INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.
RICE UNIVERSITY

Essays on Fiscal Transfers and Redistribution in Mexico

by

Héctor Peña Baca

A THESIS SUBMITTED IN PARTIAL
FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE

Doctor of Philosophy

APPROVED THESIS COMMITTEE:

Peter Mieszkowski, Professor, Chair
Economics

George Zodrow, Professor
Economics

David Brown, Assistant Professor
Political Science

HOUSTON, TEXAS

OCTOBER, 2001
To Karla and Hector Carlos,

for sharing this project with me
October, 2001

Abstract

Essays on Fiscal Transfers and Redistribution in Mexico

by

Héctor Peña Baca

The first essay applies four standard models of fiscal equalization to simulate a set of alternative allocations of equalizing subsidies across states in Mexico. Equalization of per capita outlays, fiscal capacity and fiscal potentials are considered. Then a methodology is developed to adjust actual, observed federal subsidies distributed to the state governments as revenue-sharing grants in order to compare these subsidies to the equalizing subsidies obtained from the simulation. The results reveal that the actual pattern of distribution of grants from the General Fund of Revenue-Sharing resembles the patterns which would result from implementing fiscal equalization of either fiscal capacity or fiscal potentials.

The second essay uses household income data to evaluate the potential redistributive effects of alternative tax/subsidy policies related to the financing of public education in Mexico. The incidence of educational subsidies are analyzed by looking at variations of per student educational subsidies across households grouped by level of income. I find that middle-income households benefit the most from subsidies to basic educational levels, while high-income households capture the highest per student educational subsidies in upper secondary and higher education. The concept of welfare dominance is then applied to assess the effect that changes in the allocation of educational subsidies across school levels will have on overall measures of income inequality and social welfare. The results
suggest that a marginal increase in subsidies for basic education, upper secondary and other (non-higher) educational services at the expense of a marginal decrease in subsidies for higher education will yield a marginal welfare improvement.

Finally, in the third essay a sample of pooled cross-sectional data for state governments in Mexico, from 1996 to 1999, is used to show that federal non-matching grants for basic education appear to have a large stimulative effect on state public expenditures in education, a result consistent with the “flypaper” effect literature. A model of local fiscal response is used to further analyze the impact of educational grants on state educational expenditures by decomposing the overall effect of grants into income and price components. The results suggest that non-matching educational grants are effectively perceived by local bureaucrats as a pure price reduction for state expenditures on education.
ACKNOWLEDGMENTS

I thank my wife Karla for her tireless and unconditional support. Her encouragement and patience were key elements in accomplishing this project. Because of her own effort, this achievement is also hers. Our son Hector Carlos shared with us our years at Rice, making the process a lot more enjoyable and providing additional motivation.

It would have been impossible to finish this dissertation without the guidance of my professor and advisor Peter Mieszkowski, whom I thank for his friendship and support. His encouragement was crucial for me to engage on this project. Through countless hours of discussions he helped me to stay focused on the relevant issues and guided me through exhaustive revisions of my work.

I’m grateful to George Zodrow and David Brown for being part of my thesis committee and for their enlightening comments on the three essays included in my dissertation.

Particularly useful were several discussions with Carlos Linares and Fernando Ramírez at Rice University. Earlier drafts of my research were also discussed during an internship at Banco de México. I also thank Carlos Garza at the Government of the State of Nuevo Leon, as well as José Ramón Cárdeno at the Ministry of Education of Mexico for providing some of the data used for my analysis.

I thank George Baker, Managing Principal of Baker & Associates, for his financial and intellectual support during my last three years at Rice. The financial support for my doctoral studies was provided by the National Council of Science and Technology (CONACYT) of Mexico.
I thank my parents, Héctor Alfredo and Luz Ofelia, for giving me the background of an undergraduate education. I am grateful to my in-law family, particularly to my mother-in-law, Silvia leticia, for their generous support and encouragement.
Table of Contents

