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SHARE OF GOVERNMENT IN GROSS NATIONAL PRODUCT

Cross-Section and Time-Series Analysis, 1950-1982

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This paper provides data on elasticities of government revenues and expenditures for 28 countries for varying periods within the time span 1950-1982. Four issues are briefly noted for which these results provide some elucidation.

1) INTRODUCTION

This paper provides empirical evidence on the shares of revenues and government expenditure in the Gross National Product of twenty-eight countries, including eleven classified as Industrial Market Economies and seventeen classified as Developing Economies, for varying periods within the time span 1950-1982[1]. In our model, revenues and expenditures are treated as functions of current Gross National Product. Regressions are made for each individual country and revenue and expenditure elasticities are calculated. The regression (and elasticity) results are used to elucidate briefly four issues noted in the economic development literature.

2) MODEL

The model for government revenue is assumed here to be the following:

$$\log T = a_T + b_T \log Y$$

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1 International Monetary Fund classification.

It is well known that the coefficient b_T in the model is the income elasticity of revenue, given by

$$\frac{dT/T}{dY/Y} \qquad \frac{\text{Percentage change in Revenue}}{\text{Percentage change in GNP}}$$

Similarly the model for government expenditures is assumed here to be:

$$\log G \quad a_G \quad b_G \log Y$$

where b_G is the income elasticity of expenditure given by

$$\frac{dG/G}{dY/Y} \qquad \frac{\text{Percentage Change in Expenditure}}{\text{Percentage change in GNP}}$$

where[2]

T current government revenues, including grants

G current government expenditures, including net lending minus repayments

Y Gross National Product in current market prices.

3) REGRESSION RESULTS

Table 1 gives some selected regression results. The first column in each of the matrices with the titles 'Revenue Elasticity' and 'Expenditure Elasticity' displays the actual value obtained for these coefficients from the computer runs using SAS regression software. The second column in each matrix displays the value of the t-statistic calculated to test if these parameter values are significantly different from zero. The third column shows the outcome of these tests.

In each test, it turned out that the values of b_T and b_G are significantly different from zero. This result indicates that GNP and T as well as GNP and G are statistically related to each other. This relationship is explained numerically as follows. The revenue elasticity for Austria, for example, is noted to be 1.06 from Table 1. This means that if the change in GNP is 100 percent, then the change in government revenues is 106 percent over the period. That is, a change in GNP of a certain magnitude is followed by a change in government revenue which is six percent larger in magnitude than that of GNP.

2 Note that data do not include local government nor public enterprise accounts.

Table 1

Revenue And Expenditure Elasticities

	Revenue Elasticity			Expenditure Elasticity		
	Value	t-Statistic	Significant?	Value	t-Statistic	Significant?
Industrial Market Countries:						
Austria (1950–1982)	1.0642	86.5	yes	1.0912	94.1	yes
Belgium (1954–1982)	1.2341	106.7	yes	1.3072	57.7	yes
Canada (1950–1982)	1.0822	56.1	yes	1.1519	66.5	yes
Finland (1952–1982)	1.0013	76.7	yes	1.0157	86.8	yes
France (1950–1982)	1.0152	147.0	yes	0.9500	87.7	yes
Germany (1951–1982)	0.9773	75.0	yes	1.0471	59.2	yes
Ireland (1950–1982)	1.1978	127.3	yes	1.2416	105.9	yes
Italy (1950–1982)	1.1370	85.7	yes	1.1948	69.7	yes
Netherlands (1950-1982)	1.1618	61.1	yes	1.2253	80.6	yes
Norway (1960–1982)	1.3652	36.6	yes	1.3713	39.7	yes
USA (1950–1982)	1.0597	69.1	yes	1.1240	58.0	yes
Developing Countries:						
Bolivia (1963–1982)	1.0365	33.9	yes	1.1678	38.0	yes
Brazil (1958–1982)	1.0116	148.7	yes	0.9700	196.2	yes
Columbia (1952–1981)	1.0740	63.9	yes	1.0786	67.2	yes
Dom. Rep. (1962–1982)	0.9182	25.5	yes	0.9310	41.9	yes
Ecuador (1950–1982)	1.1327	22.4	yes	1.1193	41.0	yes
El Salvador (1960-1982)	1.0934	34.2	yes	1.2160	44.6	yes
Guatemala (1958–1982)	0.9392	23.7	yes	1.0190	20.5	yes
Honduras (1950–1982)	1.3026	74.6	yes	1.3608	59.1	yes
Jamaica (1962–1980)	1.1477	66.8	yes	1.2864	38.1	yes
Nicaragua (1958–1982)	1.3019	31.9	yes	1.5091	35.6	yes
Paraguay (1958–1982)	0.9970	43.8	yes	0.9839	39.6	yes
Peru (1950–1982)	1.0278	117.0	yes	1.0677	160.6	yes
Sri Lanka (1950–1982)	1.0170	48.8	yes	1.1818	45.3	yes
Thailand (1952–1982)	1.0406	95.0	yes	1.0638	55.6	yes
Turkey (1950–1981)	1.0860	94.8	yes	1.0993	94.3	yes
Venezuela (1950–1982)	1.1469	48.5	yes	1.1658	45.2	yes
Zambia (1964–1982)	0.7216	11.3	yes	1.0328	15.3	yes

