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Economic Determinants of Government Subsidies

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Abstract

The paper studies the economic determinants of government subsidies using panel data for 40 countries over 18 years (from 1975 to 1992) and finds that individual country-specific factors play a sizeable role in determining government subsidies. But it also suggests several characteristics—a small government, a small external current account deficit, and a productive structure geared more toward services and agriculture than manufacturing—may make it easier to keep subsidy expenditures down. The paper also suggests that globalization and the associated increase in openness are not impediments to reducing subsidies. In itself, an IMF-supported adjustment program is found not to be a significant determinant of government subsidy expenditures.

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SUMMARY

This paper provides an empirical analysis of the economic determinants of government subsidies. A simple public choice model is developed and econometrically tested using panel subsidy data from the United Nations System of National Accounts (SNA). The paper finds that the data are a reasonably good proxy for a more comprehensive measure of subsidies.

The econometric results from testing the fixed-effect representation of the structural model indicate that the size of government has a significant bearing on subsidy expenditures, with each percentage point increase in the government spending to GDP ratio leading to about a fourth-tenths of a percentage point increase in the ratio of subsidies to GDP. The results also reveal that government subsidies are comparatively higher in countries with high ratios of government interest expenditure to GDP, large manufacturing sectors, large external current account deficits, and a low degree of urbanization. The degree of openness, the dependency ratio, and the existence of an IMF program are found to have a statistically insignificant impact on subsidy expenditures. The statistical insignificance of the dummy variable for IMF programs may reflect the fact that IMF-supported adjustment programs are tailored to the specific circumstances of each country, and there is no uniform pattern that holds across all countries.

An interesting aspect of the results is that they suggest that globalization and the associated increase in economic openness are not impediments to reducing subsidies; countries that have opened up have not, on average, been forced to use subsidies to address any of the social costs associated with greater exposure to international trade.

I. INTRODUCTION

This paper explores the economic determinants of government subsidies across countries and over time. In the most general terms, a subsidy can be defined as any government assistance that allows consumers to purchase goods and services at prices lower than those offered by a perfectly competitive private sector, or raises producers' incomes beyond those that would be earned without this intervention. A particular concern about extensive government subsidies is that they may easily become "unproductive" in the sense that a much lower level of government expenditure would yield the same aggregate social benefit but at a much lower cost, as discussed in Chu and others (1995). Tanzi and Schuknecht (1995, 1996), in their analyses of industrial countries, showed that over the last century, transfers to households and subsidies have expanded more rapidly than all others categories of government expenditures.[2] While much of this increase reflects the growth of social security expenditures, subsidy expenditures have been growing in line with the expansion of the state over the last century. Although skepticism about the ever-expanding role of government has grown stronger since the 1970s, public expenditure usually kept rising, driven, among other reasons, by continued increases in spending on the "welfare state," which may broadly be defined to include both government subsidies and transfers to households.

While concerns about subsidization policies and their economic effects have clearly been growing, as evidenced also by the increasing number of reports and studies issued by governments and international organizations,[3] few of the industrial countries surveyed by Tanzi and Schuknecht (1995, 1996) have actually shifted their policy regimes. These results are supported by Clements and others (1995) who show that in the European Union, for example, government subsidies continued to grow even after the 1970s.

Tanzi and Schuknecht (1996) contend that the failure to reign in public expenditure in industrial countries largely reflects entitlements and the power of interest groups. In the case of government subsidies, this may be explained, in part, by the fact that what constitutes a subsidy is often rather elusive (Houthakker, 1972); also, whereas for most government spending programs it is only the benefits that are often elusive and difficult to quantify, for subsidy programs it is frequently both benefits and costs (Break, 1972).

As a result of these measurement problems, relatively few papers have analyzed the determinants of government subsidies. Houthakker (1972) proposes that subsidies can be considered gifts, and he argues that "as we all know from birthdays and Christmas Eves, the exchange of gifts, even of rather useless gifts, frequently helps to stimulate good fellowship and a sense of community." In contrast, Tait and Heller (1982) explore some of the economic

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[2]See Alesina (forthcoming) for an analysis of changes in the level and composition of government expenditure in OECD countries from the 1960s to the 1990s.

[3]See Schwartz and Clements (forthcoming) for an overview.

determinants of government spending on subsidies and transfers. Based on data for 76 countries taken from the IMF's *Government Finance Statistics* (GFS) database, they show that defense expenditures to GDP, education outlays as a share of GDP, social security and welfare expenditure to GDP, and per capita income are all significant determinants of the level of subsidies and transfers. More recently, using pooled GFS data for developing countries for 1978–86, Heller and Diamond (1990) discovered that the ratio of education spending to GDP, as well as the level of social security and welfare outlays to GDP, were the only significant determinants of government subsidies and transfers. A similar equation was estimated to assess the determinants of subsidies and transfers net of spending for social security. The results indicate that the level of economic services spending as a share of GDP, education spending as a share of GDP, government health outlays to GDP, and GDP per capita are all significant factors in explaining the share of GDP devoted to subsidies and transfers (net of social security) across countries.

Given the aggregation of subsidies and transfers in the GFS data, the few existing studies using these data offer limited guidance concerning the economic determinants of government subsidies alone. For example, while Heller and Diamond (1990) show that education and social security spending determine aggregate outlays on transfers and subsidies, it seems reasonable to assume that these mainly affect expenditures on transfers to households rather than subsidies. Thus, there is a need for an analysis of the determinants of subsidy spending alone, given the limited insights one can derive concerning subsidies from data that also include transfers. Unfortunately, this prevents using GFS data, as very few countries report separately their expenditures on subsidies. Even fewer countries report these subsidies at the level of general government. In light of these drawbacks of the GFS data on subsidies, data from the United Nations' *System of National Accounts* (SNA) are used for the econometric work presented in this paper.[4]

The paper is organized as follows. The next section develops the theoretical model used as a basis to understand which variables determine subsidies in general. Section III discusses several issues regarding data collection and the definition of subsidies used in this study. The econometric results are presented in Section IV; Section V concludes.

II. AN ECONOMETRIC MODEL OF GOVERNMENT SUBSIDIES

The existing literature on the determinants of government subsidies has largely relied on empirical, inductive methods to assess the factors associated with high levels of subsidy expenditure. For example, both Heller and Diamond (1990) and Freinkman and Haney (1997) use factor analysis to determine the interrelationships in the data. In the case of Freinkman and Haney (1997), "a total of twenty-four unique...independent variables were examined as potential subsidy determinants in the regression analysis." Although all variables can be

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[4]For a discussion of differences between the GFS and SNA data, see Clements and others (1995).

hypothesized to have some effect on subsidy behavior, factor analysis is mostly useful when one has no clear idea on how the various data are related, or, when, in the words of Heller and Diamond (1990), "we are confronted by a bewildering array of possible causal influence and a large number of possible indicators, all of which appear highly correlated."