Preface ix

CHAPTER 1 Fiscal Equalization in Mexico: A Simulation Analysis .......... 1
  1.1 Fiscal Equalization: Why Redistribute? ........................................ 2
  1.2 Models of Vertical Equalization .................................................. 4
    1.2.1 Equalization of Per Capita Spending, Plan 1 ............................ 5
    1.2.2 Equalization of Fiscal Capacity, Plan 2 .................................. 7
    1.2.3 Equalization of Fiscal Potentials Considering Differentials in Capacity, Plan 3 . . . . . . 9
    1.2.4 Equalization of Fiscal Potentials Considering Differentials in Capacity and Differentials in Need, Plan 4 ........................................... 10
  1.3 Case Study: Intergovernmental Fiscal Relationships in Mexico .......... 11
    1.3.1 Fiscal Disparities in Mexico ................................................. 12
    1.3.2 State and Local Own Revenues ............................................ 13
    1.3.3 Input Data ................................................................... 14
      1.3.3.1 Calculation of Per Capita Income .................................. 15
      1.3.3.2 State and Local Revenues and Expenditures and Own Tax Rates 16
      1.3.3.3 Federal Revenue-Sharing Grants ..................................... 17
      1.3.3.4 Index of Need ................................................................. 17
  1.4 Ideal Simulated Values for Equalizing Transfers ......................... 17
  1.5 Framework for Contrasting Actual to Simulated Subsidies .............. 21
    1.5.1 The Adjusted Actual Net Subsidy (AANS) .................................. 23
      1.5.1.1 Head Tax Case ............................................................... 24
      1.5.1.2 Proportional Tax Case .................................................. 25
  1.6 Comparison to Actual Federal Block Grants .................................. 26
    1.6.1 The National System of Fiscal Collaboration (NSFC) .................. 26
    1.6.2 Differentials between Equalizing and Actual Per Capita Subsidies 28
    1.6.3 Ideal Simulated and Observed Patterns of Equalization Subsidies 29
    1.6.4 Correlation Analysis ............................................................ 36
  1.7 Conclusions and Policy Implications ............................................ 39

Appendix A: Description of Variables 41
Appendix B: Data Tables 44

CHAPTER 2 Redistribution and Welfare Dominance: An Analysis of Subsidies for Education in Mexico ......................................................... 45
  2.1 The Incidence of Educational Subsidies ....................................... 48
    2.1.1 Educational Subsidies and Income Redistribution ...................... 54
  2.2 Decomposing Inequality .............................................................. 56
    2.2.1 Decomposing the Gini Coefficient ........................................ 56
    2.2.2 Consumption Inequality in Mexico ........................................ 59
  2.3 Welfare Improving Shifts in Educational Subsidies ....................... 63
    2.3.1 The Conditions for Welfare Dominance .................................. 64
    2.3.2 The Extended Gini Coefficient ............................................. 70
  2.4 Welfare Improving Shifts in Educational Subsidies in Mexico ........... 71
2.4.1 Identifying the Necessary Conditions for Welfare Dominance ........................................... 71
2.4.2 Checking for Marginal Conditional Stochastic Dominance ............................................. 74
2.4.3 Subsidies Financed by Increasing the Income Tax .............................................................. 81
2.5 Policy Implications and Concluding Remarks ..................................................................... 82

Appendix C: Difference in Concentration Curves 85

CHAPTER 3 The Impact of Federal Grants for Basic Education in Mexico .......................... 89

3.1 Grants for Basic Education in Mexico ............................................................................. 90
3.2 The Impact of Educational Grants on State Expenditures ............................................... 91
  3.2.1 The Flypaper Effect ......................................................................................................... 92
  3.2.2 Empirical Evaluation of the Impact of Educational Grants ............................................. 94
  3.2.2.1 Description of the Data ............................................................................................. 95
  3.2.2.2 The Stimulative Effects of Educational Grants .......................................................... 96
3.3 A Model of Local Fiscal Response to Federal Grants ....................................................... 99
  3.3.1 The Post-Grant Local Budget Constraint ..................................................................... 99
  3.3.2 Identifying the Effective Budget Constraint ................................................................... 102
  3.3.3 A Model of Local Fiscal Response to Grants ................................................................. 103
  3.3.4 Normalization of Preferences ....................................................................................... 109
3.4 Analyzing Federal Grants for Basic Education ................................................................. 109
  3.4.1 Test for Multipart Pricing in the Grant Mechanism ....................................................... 110
  3.4.2 Test for a Pure Price Effect ............................................................................................ 113
3.5 Comparison of Results ..................................................................................................... 116
3.6 Policy Implications and Concluding Remarks ................................................................. 117

References 119
Preface

The following collection of essays deals with two important and interrelated aspects of contemporary fiscal reform in Mexico. First, fiscal transfers both between different levels of government and between individuals are considered. Also, the redistributional effects of such transfers are studied in the context of fiscal equalization, social welfare implications and local fiscal response.

The debate on fiscal decentralization in Mexico has raised the interest for understanding the potential consequences of alternative arrangements in fiscal intergovernmental relationships. The first essay approaches this issue by comparing the actual flow of federal revenue-sharing grants to states against an ideal simulated flow of funds on the basis of fiscal equalization. In the third essay the aim is to evaluate the impact that federal categorical non-matching grants for education have on state governments’ decisions about how to allocate their own resources between aided and non-aided spending categories.

Fiscal transfers between individuals take the form of taxes and subsidies on private expenditures in the second essay. Revenue-neutral marginal changes in tax/subsidy allocation across educational levels are analyzed on the basis of their impact on the distribution of household income and, ultimately, on social welfare.