Source: Calculations made on data from International Monetary Fund, **International Financial Statistics**, various issues. Classification of countries as to Market Industrial and Developing is taken from International Monetary Fund. Periods differ because of lack of availability of consistent data. Revenues and grants received are summed; expenditures and net lending minus repayments are summed, when applicable. Data are in own currency. SAS software was used for statistical computations.

Our results might lead one to make an a **priori** assumption of a causal relationship between GNP and T and GNP and G, that is, a change in GNP causes a change in G and T. In fact, for every country, the coefficient of determination, R^2, was calculated and this was found to be very close to unity (.99 or more). This indicates a very high positive correlation between GNP and T, and GNP and G. This high correlation does not, however, mean that current year GNP is the main determinant of the current year T and G in a causal sense. Two important factors might underlie this high correlation. First, there are the restrictive assumptions imposed on the regression model:

(1) T and G are functions of nominal GNP only. That is, the statistical relationship is restricted to simple and not multiple regression.

(2) A simple double log linear regression model is assumed here to derive directly a measure of elasticity.

Secondly, it is important to note that data used here is time-series data. Time-series data quite often has a built-in feature of serial correlation. That is, the consecutive error terms obtained as the difference between the observed value and the calculated theoretical values from the model might be correlated. Therefore one has to investigate if there is serial correlation in the data, that is, if the values of the variables for consecutive years are correlated. If the disturbances of a regression model are related in a certain way rather than being independent of each other, they are said to exhibit autocorrelation. The circumstances involved in time-series regression models make this an occurence in many cases (Mirer, 1983: 253-261). One of the factors contributing to the disturbance term in any regression model is measurement error for the dependent variable. It seems possible that measurement errors, especially in GNP and government budgetary data, may be serially correlated because of repetition in data-gathering techniques. A second factor usually contributing to the disturbance term is the exclusion of some relatively unimportant explanatory variables. Each of these is likely to vary systematically with time, and the combination of the unimportant variables may be serially correlated. Hence data collection techniques as well as specification problems contribute to serial correlation.

In fact, a positive autocorrelation was found in the data used for the regressions. The details of this analysis are discussed via Table 2. Table 2 shows the results of autocorrelation tests using the Durbin-Watson Statistic. In each of the matrices with the titles `Revenue`