This paper offers a somewhat different approach to the analysis of government subsidies. In particular, we borrow from models that were developed by Hewitt (1991) for military expenditure and Hewitt and Van Rijckeghem (1995) for wage expenditure and develop an explicit optimization approach to government subsidies. These models—which are rooted in public choice theory—assume that there exists a government that selects economic policies so as to maximize its own welfare, subject to constraints. The welfare function does not necessarily imply that the government only pursues its own self-interest: any consideration (such as altruism, public well-being, etc.) can enter into the model. In particular, the welfare function may include citizens' evaluation of the government's objectives and actions (e.g., via public opinion polls), and how these evaluations influence the government's decisions. The model we develop suggests that there exists simultaneity in the determination of government subsidies and total government expenditures: one may think of government subsidies as being determined in the context of overall government expenditures. This can be captured through two equations that can be tested empirically.

Economic welfare (W), as perceived by the government, can be expressed by the following function:

$$W = W(UC, UE, UO, state\ variables) \tag{1}$$

where

UC = utility derived from private consumption
UE = utility derived from pursuing equity objectives
UO = utility derived from pursuing other political objectives

Accordingly, the government decides where to allocate expenditure to maximize welfare. It is assumed that the government uses subsidies to pursue its efficiency and equity objectives through the following transformation or cost functions:

$$UC\ = UC(TPC;\ state\ variables) \tag{2}$$
$$UE\ = UE(SE;\ state\ variables) \tag{3}$$
$$UO\ = UO(OE;\ state\ variables) \tag{4}$$

where

TPC = total private consumption
SE = subsidies for equity reasons
OE = other government expenditures

In general, subsidy expenditures affect the welfare function, as they lower the costs associated with each level of private consumption. TPC, which is an observable variable, is in

turn a function of two unobservable components: consumption derived from private initiative or simply "private consumption" (C), and consumption derived from public intervention (CP), where CP itself is a function of subsidies that affect efficiency or are provided for efficiency reasons (SC). Under this assumption, we could express UC in equation (2) as a function of C and SC alone, so that

$$UC = UC(C, SC;\ state\ variables) \tag{2'}$$

The government must allocate expenditures subject to two equality constraints. First, total government expenditure *(TE)* consists of government subsidies, other government expenditure, and interest expenditure *(IE)*. For simplicity, variable *IE* is assumed to be exogenously determined; in other words, *IE* limits what the government may spend on subsidies and other expenditures. Hence, we have:

$$TE = S + OE + IE \tag{5}$$

Total subsidies *(S)* consist of efficiency and equity subsidies:

$$S = SC + SE \tag{6}$$

Since we do not have data on *SC* or *SE*, we assume that they are functions of total subsidies (S), so that

$$SC = SC(S;\ state\ variables) \tag{7}$$
$$SE = SE(S;\ state\ variables) \tag{8}$$

The model assumes that none of the additional income or purchasing power that government transfers or subsidies provide to households leads to higher household savings; in other words, the macroeconomic effects of these government expenditures are similar to government outlays on goods and services. Under this assumption, total government expenditure *(TE)* net of interest expenditures (IE) is constrained by the country's Gross Domestic Product (GDP), consumption from private initiative (C), and foreign savings. Higher foreign savings (i.e., a worsening of the current account balance (CA)) allows for greater government expenditure; a reduction in foreign savings (i.e., a strengthening of CA) requires lower total government expenditures.[5] Hence we have:

$$TE = GDP - CA - C + IE \tag{9}$$

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[5]The econometric analysis in the paper uses the actual balance on the trade of goods and services (rather than the current account balance) to test the model. See Appendices 1 and 2 for more details on the variables used in the econometric testing.

Private investment is excluded from equation (9) as it can be thought of as deferred consumption, so that consumption from private initiative, C, would include both current and deferred private consumption.

After substituting expressions (2'), (3) and (4) into equation (1), the latter can be written as:

$$W = W(C, S, OE; \text{ state variables})$$ (10)

The welfare function in (10) can be approximated by a Cobb-Douglas function, so that the government's optimization problem can be expressed as a problem of maximizing:

$$AC^{\alpha}S^{\beta}OE^{\gamma}$$ (11)

subject to

$$TE = S + OE + IE \quad \text{and}$$
$$TE = GDP - CA - C + IE$$

and where α, β, γ are coefficients that represent the relative value in the social welfare function of different types of expenditures. The government's optimization problem is with respect to three variables: C, S, and OE. From the first order conditions of the Lagrangian expression:

$$\text{Max } W = AC^{\alpha}S^{\beta}OE^{\gamma} + \lambda (TE - S - OE - IE) + \delta (TE - GDP + CA + C - IE)$$
$$C,S,OE$$

(where λ and δ are the Lagrangian multipliers that reflect the relative value of the two constraints) we can derive the following recursive system:[6]

$$S/GDP = R1[(TE - IE)/GDP; \text{ state variables }]$$ (12)

$$TE/GDP = R2[IE/GDP, -CA/GDP; \text{ state variables }]$$ (13)

Equation (12) can be interpreted as saying that government subsidies increase as the size of government increases, as proxied by total government expenditure net of interest. Equation (13) can be viewed as indicating that total government expenditures increase with interest expenditures, and that a strengthening of the current balance (i.e., a higher value for CA/GDP) reduces the amount of resources available to finance government expenditures.

The state variables in the equations for subsidies (12) and total government expenditures (13) are economic variables that may affect the relative weights the government attaches to each political objective as well as the transformation functions. State variables on government expenditures fall into two categories: those that affect both the subsidy equation

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[6]See also Hewitt and Van Rijckeghem (1995).

and government expenditure equation, and those that affect either the subsidy equation or the government expenditure equation. An overview of different state variables we use is provided in Appendix 1.

A key question addressed in this study is whether the existence of a IMF-supported adjustment program is associated with lower subsidy expenditure. The IMF's policy advice often calls for countries to reduce unproductive spending, including generalized subsidies, as they are an inefficient means of achieving equity objectives (Chu and others, 1995). Two recent studies (International Monetary Fund, 1997; Abed and others, 1998) show that IMF-supported adjustment programs have indeed been associated with reductions in subsidies and transfers as a share of GDP. The general model above permits an empirical assessment of how IMF-supported programs might affect subsidies, either directly (in the subsidies equation) or indirectly (through the government expenditures equation). The effect of IMF programs is assessed by including a dummy variable for the existence of IMF programs in the list of state variables in equations (12) and (13).

