28.33510

OIL EQUATION			
VARIABLES	PARAMETER	STANDARD ERROR	T-STATISTIC
CONSTANT	-0.19220	1.01628	-0.18912
LINEAR TREND	0.02432	0.14787	0.16446
QUADRATIC TREND	-0.00023	0.00613	-0.03753
CUBIC TREND	0.00000	0.00008	-0.02648
LAGGED OIL	0.09454	0.06187	1.52810
AUTOCORRELATION	0.46525	0.06887	6.75543

APPENDIX B: Washington Consensus Policies "Style"

Table B.1: The feedback rule matrix g

Exchange	-0.01
Wage	-0.04
Money	0.09
Gas	-0.05
Gov. Exp.	0.02
Gov.Inv.	0.06
Tariffs	0.05
Taxes	0.05

Table B.2: The transpose of the feedback rule matrix G

	Exchange	Wage	Money	Gas	Gov. Exp.	Gov.Inv.	Tariffs	Taxes
Inflation	-0.54	0.11	0.38	0.23	0.10	-0.08	0.26	0.07
Growth	0.12	0.09	-0.09	-0.13	0.33	-0.16	0.19	0.08
Poverty	-0.03	-0.23	-0.02	0.36	0.09	-0.10	0.12	-0.03
Interest	-0.22	0.19	0.15	0.43	-0.13	-0.13	0.09	-0.08
External	-0.55	0.02	0.16	0.04	-0.12	0.33	0.28	0.00
Fiscal	0.22	-0.19	0.12	0.30	-0.34	0.30	0.43	0.29
Inflation	0.07	0.17	0.18	0.01	-0.29	0.06	0.34	0.13
Growth	-0.45	0.30	0.41	-0.04	0.07	-0.28	0.53	0.46
Poverty	0.36	0.22	-0.27	-0.07	-0.30	-0.35	-0.30	0.37
Interest	-0.30	-0.46	-0.30	-0.05	0.06	-0.14	-0.18	0.25
External	-0.29	-0.02	-0.01	0.18	0.43	-0.09	0.26	-0.43
Fiscal	-0.45	0.04	0.23	-0.19	0.13	0.18	-0.10	-0.22
Exchange	-0.10	0.21	0.17	0.45	0.45	0.11	0.18	0.17
Wage	-0.31	-0.20	-0.01	-0.34	0.31	0.22	0.18	-0.06
Money	0.15	-0.13	0.55	-0.16	0.18	-0.13	-0.44	-0.21
Gas	0.50	0.25	-0.08	0.21	-0.04	0.48	0.14	-0.74
Gov. Exp.	-0.70	-0.19	-0.30	0.08	-0.28	0.51	0.18	-0.10
Gov.Inv.	-0.28	-0.20	-0.25	-0.14	-0.38	-0.03	-0.87	0.44
Tariffs	-0.26	0.20	-0.02	0.03	-0.60	-0.08	0.12	0.09
Taxes	0.17	0.03	0.02	-0.15	-0.26	0.06	0.03	-0.03
Exchange	0.05	0.08	0.21	0.14	-0.08	-0.09	-0.19	-0.09
Wage	0.32	0.06	-0.43	-0.09	-0.02	0.09	-0.18	0.43
Money	-0.09	-0.15	0.04	0.08	0.30	0.06	-0.37	0.19
Gas	-0.31	0.25	-0.51	0.10	-0.12	0.07	-0.28	-0.04
Gov. Exp.	-0.28	-0.41	-0.02	0.16	1.22	0.15	-0.14	-0.32
Gov.Inv.	-0.08	-0.19	-0.96	-0.31	-0.03	0.18	0.05	0.21
Tariffs	-0.30	0.21	-0.14	-0.16	0.39	-0.10	-0.30	-0.85
Taxes	-0.38	0.18	0.26	-0.07	0.44	-0.02	-0.45	-0.58