Table 2

Results Of Durbin-Watson Test For Autocorrelation

Country	Sample Size	Revenue: Durbin-Watson Statistic	Revenue: Positive Auto-Correlation?	Revenue: Auto-Correlation Value	Expenditure: Durbin-Watson Statistic	Expenditure: Positive Auto-Correlation?	Expenditure: Auto-Correlation Value
Industrial Market Countries:							
Austria	33	.536	yes	.577	.824	yes	.525
Belgium	29	.521	yes	.724	.623	yes	.603
Canada	33	.395	yes	.794	.730	yes	.625
Finland	25	.864	yes	.550	.824	yes	.560
France	33	.500	yes	.689	.589	yes	.570
Germany	32	1.582	no	.186	1.490	Indecisive	.229
Ireland	33	1.402	Indecisive	.271	1.209	yes	.375
Italy	33	.558	yes	.580	.654	yes	.588
Netherlands	33	.188	yes	.791	.319	yes	.676
Norway	23	.588	yes	.666	.662	yes	.616
USA	33	1.223	yes	.230	1.255	yes	.326
Developing Countries:							
Bolivia	23	.692	yes	.377	1.296	yes	.129
Brazil	25	1.072	yes	.417	1.177	yes	.228
Colombia	30	.640	yes	.666	.814	yes	.567
Dom. Rep.	21	1.134	yes	.280	1.428	yes	.154
Ecuador	33	1.678	no	.154	.442	yes	.715
El Salvador	23	1.115	yes	.413	.951	yes	.410
Guatemala	25	.406	yes	.721	.508	yes	.628
Honduras	33	.959	yes	.430	.798	yes	.574
Jamaica	19	1.030	yes	.437	.415	yes	.720
Nicaragua	25	.445	yes	.647	.541	yes	.544
Paraguay	25	.708	yes	.583	.873	yes	.458
Peru	33	.958	yes	.516	1.496	Indecisive	.176
Sri Lanka	33	.887	yes	.333	1.160	yes	.311
Thailand	31	1.330	yes	.310	1.061	yes	.456
Turkey	32	1.520	no	.207	1.516	no	.195
Venezuela	32	1.160	yes	.417	.981	yes	.505
Zambia	19	1.778	no	.080	1.752	no	.069

and 'Expenditure', the first column shows the actual value of the Durbin-Watson Statistic, the second column shows the results of the test as to whether or not there is positive autocorrelation, and the third column shows the numerical value of such an autocorrelation. It is easy to see from Table 2 that for almost all countries, consecutive error terms are highly positively correlated. That is, T for the current year is not only the function of current year GNP, but is dependent upon T and GNP of the previous years also, and perhaps other factors. This makes the **a priori** assumption that current T is simply a function of current GNP untenable.

A point to note here is that since a positive autocorrelation is found in the data, the fact that the coefficient of determination, R^2, is very close to unity for the regression model does not necessarily mean that the fit is as good as the numbers suggest. The way to obtain a better fit is to use the generalized least squares technique and remove autocorrelation. For this purpose, the numerical value of autocorrelation, as shown for each country in Table 2 can be used and two new sets of variables can be formed as follows:

$$T' = \log T_t - \log T_{t-1}$$

$$Y' = \log Y_t - \log Y_{t-1}$$

This can be regressed then to obtain a model of the form

$$T' = a + bY'$$

The Durbin-Watson Statistic, in such a case, will usually permit the acceptance of the hypothesis of no autocorrelation. The above revised model will be a better (more efficient) estimate of the relationship.

4) EXAMINATION OF EMPIRICAL EVIDENCE

The empirical evidence obtained from the above regressions however, is examined to investigate the validity of four propositions that we noted in the economic development literature.

1. Khan and Knight of the International Monetary Fund have developed an econometric framework for a stabilization model (Khan and Knight, 1981). In their model the desired level of expenditure and level of income are both related to the level of nominal income. Khan and Knight state that

> "it was probably reasonable to assume that in the long run the government would wish to increase its expenditures in line with the growth of nominal income and therefore one would expect a priori that the income elasticity would be equal or close to unity. Such a restriction would normally also be required to ensure that the overall model has a steady-state solution when capacity income and foreign prices, or the exchange rate, are allowed to change over time. (Ibid.: 12)

The above constraint (unitary elasticity) was not imposed on the tested model in the cited study by Khan and Knight because of the short period tested. The result of the estimation was that both elasticities were highly significant, with the revenue elasticity being greater than unity, and the expenditure elasticity being close to unity. As a result when a one-period monetary shock is imposed on the endogenous variables of the model, certain results were found for the government's budgetary position as stated below:

> "A small fiscal surplus is created as nominal income rises, because the response of tax revenue is slightly larger than that of nominal government spending; this surplus disappears as prices and output fall back to their initial levels. These effects are small because the parameters (γ_{82}) that govern the short-run response of nominal government spending are estimated from the sample to be only slightly smaller than those that govern short-run changes in tax revenue. ($\gamma_{10}\gamma_{11}$) However, the dynamic path of prices is quite sensitive to the values of these parameters. Since the government has the power to alter taxing and spending policies at will, it would undoubtedly be interesting to analyze the consequences of different types of budgetary policy in the model in more detail, although this is not done here." (Ibid.: 29)