III. THE DATA

Given the difficulty of finding a comprehensive measure of subsidies,[7] the advantages and disadvantages of various data sources merit discussion. As shown in Table 1, the available data on subsidies vary not only according to their "extensiveness"—how many countries are covered and for what number of years—but also according to their "intensiveness"—how broadly they capture the different channels through which governments may provide subsidies. GFS and SNA have the most extensive coverage, but in terms of intensiveness they do not perform well, since only direct transfers to producers are counted as subsidies.

This paper utilizes SNA data for subsidies for the estimation of the econometric model. In the SNA, government subsidies are defined as "...current unrequited payments that government units, including non-resident government units, make to enterprises on the basis of their production activities or the quantities or values of the goods and services which they produce, sell or import" (Inter-Secretariat Working Group on National Accounts, 1993). Hence, the SNA data only consist of direct transfers to producers and do not include other types of subsidy-creating government interventions such as tax reductions and equity participations. As discussed in Clements and others (1995), while methodologically similar, SNA data are preferable to GFS data. First, the SNA data better reflect the macroeconomic impact of government subsidies, since they are recorded on an accrual basis (and thus also include imputed transactions that involve payments pertaining to, but not necessarily taking place in, the current period), whereas the GFS data reflect a strict cash concept. Finally, the SNA data pertain to the general government and also include transactions with supranational organizations, such as the agricultural subsidies received by European Union (EU) member countries through the Commission of the European Communities (CEC), whereas GFS data

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[7] See Schwartz and Clements (forthcoming).

Table 1. Summary of Coverage and Measurement of Government Subsidies in Various Databases

Data Base	Transactions covered	Sectoral Coverage	Measurement Basis	Institutional Coverage	Period Covered	Country Coverage
SNA	current unrequited payments to producers (accrual basis)	All	Gross cost to government	General government	1975–1992[1]	UN member countries
GFS	current unrequited payments to producers (cash basis)	All	Gross cost to government	Consolidated central government	1975–1992[1]	IMF member countries
CEC (1989, 1990,1992)	current unrequited payments to producers ("cash grants,") soft loans, guarantees, equity subsidies, tax subsidies (i.e., foregone tax revenue)	Manufacturing, agriculture, fisheries, coal, inland waterways, railways	Net grant equivalent[2]	General government	1981–1986 1986–1988 1988–1990	European Union member countries (Spain and Portugal excluded for some years)
EFTA (1986,1990)	current unrequited payments to producers, soft loans, guarantees, equity subsidies	Manufacturing, energy, mining, fisheries	Net cost to government[2]	General government	1980–1984 1985–1989	EFTA member countries

[1]For the purpose of this paper.
[2]The net concepts used by the CEC and EFTA primarily measure subsidies as the total cost to the public sector of government subsidization activities net of any cost recoveries (e.g., repayments). For some categories of subsidies, the net cost to the government is proxied by the benefit received by the recipient. For example, the CEC measures the subsidy element of soft loans as the difference between the market rate of interest facing the recipient and the soft loan rate. See CEC (1989) for a detailed elaboration of measurement concepts used for different subsidy categories.

are available primarily for the central government alone. Finally, relatively few countries provide separate data on subsidies for the GFS database; for many countries, only an aggregate figure for subsidies plus transfers is available.

Despite the broad country coverage of the SNA database, the limited concept of subsidies that is utilized in the SNA raises the question as to what extent these data are representative of government subsidization policies. Fortunately, SNA subsidies appear to be a fairly good proxy for a more comprehensive measure of subsidies. We arrive at this conclusion by comparing SNA data with other, more comprehensive measures of subsidies that exist for a smaller number of countries, such as four surveys on state subsidies by the CEC (1989, 1990, 1992, 1995), and periodic surveys on government subsidies by the European Free Trade Association (EFTA, 1986, 1990).

Table 2 presents correlation coefficients between the SNA data and the CEC and EFTA data on subsidies.[8] The results indicate a close correspondence between subsidies measured by the SNA and other sources. Overall, the correlation coefficient between the SNA and CEC measures of government subsidies is 0.87. For most of the countries there is a very strong positive correlation between the two subsidy measures, and only for two countries do the SNA data fail to track the broader CEC data (France has a coefficient of -0.38 and Luxembourg a coefficient of only 0.19). Similarly for the EFTA countries, there is also a good overall correlation of 0.67 between the two measures of government subsidies. Again, for most countries the degree of correlation is high; only for Norway it is poor (with a correlation coefficient of -0.08).

A look at the composition of government subsidies reveals a similar picture. For example, the CEC data for the periods 1981–86, 1986–88, and 1988–90 show that "cash grants" (current unrequited payments to producers) constitute the largest share of subsidies, averaging about 57 percent of the total during the 1981–90 time period (Figure 1). The pattern is fairly stable over time, implying that these payments to producers for current operations—which are close in definition to SNA subsidies—are approximately a fixed proportion of all subsidies in the EU.

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[8]Comparing data from the CEC with the SNA is somewhat difficult, since the former only includes subsidies paid by national governments and does not include transfers from supranational organizations that are included in the latter. This is important in the case of Europe, where much of subsidy policy is carried out through the Commission of the European Communities. To make the CEC data more comparable to the SNA data for the purpose of the correlation analysis, transfers from supranational organizations were added to the CEC figures. It should be noted that the subsidy data of both the SNA and CEC involve aid that is delivered to producers, even though consumers may be the ultimate beneficiaries (e.g., subsidies to state enterprises selling products at prices below the cost of production).

Table 2. Correlation Coefficients Between Subsidy Data from CEC and EFTA
Relative to SNA Data, 1981–86

Country	Correlation Coefficient
Total for EU-10	**0.87**
Belgium	0.59
Denmark	0.39
France	-0.38
Germany	0.75
Greece	0.85
Ireland	0.86
Italy	0.36
Luxembourg	0.19
Netherlands	0.89
United Kingdom	0.76
Total for EFTA	**0.67**
Austria	0.74
Finland	0.71
Iceland	0.66
Norway	-0.08
Sweden	0.34
Switzerland	0.34

Source: Authors' estimates.