A significant degree of income inequality among individuals, as well as marked differences in availability of resources across regions make the study of redistribution particularly compelling in the case of Mexico. The redistributive implications of economic policy is relevant not only because policy makers may explicitly aim to alter the allocation
of resources, but also because numerous policies have unintended redistributive effects which may determine the effectiveness of such policies, or may even be determinant of whether or not such policies are ever implemented.
1 Fiscal Equalization in Mexico: A Simulation Analysis

An important element in Mexican Fiscal intergovernmental relationships is the Sistema Nacional de Coordinación Fiscal (National System of Fiscal Collaboration or NSFC hereinafter), a revenue sharing agreement between the three basic levels of government. Under this system the state and local governments give up their right to exploit various tax bases in exchange for federally financed unconditional block grants. The first part of this thesis analyses the degree to which the revenue sharing system is effecting a presumed redistributive objective. Is there a net (of taxes) flow of fiscal resources from the “richer” toward the “poorer” states? In answering this question I will focus on the unconditional block grants the central government transfers to state and local governments under the NSFC. Although the federal government also transfers resources to the state governments through other programs, revenue-sharing grants account for most of these transfers. Moreover, revenue-sharing grants represent (as of 1996) 43% of total state revenues.¹

To study the effectiveness of fiscal equalization we need a measure to distinguish between “richer” and “poorer” states and to establish a benchmark for the analysis. I shall adopt various models of vertical equalization developed in the fiscal equalization literature,² and will present simulations of these approaches against which the actual programs can be compared.³ I shall concentrate on what Musgrave (1961) has called “pure

¹. Except for educational grants, federal transfers other than revenue sharing grants are no very significant. These smaller programs include grants for health and antipoverty programs.
equalization" plans, or plans seeking to comply with certain criteria of equity across states, and will abstract from the effects of these programs on state and local own fiscal effort.

The numerical analysis will provide an ideal hypothetical flow of resources between states against which to compare the observed distribution of federal block grants to the states. Because the ideal equalizing subsidies resulting from this analysis are net of federal taxes and are obtained under the assumption of a balanced budget of the central government, the actual flow of revenue-sharing grants is not directly comparable to the equalizing subsidies. Hence, I will develop a methodology to adjust the actual subsidies to make them both net of federal taxes and consistent with a balanced budget situation. This is one of the main contributions of this essay, and is only after this adjustment is made that it will be possible to compare actual to ideal equalizing subsidies. Thus, this chapter compares the actual flow of federal funds to states against an ideal simulated flow of funds on the basis of fiscal equalization and goes on to establish how the implementation of different alternative equalization plans would affect the actual allocation of unconditional block grants across states.

1.1 Fiscal Equalization: Why Redistribute?

Fiscal equalization has been widely used by upper levels of government to reduce or to eliminate fiscal disparities between lower level jurisdictions. The central government may decide to transfer resources to state governments in order to reduce any differences in own revenue collection among these states. Similarly, state governments may have their own

---

3. I will have to exclude Buchanan's horizontal equity approach since I don't have information about the distribution of the tax base inside each state.
fiscal equalization programs in order to reduce any fiscal disparities between local
governments under their jurisdiction.

Oakland (1994) divides the sources of fiscal disparities in two groups: (1) disparities
resulting from differences in the cost of providing public goods and services; and (2)
disparities arising because of differences in access to resources. Differences in wage rates
result in some local governments facing a relatively higher cost of public goods provision.
Moreover, a state with a large share of indigenous population may find it more expensive
to finance basic education as several native languages coexist in the same territory,
communities with hot weather will have to spend extra money on higher quality pavement
in order to avoid early degradation by high temperatures and a large metropolitan area
may find it more expensive to maintain a given standard of public safety.

On the other hand, disparities in access to resources may arise because of differences
in tax bases across communities, as well as different endowments of natural resources.
Thus, a state with a less affluent population will have to impose higher tax rates than states
with a richer population in order to collect any given amount of revenues. Similarly, a
state with oil fields will have access to a broader tax base than non-oil states if those oil
fields are not under the common ownership of the federation.4

The issues of whether or not it is desirable to eliminate fiscal disparities,5 as well as
how such reduction or elimination should be accomplished have been extensively studied
in the literature but these questions are beyond the scope of this essay.6 This discussion

---

4. This observation applies for any non-residential tax base.
5. By example, see Oakland (1994).
6. Some of this discussion will be briefly described in the next section.
often involves a concern about a distortion of incentives which may lead to an inefficient outcome, by example in the form of lower than optimal state and local tax effort.

The next section of this chapter presents a formal description of four alternative plans for vertical fiscal equalization. The third and fourth sections report the empirical implementation of each of the fiscal equalization plans to Mexican data in the context of the allocation of the General Fund of Revenue Sharing, the largest of the pools of funds distributed by the central government to the lower levels of government. Section 1.5 explains the analytical framework to be used in comparisons between our ideal fiscal equalizing subsidies and our observed federal block grants to states; whereas Section 1.6 applies this framework to the Mexican case. The final section concludes.