The results of the present study indicate that both the income and expenditure elasticities in most individual cases are significantly greater than unity over the periods examined. To further emphasize this point Table 3 shows results of a test as to whether or not revenue and expenditure elasticities are statistically significantly different from unity. The first column in each of the matrices with the titles 'Reve-

Table 3

Tests For Elasticities Significantly Different From Unity

	Revenue Elasticity			Expenditure Elasticity		
	Computed Value	Table Value	Equal to One?	Computed Value	Table Value	Equal to One?
Industrial Market Countries						
Austria	5.22	2.050	no	7.86	2.040	no
Belgium	20.24	2.056	no	13.55	2.056	no
Canada	4.27	2.040	no	8.77	2.040	no
Finland	0.10	2.045	yes	1.34	2.045	yes
France	2.20	2.040	no	4.65	2.040	no
Germany	1.75	2.040	yes	2.66	2.049	no
Ireland	21.03	2.040	no	20.60	2.040	no
Italy	10.32	2.040	no	11.37	2.040	no
Netherlands	8.50	2.040	no	14.82	2.040	no
Norway	9.80	2.080	no	10.75	2.080	no
USA	3.89	2.040	no	6.40	2.040	no
Developing Countries:						
Bolivia	1.19	2.101	yes	5.46	2.101	no
Brazil	1.70	2.101	yes	6.07	2.069	no
Colombia	4.40	2.048	no	4.89	2.048	no
Dom. Rep.	2.27	2.093	no	3.11	2.093	no
Ecuador	2.63	2.040	no	4.37	2.040	no
El Salvador	2.92	2.080	no	7.92	2.080	no
Guatemala	1.53	2.069	yes	0.39	2.069	yes
Honduras	17.33	2.040	no	15.66	2.040	no
Jamaica	8.60	2.110	no	8.47	2.110	no
Nicaragua	7.41	2.069	no	12.00	2.069	no
Paraguay	0.13	2.069	yes	0.65	2.069	no
Peru	3.16	2.067	no	10.18	2.069	no
Sri Lanka	0.57	2.040	yes	6.97	2.040	no
Thailand	3.71	2.045	no	3.34	2.045	no
Turkey	7.51	2.042	no	8.52	2.042	no
Venezuela	6.21	2.040	no	6.43	2.040	no
Zambia	4.35	2.110	no	0.48	2.110	yes

nue Elasticity' and 'Expenditure Elasticity' gives the actual value of the statistic:

$$\frac{b_T - 1}{\text{standard error of } b_T} \quad \text{or} \quad \frac{b_G - 1}{\text{standard error of } b_G}$$

The second column displays the value obtained from t-tables with appropriate degrees of freedom and the third column shows the outcome of the test. In most cases the parameter turned out to be significantly different from unity. Therefore we have shown that most often the elasticities do not equal unity. This is true for countries in both the 'developing country' group and the 'industrial market' group. These results may not represent the so-called desired levels of revenue and expenditure for the individual countries but they do give empirical evidence that national governments have been expanding their revenue and expenditure more rapidly than nominal income has been expanding.

2. Wagner's Law can be simply stated as: "The income elasticity of the demand for public goods and services is greater than unity."[3] Do our results indicate the validity of Wagner's Law?

The values of the expenditure elasticities found in Table 1 indicate that government expenditures generally increase more rapidly than GNP over the period examined. An elasticity above unity characterizes all countries in the sample except for France, Brazil, the Dominican Republic and Paraguay. Such results can be interpreted as confirmation of the hypothesis that government expenditures constitute a growing proportion of GNP over time in most countries[4].

3. Is there a causal relationship from GNP to expenditures? Marian Krzyzaniak disputes the simple causal relationship between GNP and expenditures in a case study of Turkey. (Krzyzaniak, 1974: 13–19). He makes the following suggestion:

> "... by regressing G on Y one may easily get statistically significant estimates of the income elasticity of government expenditures, but their interpretation is a problem. National income and government expenditures could be jointly

3 There are many references for this statement. See a summary in Yousefi and Abizadeh, (1985).

4 As has been stated by various authors, such results may not represent "demand" for government services, i.e., increased output, but rather increased "cost" of these services.

dependent variables, in which case the income elasticity estimate of the latter cannot be given a causal interpretation. Its estimation by the least squares method is also then illegitimate, the estimate being both biased and inconsistent." (Ibid.: 18)

"For Wagner's Law to represent a causal relationship requires that G = f (Y) and not vice versa (as the Keynesian theory taught us)." (Ibid.: 18)

"The income elasticity of total government expenditures measures no causal relationships. Wagner's Law is invalid [G = f (Y)] even if the computed coefficient [elasticity] estimate is statistically significant. (Ibid.: 10).