Figure 1: Types of Government Subsidies in the European Community, 1981-90
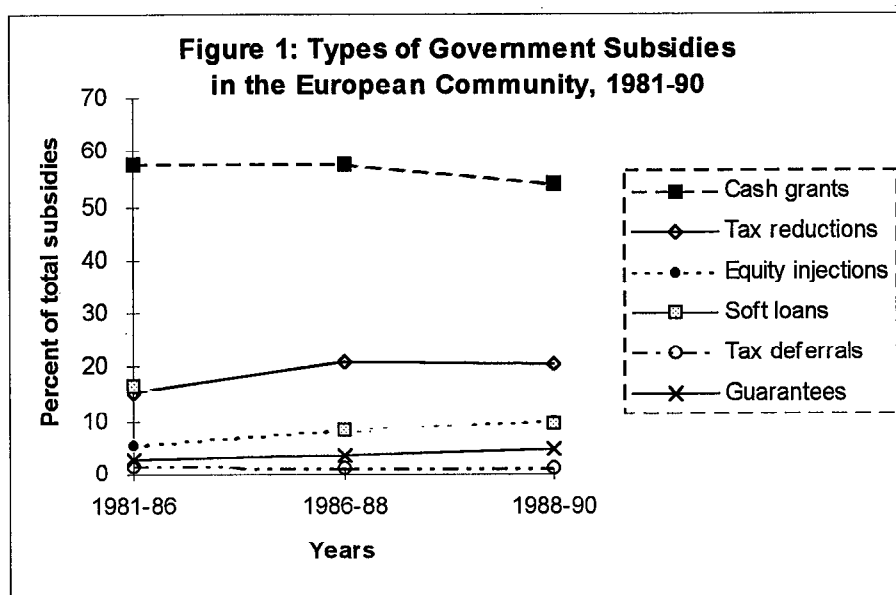
Source: Commission of the European Communities, different years.

From these considerations we conclude that the SNA database achieves a sizable coverage of countries and years and provides a fairly representative picture of the level of subsidies across and within countries. That is, it appears that governments that heavily rely on "cash grant" subsidies are, in general, also heavy users of other kinds of subsidies. Therefore, the SNA data may be used (and considered as an instrument) to estimate the general model for subsidies developed above.

IV. ECONOMETRIC RESULTS

In this section, we estimate the simple two-equation model outlined above. We focus mainly on the structural system, although we also look at the reduced form of the subsidy equation. The structural system allows us to establish which variables determine government subsidies *and* the channels through which these variables transmit their influence: directly (through the subsidies equation), or indirectly (through the total government expenditures equation). Data for all variables of the model were collected for 40 countries for the period 1975–92.[9]

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[9]See Appendix 2 for the list of countries included in the study. Countries were selected on the basis of data availability. Countries with very few annual observations were excluded, given the difficulty of correcting for autocorrelation in these cases.

The two equation system we estimate for government subsidies and total government expenditures is as follows:

$$(S/GDP)_{it} = \alpha_0 + \alpha_1(TE/GDP)_{it} + \alpha_2(IE/GDP)_{it} + \alpha_3(CA/GDP)_{it} + \alpha_4(MAN/GDP)_{it}$$
$$+ \alpha_5(AGR/GDP)_{it} + \alpha_6 OPEN_{it} + \alpha_7 FP_{it} + \epsilon_{it}$$

$$(TE/GDP)_{it} = \beta_0 + \beta_1(IE/GDP)_{it} + \beta_2(CA/GDP)_{it} + \beta_3(AGR/GDP)_{it} + \beta_4 OPEN_{it}$$
$$+ \beta_5 DEP_{it} + \beta_6 URB_{it} + \beta_7 FP_{it} + v_{it}$$

with
$\quad$ (MAN/GDP) = manufacturing share of GDP
$\quad$ (AGR/GDP) = agriculture share of GDP
$\quad$ $OPEN$ = degree of openness
$\quad$ DEP = dependency ratio
$\quad$ URB = urbanization ratio
$\quad$ FP = existence of an IMF-supported adjustment program (dummy variable)

It should be noted that the formulation above includes interest expenditure as a state variable in the subsidy equation. This is done to capture the fact that in financially constrained or highly indebted countries, high interest outlays could exert pressure to lower all other outlays. To capture this possibility, interest expenditures are separated from other government expenditures.

In the subsidy equation, the shares of manufacturing and agriculture in GDP are included as explanatory variables.[10] For an economy that comprises manufacturing, agriculture, and services, the coefficients of these two variables indicate how much subsidies as a share of GDP change when one percent of GDP is shifted away from services to either agriculture or manufacturing.

Initial tests indicated the existence of first-order autocorrelation for a number of countries. To compute the correct standard errors for the regression coefficients, we used the autocorrelation correction described in Pindyck and Rubinfeld (1991).[11] As a result, the variables were appropriately transformed. From the original model we have:

$$Y_{it} = \alpha + \beta X_{it} + \epsilon_{it}$$

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[10] The variable for manufacturing also includes the mining sector.

[11] See Pindyck and Rubinfeld (1991), pp. 228–29.

with $\epsilon^*_{it} = \rho_{it} \epsilon^*_{it-1} + u_{it}$. After computing the autocorrelation coefficients (ρ_i) from the residuals of each country individually, the model can thus be transformed into:

$$Y^*_{it} = \alpha(1 - \rho_i) + \beta X^*_{it} + \epsilon^*_{it}$$

where

$$Y^*_{it} = Y_{it} - \rho_i Y_{it-1} ; \qquad X^*_{it} = X_{it} - \rho_i X_{it-1} ; \qquad \epsilon^*_{it} = \epsilon_{it} - \rho_i \epsilon_{it-1}$$

Applying this correction left us with a total of 580 observations. All variables in the model can be expected to be stationary in the sense that they have a limited variance, as they are all expressed as ratios varying between zero and one (with the exception of the dummy for IMF-supported programs).

We then tested 2 versions of the structural model. The first version was the simple pooled model, which after the correction for first-order autocorrelation, effectively covers the period from 1976 to 1992. The pooled model attempts to explain differences in subsidy expenditure both between countries and within countries. The second version of the model we tested was the fixed effects model, which does not restrict the 40 countries to a common intercept but allows for individual country ("fixed") effects. The fixed effect model attempts to explain variations in subsidy expenditure within countries by holding constant any between-country differences with a unique intercept term for each country. Both the pooled and the fixed effects specifications were tested using full-information maximum likelihood (FIML) estimators; the results are shown in Tables 3 and 4. An advantage of the FIML estimators is that they do not lose efficiency when the regression residuals are not normally distributed. The estimation involves applying the maximum likelihood principle to the two equations simultaneously; the estimators are consistent, asymptotically efficient, and their asymptotic frequency distribution is normal. The FIML estimators have the same asymptotic properties, including the same asymptotic variance-covariance matrix, as the Three-Stage Least Squares (3SLS) estimators. The advantages and disadvantages of the two model specifications (pooled and fixed effects) are indicated below in the discussion of the econometric results.