1.2 Models of Vertical Equalization

The debate between the vertical equity and horizontal equity approaches to fiscal equalization has persisted for five decades. Buchanan (1950) criticized the vertical equity approach called fiscal capacity equalization arguing there is no justification for fiscal equalization between governmental units, and that the appropriate target should be equalization between individuals.

One of the difficulties with Buchanan’s horizontal equity approach is that it is extremely difficult to operate since it requires transfers from individuals to individuals. Even the simple calculation of the ideal subsidies is very difficult to achieve in practice as it requires complete information about the distribution of the tax base inside every state. Hence, I will not consider the horizontal equity approach in this study.

7. See Mieszkowski and Musgrave (1999).
The four fiscal equalization plans described in this section were first developed by Musgrave (1961) who considered different principles of equalization on the assumption that the budget of the central government is balanced. Thus, additional subsidies for a given subset of states will be financed by reducing subsidies or increasing taxes on the states. This assumption will allow us to focus on the redistributional implications of the equalization plans.

1.2.1 Equalization of Per Capita Spending. Plan 1

I begin with the simplest model of vertical equalization. Let us define the budget constraint of state \( i \) as

\[
A_i = R_i^o + G_i - R_i^c \quad \forall \ i = 1, 2, \ldots, n
\]  

(1)

where \( A_i \) and \( R_i^o \) represent total own expenditure and total own revenue of state \( i \) respectively, \( G_i \) is the gross subsidy received by the \( i \)th state from the central government, and \( R_i^c \) represents the amount of central taxes collected from state \( i \).

Dividing equation 1 by the population of the \( i \)th state, \( h_i \), we can rewrite the state budget constraint in per capita terms as

\[
a_i = r_i^o + g_i - r_i^c \quad \forall \ i = 1, 2, \ldots, n
\]  

(2)

where

\[
a_i = \frac{A_i}{h_i}, \ r_i^o = \frac{R_i^o}{h_i}, \ g_i = \frac{G_i}{h_i}, \ \text{and} \ r_i^c = \frac{R_i^c}{h_i}
\]  

(3)

8. Hereinafter the term state will be used as a synonym of state and local.
Assume the objective of the central government is to equalize per capita expenditure on state services in all states, i.e.

$$a_i = a \quad \forall \ i = 1, 2, \ldots, n$$ (4)

such that

$$a = \frac{\sum_{i=1}^{n} A_i}{\sum_{i=1}^{n} h_i}$$ (5)

Hence, per capita outlays on state services will be equalized in all states at a level equal to the per capita spending on state services by the aggregate of the $n$ states. And since a balanced central budget is assumed, we have that the system must meet the condition

$$\sum_{i=1}^{n} S_i = \sum_{i=1}^{n} h_i s_i = 0$$ (6)

where $S_i$ is the $i$th state's subsidy net of federal taxes, and the per capita representation of this net subsidy is defined as

$$s_i = g_i - r_i^c$$ (7)

---

9. It can be demonstrated that the per capita level of outlays described by (equation 5) is equivalent to the weighted average of expenditure on state services when the spending of the $i$th state is weighted by its correspondent population.
1.2.2 Equalization of Fiscal Capacity. Plan 2

In the second plan the objective of the central government is for each state to attain a centrally set level of fiscal performance, \( m \), taking into account differences in fiscal capacity. The level of fiscal performance could be, for example, an average level of resources that the central government considers should be available to each state government.

For this second alternative policy objective the budget constraint in per capita terms for state \( i \) will be set as before; i.e.

\[
a_i = r_i^o + g_i - r_i^c \quad \forall \ i = 1, 2, ..., n
\]  

(8)

and the subsidy to state \( i \) will be defined by the equation

\[
s_i = m - t_c b_i
\]  

(9)

where \( t_c \) is the tax rate the central government imposes on state \( i \)’s tax base in order to finance the grant system, and \( b_i \) represents the per capita tax base of state \( i \) as defined by

\[
b_i = \frac{B_i}{h_i}
\]  

(10)

where \( B_i \) represents the total tax base of the \( i \)th state. In equation 9, \( m \) should be interpreted as a subsistence level of performance that is set by the central government. It will be assumed that the central government chooses \( m \) such that

\[
m = \bar{r}^o + \bar{g}
\]  

(11)

where the average per capita state and local government revenue \( \bar{r}^o \) is defined as
\[
\bar{r}^o = \frac{\sum_{i=1}^{n} h_i r_i^o}{\sum_{i=1}^{n} h_i}
\] (12)

and \(\bar{g}\) represent the observed average gross transfer actually received by a typical individual. Thus \(\bar{g}\) is defined by

\[
\bar{g} = \frac{\sum_{i=1}^{n} h_i g_i}{\sum_{i=1}^{n} h_i}
\] (13)

In addition, the central proportional tax rate, \(t_c\), must meet the condition

\[
m = t_c \bar{b}
\] (14)

where \(\bar{b}\) is defined by

\[
\bar{b} = \frac{\sum_{i=1}^{n} h_i b_i}{\sum_{i=1}^{n} h_i}
\] (15)

Thus \(\bar{b}\) does represent the population-weighted average tax base.