Table 2 supports the statement made by Krzyzaniak that T and GNP and G and GNP could be jointly dependent variables and that the income elasticity of revenue cannot be given a strictly causal interpretation. For the data used by Krzyzaniak for Turkey the Durbin-Watson test led to an 'Indecisive' conclusion. For the data for the larger sample studied here most of the Durbin-Watson tests turned out to show a positive autocorrelation which clearly indicated the interdependence of G and GNP and T and GNP over the entire period examined.

4. Ability to Raise Government Revenue

It is often suggested that developing countries run larger budget deficits than developed countries because of their inability to raise revenue to meet their expenditures. One interesting and generally unexpected result of our regressions therefore is the high expenditure elasticity of the industrial market countries relative to their revenue elasticities.

In Table 4 we show the differences between the expenditure and revenue elasticities for the period. We express these differences as the percentage points by which expenditure elasticity exceeds revenue elasticity. It is clear that, on the whole, and in most individual cases, industrial market countries have been unable to raise the current revenue necessary to finance expenditure. In fact, other than for France expenditure elasticity has been greater than revenue elasticity for all the included industrial market countries. It is generally expected that

Table 4
Expenditure Elasticity And Revenue Elasticity

	Percentage Points G − T[1]	Implied Average Budget surplus (+) or deficit (−)
Industrial Market Countries:		
Austria (1950–1982)	2.69	(−)
Belgium (1954–1982)	7.30	(−)
Canada (1950–1982)	6.97	(−)
Finland (1952–1982)	1.44	(−)
France (1950–1982)	− 6.56	(+)
Germany (1951–1982)	6.98	(−)
Ireland (1950–1982)	4.38	(−)
Italy (1950–1982)	5.78	(−)
Netherlands (1950–1982)	6.35	(−)
Norway (1960–1982)	0.61	(−)
USA (1950–1982)	6.43	(−)
Developing Countries:		
Bolivia (1963–1982)	13.13	(−)
Brazil (1958–1982)	− 4.16	(+)
Colombia (1952–1981)	0.46	(−)
Dom. Rep. (1962–1982)	1.28	(−)
Ecuador (1950–1982)	− 1.34	(+)
El Salvador (1960–1982)	12.27	(−)
Guatemala (1958–1982)	8.00	(−)
Honduras (1950–1982)	5.82	(−)
Jamaica (1962–1980)	13.87	(−)
Nicaragua (1958–1982)	20.72	(−)
Paraguay (1958–1982)	− 1.31	(+)
Peru (1950–1982)	3.99	(−)
Sri Lanka (1950–1982)	17.00	(−)
Thailand (1952–1982)	2.33	(−)
Turkey (1950–1981)	1.33	(−)
Venezuela (1950–1982)	1.88	(−)
Zambia (1964–1982)	31.12	(−)

1 Negative sign means that the income elasticity of current revenue is greater than that of expenditure over the period.

developing countries would have higher expenditure elasticities than current revenue elasticities, and for the most part our study supports this expectation. What is surprising is that several of the developing countries have either had a small "deficit" or have run "surpluses" on average.

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ÖZET

GAYRİ SAFİ MİLLİ HASILA İÇİNDE KAMU SEKTÖRÜNÜN PAYI

Bu yazıda 1950-1982 yılları arasındaki çeşitli dönemler için sanayileşmiş pazar ekonomilerini ve azgelişmiş ülkeleri kapsayan 28 ülke için merkezi kamu harcama ve gelir esneklikleri değerlendirilmektedir. Harcama ve gelir esneklikleri incelenen dönemlerde her iki ülke grubundaki çoğu ülke için birden büyük çıkmıştır. Bulgular Wagner Kanunu çerçevesinde de değerlendirilmektedir.