A. The Pooled Model

The **government expenditure equation** has an adjusted R^2 of 0.95, which is a very good fit for panel data. Overall, the results are largely consistent with previous studies. Six of the seven independent variables turn out to be significant in the regression; all have the expected sign. In general, the estimated government expenditure equation in the pooled model points to the importance of constant or invariable factors in explaining government expenditures, as the coefficient for the constant term is 15.1 percent of GDP.

The results indicate that higher interest expenditure is associated with higher total government expenditure. As the estimated coefficient exceeds 1, the results suggest that there

Table 3. Results from Estimating the Structural Model (Pooled Data), 1975–92 1/

Variable	Ratio of Government Subsidies to GDP	Ratio of Government Expenditures to GDP
Constant	-7.73 ** (-14.66)	15.12 ** (9.37)
Ratio of government expenditures to GDP *(TE/GDP)*	0.212 ** (13.38)	
Ratio of interest expenditures to GDP *(IE/GDP)*	-0.125 ** (-4.32)	1.694 ** (19.88)
Ratio of external current account balance to GDP *(CA/GDP)*	-0.023 ** (-3.94)	-0.016 (-0.82)
Share of manufacturing in GDP *(MAN/GDP)*	0.084 ** (12.73)	
Share of agriculture in GDP *(AGR/GDP)*	0.157 ** (13.10)	-0.583 ** (-12.93)
Degree of openness *(OPEN)*	-0.004 ** (-1.85)	0.324 ** (2.84)
Dependency ratio *(DEP)*		0.874 ** (5.56)
Urbanization ratio *(URB)*		0.155 ** (10.83)
Existence of IMF program *(FP)*	-0.004 (-0.04)	-1.677 ** (-5.07)
Number of observations	580	580
Adjusted R-squared	0.70	0.95

Source: Authors' estimates using FIML estimators.

1/ T-statistics in parenthesis; ** shows statistical significance at the 5-percent level (one-tailed test); * shows statistical significance at the 10-percent level (one-tailed test).

Table 4. Results from Estimating the Structural Model (Fixed Effects), 1975–92 1/

Variable	Ratio of Government Subsidies to GDP	Ratio of Government Expenditures to GDP
Ratio of government expenditures to GDP *(TE/GDP)*	0.361 ** (27.78)	
Ratio of interest expenditures to GDP *(IE/GDP)*	-0.451 ** (-13.07)	1.500 ** (12.17)
Ratio of external current account balance to GDP *(CA/GDP)*	-0.028 ** (-3.48)	0.215 (-1.01)
Share of manufacturing in GDP *(MAN/GDP)*	0.035 ** (3.68)	
Share of agriculture in GDP *(AGR/GDP)*	0.111 ** (4.74)	-0.140 ** (-1.80)
Degree of openness *(OPEN)*	0.022 ** (4.55)	-0.073 ** (-5.18)
Dependency ratio *(DEP)*		-0.060 (-0.98)
Urbanization ratio *(URB)*		0.081 (0.60)
Existence of IMF program *(FP)*	0.367 (0.25)	-0.144 (-0.38)
Number of observations	580	580
Adjusted R-squared	0.79	0.96

Source: Authors' estimates using FIML estimators.

1/ T-statistics in parenthesis; ** shows statistical significance at the 5-percent level (one-tailed test); * shows statistical significance at the 10-percent level (one-tailed test). Coefficient estimates for dummy variables are not shown.

is no partial adjustment that forces governments with higher interest expenditure to spend less on other expenditure categories. In fact, according to these estimates, countries with high interest expenditures, other things being equal, tend to spend more on other expenditure items.

The share of agriculture in GDP has a negative impact on government spending. This is consistent with the notion that agriculture, as a sector that is difficult to tax, constrains the government's ability to raise revenues (Bahl, 1972) and, hence, its ability to spend.

The variable for the degree of openness is introduced in our model following Rodrik (1996), who found a positive relationship between openness and government expenditures.[12] Rodrik's interpretation was that government expenditures provide a shelter from external risks: the more open an economy, the more it is affected by external risks that arise from shocks in world markets, and the more government expenditures are used to reduce these risks. As in Rodrik (1996), the degree of openness enters the estimated equation with a positive sign: hence, countries with a high level of total trade are also likely to have a high level of government expenditure.

Both the dependency ratio and the urbanization ratio have the expected positive sign. Hence, countries with large shares of their population that are not of working age or countries with a high degree of urbanization are likely to have higher expenditures than other countries; this can be attributed to income support payments in the former, and to the high demand for public services in the latter. Since the coefficient is less than 1, there may also be important "economies of scale" that prevent government expenditures from rising in line with the degree dependency or urbanization, respectively.

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[12] In this paper, the degree of openness is measured as total trade (the sum of exports plus imports of goods and services) divided by GDP. To check for multicollinearity with the current account balance (defined here for simplicity's sake as the balance on goods and services, that is, exports of goods and services minus imports of good and services divided by GDP), we calculated the correlation coefficient for these two variables. This turned out to be only 0.12, which leads us to conclude that multicollinearity is not a problem.

The dummy variable identifying IMF-supported adjustment programs[13] also has the expected negative sign, suggesting that IMF-supported adjustment programs are associated with lower government spending. This result should be interpreted with caution, however, as in the pooled model specification, the significance of this variable could reflect two entirely different factors. First, it could reflect the effect of IMF-supported adjustment programs on spending within countries—that is, the effect that IMF-supported adjustment programs have on a given country's total government expenditure. Alternatively, however, it could reflect the fact that IMF-supported adjustment programs are usually found in developing countries rather than industrial countries, where the former tend to have significantly lower expenditure to GDP ratios. Noteworthy is the fairly large sign on this variable in the estimated regression, which would suggest that the existence of an IMF program would be expected to reduce government expenditure by 1.68 percentage points of GDP.

The **government subsidies equation** has an adjusted R^2 of 0.70. Overall, 6 of the 7 independent variables turn out to be significant, but only 5 of these have the expected sign. As predicted by the theoretical model, government expenditures enter positively in the subsidy equation. This makes the estimation of the structural model a useful tool for separating the direct effects of the variables on subsidies from the effects that arise from changes in government expenditures alone. The coefficient for interest expenditures in relation to GDP is small but significant, and has the expected negative sign indicating that higher interest expenditure tends, to some extent, to "crowd out" subsidies. The coefficient for the current account balance is negative, suggesting the possibility that a worsening trade deficit calls for higher levels of subsidies. Both the manufacturing and agriculture shares of GDP have a positive impact on subsidies, reflecting the fact that these are highly subsidized sectors, as assumed in the theoretical model. The estimates suggest that moving one percentage point of GDP from services to agriculture, for example, increases the ratio of subsidies to GDP by 0.16 percentage point; moving one percentage point of GDP from manufacturing to services would decrease subsidies to GDP by 0.08 percentage point.