Equation 14 assures that the central budget will be balanced so that the condition
\[ \sum_{i=1}^{n} h_i s_i = 0 \]  

(16)

is met.

1.2.3 Equalization of Fiscal Potentials Considering Differentials in Capacity. Plan 3

The two plans described above have a common characteristic: they do not take into account the tax effort of each state. Next, we examine some models for which the central government seeks to equalize fiscal potentials.

For this model the budget constraint of state \( i \) will be written in a slightly different form. The state budget constraint will be given by

\[ a_i = b_i t_i + s_i \quad \forall \quad i = 1, 2, \ldots, n \]  

(17)

where \( t_i \) is the state \( i \)'s own tax rate and the per capita net (after central taxes) subsidy, \( s_i \), of this state is defined by the equation

\[ s_i = (\bar{b} - b_i) t_i - b_i t_c \]  

(18)

The inclusion of state \( i \)'s own tax rate, \( t_i \), in equation (17) will allow the central government to discriminate between states on the basis of each state's chosen tax rate. Equation (18) implies that, depending on whether the level of per capita income of a state is lower, higher or just equal to the national average, the net subsidy received by that state will increase, decrease or remain unchanged respectively, as its own tax rate increases. In addition, the net subsidy a state receives decreases as its level of per capita income increases.
Since the central budget must be balanced, the system, once again, must meet the condition

$$\sum_{i=1}^{n} h_i s_i = 0 \quad (19)$$

Multiplying equation 18 by $h_i$ and summing up over $i$, and using equation 19 it follows that

$$t_c = \frac{\sum_{i=1}^{n} h_i (\bar{b} - b_i) t_i}{\sum_{i=1}^{n} h_i b_i} \quad (20)$$

1.2.4 Equalization of Fiscal Potentials Considering Differentials in Capacity and Differentials in Need. Plan 4

Finally, in our fourth plan the central government seeks to equalize fiscal potentials, but now takes into account both differentials in capacity and differentials in need.

The budget constraint for state $i$ will be given as before by

$$a_i = b_i t_i + s_i \quad \forall \ i = 1, 2, ..., n \quad (21)$$

whereas state $i$'s subsidy will be defined as

$$s_i = (\bar{b} - b_i) t_i + (x_i - \bar{x}) t_i \bar{b} - b_i t_c \quad (22)$$
where $x_i$ represent an index of need\textsuperscript{10} for the $i$th state. This index will be standardized such that the average index of need, $\bar{x}$, is given by

$$\bar{x} = \frac{\sum_{i=1}^{n} h_i x_i}{\sum_{i=1}^{n} h_i} = 1$$

(23)

The balanced central budget condition requires that

$$\sum_{i=1}^{n} h_i s_i = 0$$

(24)

Summing over $i$ on equation 22 and using equation 24 we can find that

$$t_c = \frac{\sum_{i=1}^{n} (\bar{x} - b_i) t_i h_i b_i}{\sum_{i=1}^{n} h_i b_i}$$

(25)

1.3 Case Study: Intergovernmental Fiscal Relationships in Mexico

The study of intergovernmental fiscal relationships in Mexico is especially interesting because of a considerable interregional variations in average income levels between states; also, there are large differences in natural resources endowments across regions;

\textsuperscript{10}In our case, an index of need for educational services will be used as I will explain later.
and a relatively large amount of resources flows between levels of government. All these characteristics enhance the relevance of interregional redistributive policies.

The federal government transfers resources to the states and local communities in three principal forms: (1) unconditional block grants under a revenue-sharing agreement between the federal government and state and local governments;\textsuperscript{11} (2) federal grants targeted to finance state educational programs;\textsuperscript{12} and (3) direct physical investment by the central government in the states and municipalities.

In Mexico the central government spends a considerable amount of its own resources in physical investment in the states. In addition, the central government provides, by means of categorical grants, most of the resources to finance public education. Other programs provide additional grants for health and welfare but these programs are not as quantitatively important as the three major programs. For simplicity, this essay will be limited to the analysis of the redistributitional features of the general revenue-sharing agreement.