The openness variable is also introduced in the subsidy equation; however, the data do not support the hypothesis that there is a positive correlation between openness and subsidies

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[13]The existence of an IMF-supported adjustment program is summarized by a dummy variable that takes on a value of one if an IMF-supported adjustment program was in existence for the particular year and country. A value of one is assigned when an IMF-supported adjustment program was in effect for more than 6 months of a calendar year. Apart from this, we follow the rules suggested by De Masi and Lorie (1988). In particular, these rules are: (i) if a program became effective in a month after July, consider it as belonging to the next calendar year; (ii) if a 12-month program is split evenly over two calendar years, consider it as belonging to the first year; (iii) if a 12-month program is split over two calendar years, consider it as belonging to the year in which it existed for the longest time; (iv) if a program extended for more than 12 months, consider it as belonging to the next calendar year as well only if it extends more than five months in the second year.

after changes in overall government expenditures are controlled for. To the contrary, the data suggest that a higher degree of openness has a small but significantly negative impact on subsidies. Finally, the existence of an IMF-supported adjustment program was found not to have a significant impact on government subsidies once its impact on overall government expenditures is controlled for.

The following section presents results from the fixed effects model, which differ in important ways from the results from the pooled model. The question of which model is preferable is presented in section IV.3.

B. The Fixed Effects Model

To some extent, the pooled model can be thought of as a particular case of the fixed effects model, namely, one where the intercepts for all countries are equal in both equations of the model. The fixed effect model isolates differences between countries and is most appropriate for assessing the impact of changes in the independent variables on government expenditures and subsidies in a given country. For example, the fixed effects model is best suited for assessing the impact over time for a country that implements IMF-supported adjustment programs.

Table 4 shows the results from estimating the fixed effects model. There is now a different intercept term for each of the 40 countries, which is omitted from the table for simplicity.[14] Overall, the fixed effects specification yielded a better fit than the simple pooled model. However, some of the improvement in the explanatory power that was derived from adding individual country effects comes at expense of reducing the significance of the coefficients for other independent variables.

The **government expenditure equation** has again a very high adjusted R^2 of 0.96, but the results are somewhat disappointing: only 3 of the 7 independent variables (ignoring the dummy variables for country-specific fixed effects) turn out to be significant; and only 2 of these have the expected sign. Accordingly, total government expenditure is a direct function of interest expenditure, while a higher share of agriculture in GDP is associated with lower government expenditure. The coefficient for the openness variable is significant, but negative, indicating that more open economies have lower government expenditures. The other independent variables (for the current account balance, the dependency ratio, the urbanization ratio, and the existence of an IMF program) all turn out to be insignificant once fixed effects are included. Ceteris paribus, the estimates would suggest that countries with the lowest ratio of government expenditures to GDP are those with low interest expenditures relative to GDP, a large agricultural sector, and a relatively closed economy. However, much of the high explanatory power of the equation clearly comes from country-specific fixed effects, which

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[14]In both equations of the model, almost all of the country-specific intercept terms turned out to be statistically significant at the 10 percent level.

dominate the effect of the various independent variables. In other words, economic variables play a small role in explaining government expenditures compared to individual country effects.

The **government subsidy equation** has a high adjusted R^2 of 0.79, and 6 of the 7 independent variables (excluding the dummy variables for country-specific fixed effects) turn out to be significant, all with the expected sign. According to the regression estimates, the shares of manufacturing and agriculture in GDP, total government expenditure, and the degree of openness are all positively related to government subsidies, whereas the current account balance and interest expenditures have a negative impact on government subsidies. Except for different parameter values, there are few differences between the subsidy equations in the fixed effects and the pooled model. This suggests that although total government expenditure is very much driven by fixed country effects, the main elements that determine subsidy expenditures are "policy variables" that are common to all economies.

Contrary to our expectations, the estimates also imply that the existence of an IMF-supported adjustment program does not necessarily lead to expenditure reductions, and neither does it lead to reductions in subsidy expenditures. To the extent that IMF-supported adjustment programs lead to a restructuring of expenditures, they largely seem to leave subsidy expenditures untouched. This could, however, reflect the fact that IMF-supported programs are tailored to the specific circumstances of each country, and there is no uniform pattern which holds across all countries. The results also show that a large agricultural sector is associated with significant subsidy outlays, so that agriculture is not just subsidized from the revenue side (e.g., via foregone tax revenue) but also from the expenditure side.

C. Pooled Versus Fixed Effects Specifications

Which of the two models is the better one? This question may be answered by assessing whether the fixed effects are statistically significant. To this end, we performed an F-test on the null hypothesis that the intercepts do not vary by country (the assumption underlying the pooled model) and tested it against the alternative of different intercepts by country (the fixed effects model). The exercise reveals the presence of significant fixed effects in both the subsidy and government expenditure equations.[15] Results from Hausman tests also

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[15]The F-test was carried out as follows. The test statistic is $F(n-1, nt-n-k)=Num/Den$, with $Num=(R^2(u) - R^2(r))/(n-1)$, and $Den=(1-R^2(u))/(nt-n-k)$. In this expression, n is the number of countries, t the number of time periods, k the number of regressors excluding the constant term, and $R^2(u)$ and $R^2(r)$ are the R^2 of the unrestricted (fixed effects) and restricted (pooled) models, respectively. Under the null hypothesis of equal intercepts this statistic is distributed as an F with degrees of freedom $(n-1, nt-n-k)$. The values of test statistic for the government spending and subsidy equations are 2.3 and 5.9, respectively, well above the 1 percent level of significance.

reject a random effects specification for the government spending and subsidy equations.[16] Therefore, we consider the fixed effects model to be our preferred model specification for both equations of the system.

D. The Reduced Form of the Subsidy Equation

For purposes of comparison, we also estimated the reduced form of the subsidy equation. In principle, both the structural and reduced-form versions of our simultaneous equation model are equally valid formulations of the same economic process, although the structural model allows for a richer policy analysis. The reduced form of the subsidy equation was derived by substituting the government expenditure equation into the subsidy equation. The resulting equation shows the overall determinants of government subsidies, although it does not allow one to separate the direct from indirect (via government expenditures) effects of different independent variables. One advantage of the reduced form model is that it allows us to assess the overall impact of the independent variables that may have offsetting effects on the government spending equation and the subsidies equation (such as openness).

Three versions of the reduced form, all of which are estimated by OLS (with White's heteroskedastic-consistent standard error estimates), are presented in Table 5: a simple "pooled" version, a "fixed-effects" version, and a "between-variation" version. The simple pooled version is just the reduced form of the pooled version for the structural model. Similarly, the fixed-effects version assumes a constant slope but a different intercept term for each country, so as to identify country-specific effects. The between-variation version is a regression on the means of each country; this eliminates all time variation and focuses exclusively on the cross-country variability of the data.

In general, there are few surprises. As before, the **fixed-effects specification of the reduced form** has the best overall fit, signaling that country-specific elements are significant in determining subsidy expenditure. The fixed effects specification of the reduced form is of particular interest, since the fixed effects specification was also shown to be the preferred way to estimate the structural model. The results in Table 5 indicate that in the fixed effects version of the reduced form, 4 of the 8 independent variables (not counting country-specific fixed effects) turn out to be significant, but only 3 have the expected sign. Accordingly, government subsidies are comparatively higher in countries with a high ratio of interest expenditure to GDP, a high ratio of manufacturing to GDP, a large external current account deficit, and a

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[16]Performing the Hausman test was somewhat complicated by the fact that the equations first had to be corrected for autocorrelation; and in capturing the residuals to correct for autocorrelation, an assumption needed to be made, *a priori*, whether the true model was characterized by fixed effects or random effects. To address this problem, we carried out the Hausman test under both sets of assumptions. In all cases the results reject the random effects model at the 1 percent level.

Table 5. Estimates of the Reduced Forms of the Subsidy Equation, 1975–92[1]

	Pooled Estimates	Fixed-Effects Estimates	Between Estimates
Constant	-2.187 * (-1.30)		-0.072 (-0.02)
Ratio of interest expenditure to GDP *(IE/GDP)*	0.022 ** (3.86)	0.134 ** (3.54)	0.418 ** (2.98)
Ratio of external current account balance to GDP *(CA/GDP)*	-0.016 ** (-2.93)	-0.017 ** (-2.12)	0.037 (0.55)
Share of manufacturing in GDP *(MAN/GDP)*	-0.006 (-0.58)	0.285 ** (2.69)	0.013 (0.30)
Share of agriculture in GDP *(AGR/GDP)*	-0.015 (-1.09)	0.016 (0.77)	0.030 (0.52)
Degree of openness *(OPEN)*	0.002 (0.61)	0.0004 (0.10)	0.012 * (1.50)
Dependency ratio *(DEP)*	0.022 ** (2.01)	-0.003 (-0.24)	-0.005 (-0.27)
Urbanization ratio *(URB)*	0.037 ** (3.16)	-0.044 ** (-2.39)	0.006 (0.30)
Existence of IMF program *(FP)*	-0.142 ** (-1.88)	-0.09 (-1.10)	-2.81 ** (-2.61)
Number of observations	580	580	40
Adjusted R²	0.54	0.87	0.40

Source: Authors' estimates using OLS with White's heteroskedastic-consistent standard error estimates.

1/ The ratio of government subsidies to GDP is the dependent variable in all 3 equations. T-statistics are shown in parenthesis; ** shows statistical significance at the 5-percent level (one-tailed test); * shows statistical significance at the 10-percent level (one-tailed test).

low degree of urbanization; only the sign on the urbanization variable is surprising. The estimates also show that the share of agriculture in GDP, the degree of openness, the dependency ratio, and the existence of an IMF program are all insignificant in determining the level of government subsidies.

In comparison, the **simple pooled specification of the reduced form** has a worse overall fit (an adjusted R^2 of 0.54), but 5 of the 8 variables turn out to be statistically significant, all with the expected sign. Compared to the fixed-effects version, the variables for the existence of an IMF program and the dependency ratio are now statistically significant, whereas the share of manufacturing in GDP is no longer statistically significant.

Although the **between-variation specification of the reduced form** has an adjusted R^2 of 0.40, only 3 of the 8 explanatory variables turn out to be significant, albeit with the expected coefficient signs. Accordingly, countries with a low ratio of interest expenditure to GDP, a low degree of openness, and an IMF-supported adjustment program, can be expected to have lower government subsidy expenditures. It appears that the significance of the IMF program variable in the pooled specification is indicative of differences across countries, rather than within a given country; thus, one cannot conclude from our results that IMF-supported programs lead a given country to reduce its subsidy expenditures.

In general, the results of the reduced form of the subsidy equation seem to indicate that most of the variability is across countries, meaning that there are strong country-specific characteristics. However, these effects cannot be detected in the simple country averages for the given time period. The behavioral variables derived from the theoretical model help to explain a significant share of the remaining (non-country specific) variability in the data, but some of the variables that were included on grounds of the theoretical model turn out to be insignificant.

V. SUMMARY AND CONCLUSIONS

This paper provides an empirical analysis of the economic determinants of government subsidies. We develop a simple public choice model of government expenditures that consists of two simultaneous equations: one for government expenditures and one for subsidies. The model predicts that total government expenditures increase with government interest expenditures and decrease with the external current account balance, and are affected by different state variables such as the dependency ratio, the urbanization ratio, the productive structure of the economy, and the economy's degree of openness. Similarly, subsidies are predicted to increase with government expenditures (net of interest), and be affected by a number of state variables.

The model is estimated using subsidy data from the United Nations System of National Accounts (SNA) for 40 countries and 18 years (1975–92). Our analysis reveals that the SNA data, although based on a narrow definition of subsidies, are a reasonably good proxy for a

more comprehensive measure of subsidies; hence, they may be used to estimate the theoretical model described in the paper.

The empirical estimates provide interesting insights into the determinants of government subsidies. The preferred specification is the fixed-effects model, which takes country-specific elements into account through intercept dummy variables for each country. Overall, the model explains 79 percent of the variation across countries and over time in government subsidies, and 96 percent of the variation in government expenditures. The estimates show that country-specific fixed effects are particularly important for government expenditures, but also (although to a lesser degree) for government subsidies.