\subsection*{1.3.1 Fiscal Disparities in Mexico}

There are large differences in per capita income across states in Mexico. Data from 1994 shows that a typical resident of the richest state, the Federal District, has an average income equal to 4.3 times that of a resident from the poorest state, Guerrero. Given these income disparities, a poor state like Guerrero or Chiapas will have to impose a much

\textsuperscript{11}This revenue-sharing agreement will be briefly described in Section 1.3.
\textsuperscript{12}Local governments in Mexico are not responsible for educational services provision. The closest they get to it is through the provision and maintenance of public libraries, and by engaging in some cultural projects. Moreover, even though states are now responsible for providing education, this may be labeled as an administrative responsibility since the education system and program design are centralized by the federal government.
higher tax rate than a rich state like the Federal District in order to attain a given level of public expenditures.

Disparities in natural resources endowments are also a source of fiscal disparities. Even though the federal government is the main beneficiary of oil-related tax collection, the oil-rich states, Campeche and Tabasco, enjoy a significant fiscal advantage relative to non-oil states. The current formula for allocation of unconditional block grants is designed in a way to encourage these states to take advantage of the location of oil deposits in their territory. As a result, these two states receive the highest levels of per capita block grants.

Differences in cost of providing public goods and services are found throughout the country. The per unit cost of providing education to a child in one of the small rural communities in Oaxaca is much higher than the cost of providing educational services to a child living in a densely populated area like Mexico City. We also expect the per capita cost of providing a given level of public safety in Mexico City to be higher than the cost of providing this service in a smaller city. This heterogeneity of the nation makes the study of fiscal equalization in Mexico especially interesting.

1.3.2 State and Local Own Revenues

The Mexican intergovernmental fiscal system is a highly centralized system on the revenue side and somewhat less centralized on the expenditure side. While some advances have been made toward decentralizing public expenditures, state and local own revenues are still quite small relative to revenues collected by the central government.\textsuperscript{13}

\begin{footnote}{13}{For example, in 1994 state and local governments collected only about 12\% of total governmental revenues in Mexico.}
States and municipalities rely heavily on transfers from the federal government for the financing of state and local public expenditures. Table 1-1 shows the different state and local own tax rates for each level of average income. The Federal District is treated as an independent state.

<table>
<thead>
<tr>
<th>Income Group</th>
<th>Number of States</th>
<th>Per Capita State and Local Own Revenues(^a)</th>
<th>Per Capita Income</th>
<th>Own Tax Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All levels average</td>
<td>32</td>
<td>471</td>
<td>11,703</td>
<td>0.0402</td>
</tr>
<tr>
<td>Federal District</td>
<td>1</td>
<td>996</td>
<td>24,791</td>
<td>0.0402</td>
</tr>
<tr>
<td>High income states</td>
<td>9</td>
<td>466</td>
<td>13,821</td>
<td>0.0337</td>
</tr>
<tr>
<td>Medium income states</td>
<td>7</td>
<td>407</td>
<td>10,023</td>
<td>0.0406</td>
</tr>
<tr>
<td>Low income states</td>
<td>15</td>
<td>370</td>
<td>6,948</td>
<td>0.0532</td>
</tr>
</tbody>
</table>

\(^a\) Own calculations using data from the National Institute of Statistics, Geography, and Informatics (INEGI).

In 1994, the group of the fifteen poorest states taxed its residents at the relatively high tax rate of 5.3%, whereas the high income group had the lowest own tax rate equal to 3.4%. The typical tax rate for the middle income group of states was close to the national average. Except for the Federal District with an average tax rate, Table 1-1 suggests a negative relationship between the average level of income in the states and the average tax rates imposed by state and local governments.

1.3.3 Input Data

As the four alternative plans for fiscal vertical equalization have been set up, we now proceed to apply this framework to public finance data for Mexico. All the data used on this study does correspond to the year of 1994, the most recent year for which observed
data is available for all variables. A complete description of each variable used for these calculations is presented in Appendix A at the end of this chapter.

1.3.3.1 Calculation of Per Capita Income

The most significant problem in implementing the analysis is the calculation of per capita income; there exist no comprehensive survey that measures the actual level of personal income per resident in every state.

To overcome this difficulty the income variable was constructed from two different sources: (1) the National Survey of Income and Expenditures of Households (ENIGH, 1994), and (2) data for each institutional sector from the System of National Accounts (SNA). Each of these dataset is subject to several limitations.

The main problem of the ENIGH data is the underreporting of income, a problem common to this kind of survey. Per capita income obtained from ENIGH is considerably lower than the comparable totals reported in the national accounts.

National account data for different states reports unreasonably large amounts of income for the Federal District and the oil-producing states (Campeche and Tabasco).¹⁴

The solution I adopt to get around these problems involves the use of the national disposable income of the household sector as published by the SNA and the allocation of this income across states using the shares derived from ENIGH data.

*National Disposable Income of Households (NDIH).* The recent release of national accounts data by institutional sector have made possible to identify disposable income of

---

¹⁴ This misrepresentation of income generation shares presumably arises from the way production and value added data is reported by the economic units and collected by the industrial censuses and other surveys.
households. National disposable income of households was taken from the 1994 SNA data.

State Share of Household Income (SSH): First, monetary and non-monetary household income was identified for each observation in the ENIGH data for 1994. Thenceforth these figures for individual observations were aggregated by state in order to calculate the share of each state out of the aggregate of all observations in the sample.

Per capita household income for state $i$ was then calculated as

$$b_i = \frac{SSH\times NDIH}{h_i}$$  \hspace{1cm} (26)

where $h_i$ represents population of state $i$. The per capita income by state figures obtained through this method are shown by Table 1-2.

1.3.3.2 State and Local Revenues and Expenditures and Own Tax Rates

A measure of each state’s own tax rate is also required. Mexican state and local governments’ own revenues are collected through a complex array of taxes and fees, and tax rates and tax bases differ across states and even across localities within the same state. For simplicity, each state’s own tax rate will be approximated by the ratio of state and local own revenues, $R_i$, to the state income tax base, $B_i$.

State and local revenues and expenditures are readily available from the National Institute of Statistics, Geography and Informatics (INEGI). Data for municipalities was

---

15. Before 1996, Mexico’s maintenance of national accounts did not allow to break the data into institutional sectors. In 1996 Mexico signed the 1993 U.N. Protocol which provides a standard for recording of national accounts data.

16. The largest component of non-monetary income is imputed housing rents.
collected from INEGI's SIMBAD database, while state data was taken from INEGI's hardcopy publication on state and local public finance.

1.3.3.3 Federal Revenue-Sharing Grants
There are several channels used by the central government to distribute federal unconditional revenue-sharing grants across states. Nevertheless, for the purpose of this project I will focus exclusively in the funds from the General Fund of Revenue-Sharing which accounts for about 84 percent of total grants received by the states as revenue-sharing transfers. The data is available from the Secretaría de Hacienda y Crédito Público (SHCP).

1.3.3.4 Index of Need
I have used a very simple imperfect index of need. It is the number of inhabitants between ages of 6 and 14 in each state and is interpreted as an indicator of elementary educational needs. An obvious improvement would be to incorporate data pertaining to typical public services like police and transit needs. Nevertheless, the specific index of need used here is a reasonable first approximation as state expenditures on education accounts for a large share of total state spending.\(^\text{17}\)

1.4 Ideal Simulated Values for Equalizing Transfers
The simulated subsidies (taxes) for each of the four equalization plans are shown in Table 1-2 below. As discussed in Section 1.2, per capita outlays equalization under Plan 1 would favor those states with a relatively low tax effort and would punish lower level

---

\(^{17}\)About 45% of total state expenditures were devoted to education between 1996 and 1999. This figure includes educational spending financed by federal grants.
governments with a relatively high level of own revenue collections. States with per capita own revenues higher than the average would be taxed in order to finance net subsidies for states with lower than average own revenues.

Moreover, since the determination of the net subsidy is independent of a state’s average income we would observe some states with a low average income and high tax effort subsidizing states with a high average income and poor tax effort. Hence, Table 1-2 shows that, if Plan 1 is implemented, poor states with high tax effort like Guerrero, Queretaro and Campeche would transfer resources to rich low-effort states like Coahuila, Jalisco and Mexico. As expected, when we classified states by income group we note a negative correlation between own tax rates and average income.

Plan 1 may be considered to be an extreme and unlikely transfer program, but it is still useful to consider it as a point of comparison with other more plausible models of allocation.