In terms of the direct determinants of subsidies, our results indicate that subsidy outlays are positively related to the level of government expenditure, the shares of manufacturing and agriculture in GDP, and the degree of openness of the economy; they were found to be negatively related to the external current account balance and the ratio of interest expenditures relative to GDP. Hence, economic policies that affect these variables can also be expected to have a significant impact on government subsidies. However, the existence of an IMF-supported adjustment program in itself was found to have a statistically insignificant impact on reducing government subsidy expenditures. Indirectly, that is via their effect on government expenditures, government subsidies were found to increase with interest expenditures, and to decrease with the share of agriculture in GDP and the degree of openness. When one puts together the direct and indirect effects of the independent variables on subsidies in the reduced form, the only variables that are significant in the fixed effect formulation are interest expenditures, the current account deficit, the share of manufacturing to GDP, and the degree of urbanization.

What are the possible policy implications of these results? Although the estimates point to the sizeable influence of country-specific factors, they also suggest that keeping government subsidy levels down may be easier when the size of government is small; when economic policies keep the current account deficit from getting too large; and when government does not go out of its way to promote the manufacturing sector. One interesting aspect of the results is that they suggest that globalization, and the associated increase in openness, are not impediments to reducing subsidies; in practice, countries that have opened up have not been forced to use subsidies to address any of the social costs associated with greater exposure to international trade.

Two recent studies (International Monetary Fund (1997), and Abed and others (1998)) show that IMF-supported adjustment programs have been associated with reductions in subsidies and transfers as a share of GDP. In contrast, the results presented here suggest that the association of IMF-supported adjustment programs and lower government subsidies disappears once country specific fixed effects are taken into account. Hence, in the fixed effects model that is presented here, IMF-supported adjustment programs do not lead to a

reduction in government expenditures or subsidies. This may be attributable to the fact that IMF-supported adjustment programs are tailored to the specific circumstances of each country, and there is no uniform pattern which holds across all countries.

APPENDIX 1: OVERVIEW ON STATE VARIABLES IN THE MODEL

This appendix discusses the various state variables that may affect the subsidy equation (13) or the government expenditure equation (14), or both.

(a)   State variables that affect the government expenditure and subsidy equations

Degree of openness: As suggested by Rodrik (1996), there may be a positive relationship between the size of government, as measured by public expenditure over GDP, and the openness of the economy, as measured by total foreign trade (exports plus imports) over GDP; this relation is explained by the role of the government in reducing external risk. As a result we would expect that government expenditures increase with the degree of openness. Similarly, price subsidies may play an important role in reducing external risk. Hence, we expect to find a positive relationship between subsidies and the degree of openness.

Value added in agriculture (relative to GDP): on one hand, this variable is intended to capture the fact that, traditionally, agriculture is a highly subsidized sector. Hence, we expect to find a positive relationship between government subsidies and value added in agriculture. On the other hand, Bahl (1972) uses the fraction of total income generated in that sector as a proxy for the part of total income that is not usually amenable to personal income taxation in developing countries, either because of high collection costs, and/or because it seems a reasonable indicator of the portion of personal income that is below the taxable range. Hence, for a given overall fiscal balance, we would expect to find lower government expenditure as the size of the agricultural sector increases.

Existence of an IMF-supported adjustment program: this variable measures the effect of IMF programs on government subsidies and expenditure. The reason for including this variable follows Hewitt and Van Rijckeghem (1995). To the extent that IMF-supported adjustment programs target reductions in fiscal imbalances, this may, as least in part, be achieved by reducing unproductive expenditures, including government subsidies, and therefore total government expenditure. Two recent studies (International Monetary Fund (1997), and Abed and others (1998)) show that IMF-supported adjustment programs have indeed been associated with reductions in subsidies and transfers as a share of GDP. Hence, we expect this variable to have a negative effect on total government spending and subsidies.

(b) State variables that affect the government expenditure equation

Dependency ratio: this variable is defined as the share of population younger than 15 years and older than 64 years relative to the working-age population (15 to 64 years old). In most countries, increases in the dependency ratio should imply increases in government expenditures because of higher expenditures for education, health care, and pensions. However, an increase in the dependency ratio also implies a smaller share of the population that pays taxes, which, in turn, could create pressures to decrease expenditures.

This variable also acts as a proxy for the level of development both between and within countries, given the high correlation between the dependency ratio and GDP per capita (r=0.6).

Urbanization ratio: this variable is defined as the percentage of the total population living in urban areas. A higher degree of urbanization may imply a higher demand for new services from the public sector, so that government expenditures increase. However, where economies of scale in providing public services are important, government expenditures as a proportion of GDP may not increase significantly with urbanization. As with the dependency ratio, this variable also helps capture the level of development, as it is highly correlated with GDP per capita in the data sample (r=0.6).

(c) State variables that affect the subsidy equation

Value added in manufacturing (relative to GDP): this variable is intended to capture the empirical fact that manufacturing is often more heavily subsidized than other sectors, as indicated, for example, in the various surveys that have been carried out by the Commission of the European Communities (1989, 1990, 1992, 1995). Hence, the expected sign for the coefficient on this variable is positive.

External current account balance (relative to GDP): in the government expenditure equation the inclusion of this variable follows directly from the theoretical model, where it is suggested that government expenditures decrease with an improvement in the external current account balance. In this sense, the effect of the current account on subsidies is an indirect one (via its effect on government expenditure). However, we also postulate that the external current account balance affects subsidies directly: countries with an external current account deficit will experience more pressures to increase competitiveness; one way to do so is by subsidizing exports. Hence, we would expect a negative relationship between the external current account balance and government subsidies. The current account balance is proxied in the econometric model by the balance on goods and services, that is, exports of goods and services minus imports of goods and services.

APPENDIX 2: VARIABLES USED AND DATA SOURCES

The period covered in the study is from 1975 to 1992. The 40 countries in the sample are:

Australia	Iran	Portugal
Austria	Ireland	South Africa
Belgium	Israel	Spain
Botswana	Italy	Sri Lanka
Cameroon	Japan	Sweden
Canada	Korea	Thailand
Costa Rica	Luxembourg	Tunisia
Denmark	Malta	United Kingdom
Finland	Mauritius	United States
France	Netherlands	Uruguay
Germany	Norway	Venezuela
Greece	Panama	Zimbabwe
Iceland	Paraguay	
India	Philippines	

The variables used in this study are derived from the following data sources:

1. Subsidies: SNA database.
2. Government expenditures: SNA database; this variable was computed as total disbursements of the government minus savings.
3. Interest expenditures: SNA database.
4. Exports of goods and services: SNA database.
5. Imports of goods and services: SNA database.
6. Value added in manufacturing: SNA database.
7. Value added in agriculture: SNA database.
8. Dependency ratio: World Bank World Tables.
9. Urbanization ratio: World Bank World Tables.
10. Existence of IMF-supported adjustment programs: constructed on the basis of the *IMF Survey* (various issues).

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