Recall that under Plan 2, which equalizes fiscal capacity, the federal government sets a standard level of performance, \( m \), given by equation 11. As implied by fiscal capacity equalization, under this plan the resulting net subsidies for any state are not influenced by the state own tax rate and, as noted by Musgrave (1961), state governments are not punished or rewarded on the basis of their tax effort. The primary determinant of net subsidies for this plan, as may be observed from Table 1-2, is the size of the state’s tax base. States with the highest average income like the Federal District, Baja California Sur, Jalisco and Nuevo Leon will pay the highest per capita taxes, while the states with the lowest per capita income, Guerrero, Hidalgo, Puebla and Tabasco, will get the highest
<table>
<thead>
<tr>
<th>State</th>
<th>Per capita state and local revenues</th>
<th>Per capita income</th>
<th>State and local own tax rates</th>
<th>Per capita ideal subsidies</th>
<th>Equalization of per capita outlays</th>
<th>Equalization of fiscal capacity</th>
<th>Equalization of fiscal potentials</th>
<th>Equalization of fiscal potentials and need</th>
</tr>
</thead>
<tbody>
<tr>
<td>National average</td>
<td>471</td>
<td>11,703</td>
<td>0.0402</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aguascalientes</td>
<td>688</td>
<td>11,522</td>
<td>0.0598</td>
<td>-218</td>
<td>13</td>
<td>-25</td>
<td>-2</td>
<td>-2</td>
</tr>
<tr>
<td>Baja California</td>
<td>449</td>
<td>15,681</td>
<td>0.0286</td>
<td>22</td>
<td>-292</td>
<td>-163</td>
<td>-220</td>
<td>-206</td>
</tr>
<tr>
<td>Baja California Sur</td>
<td>995</td>
<td>17,944</td>
<td>0.0554</td>
<td>-524</td>
<td>-459</td>
<td>-402</td>
<td>-443</td>
<td>-503</td>
</tr>
<tr>
<td>Campeche</td>
<td>780</td>
<td>7,676</td>
<td>0.1016</td>
<td>-309</td>
<td>296</td>
<td>385</td>
<td>398</td>
<td>387</td>
</tr>
<tr>
<td>Coahuila</td>
<td>192</td>
<td>11,956</td>
<td>0.0161</td>
<td>279</td>
<td>-19</td>
<td>-41</td>
<td>-54</td>
<td>-54</td>
</tr>
<tr>
<td>Colima</td>
<td>812</td>
<td>10,136</td>
<td>0.00801</td>
<td>-341</td>
<td>115</td>
<td>94</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>Chiapas</td>
<td>510</td>
<td>6,811</td>
<td>0.0749</td>
<td>-40</td>
<td>360</td>
<td>345</td>
<td>443</td>
<td>443</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>759</td>
<td>12,172</td>
<td>0.0624</td>
<td>-288</td>
<td>-34</td>
<td>-67</td>
<td>-146</td>
<td>-146</td>
</tr>
<tr>
<td>Distrito Federal</td>
<td>996</td>
<td>24,791</td>
<td>0.0402</td>
<td>-526</td>
<td>-962</td>
<td>-603</td>
<td>-714</td>
<td>-714</td>
</tr>
<tr>
<td>Durango</td>
<td>96</td>
<td>8,302</td>
<td>0.0116</td>
<td>374</td>
<td>250</td>
<td>14</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Guanajuato</td>
<td>416</td>
<td>9,514</td>
<td>0.0437</td>
<td>55</td>
<td>161</td>
<td>66</td>
<td>98</td>
<td>98</td>
</tr>
<tr>
<td>Guerrero</td>
<td>685</td>
<td>5,755</td>
<td>0.1190</td>
<td>-214</td>
<td>437</td>
<td>690</td>
<td>856</td>
<td>856</td>
</tr>
<tr>
<td>Hidalgo</td>
<td>78</td>
<td>5,884</td>
<td>0.0132</td>
<td>393</td>
<td>428</td>
<td>59</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Jalisco</td>
<td>276</td>
<td>14,129</td>
<td>0.0195</td>
<td>195</td>
<td>-178</td>
<td>-91</td>
<td>-96</td>
<td>-96</td>
</tr>
<tr>
<td>México</td>
<td>364</td>
<td>13,550</td>
<td>0.0268</td>
<td>107</td>
<td>-136</td>
<td>-92</td>
<td>-98</td>
<td>-98</td>
</tr>
<tr>
<td>Michoacán</td>
<td>476</td>
<td>7,902</td>
<td>0.0603</td>
<td>-6</td>
<td>280</td>
<td>205</td>
<td>258</td>
<td>258</td>
</tr>
<tr>
<td>Morelos</td>
<td>182</td>
<td>9,702</td>
<td>0.0188</td>
<td>288</td>
<td>147</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Nayarit</td>
<td>118</td>
<td>7,193</td>
<td>0.0163</td>
<td>353</td>
<td>332</td>
<td>51</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Nuevo León</td>
<td>651</td>
<td>15,367</td>
<td>0.0424</td>
<td>-180</td>
<td>269</td>
<td>-203</td>
<td>-256</td>
<td>-256</td>
</tr>
<tr>
<td>Oaxaca</td>
<td>29</td>
<td>7,133</td>
<td>0.0040</td>
<td>442</td>
<td>336</td>
<td>-8</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Puebla</td>
<td>402</td>
<td>6,211</td>
<td>0.0648</td>
<td>68</td>
<td>404</td>
<td>337</td>
<td>398</td>
<td>398</td>
</tr>
<tr>
<td>Querétaro</td>
<td>691</td>
<td>6,382</td>
<td>0.1083</td>
<td>-221</td>
<td>391</td>
<td>557</td>
<td>635</td>
<td>635</td>
</tr>
<tr>
<td>Quintana Roo</td>
<td>517</td>
<td>11,235</td>
<td>0.0460</td>
<td>-46</td>
<td>34</td>
<td>-13</td>
<td>-34</td>
<td>-34</td>
</tr>
<tr>
<td>San Luis Potosí</td>
<td>605</td>
<td>7,525</td>
<td>0.0804</td>
<td>-134</td>
<td>307</td>
<td>313</td>
<td>369</td>
<td>369</td>
</tr>
<tr>
<td>Sinaloa</td>
<td>223</td>
<td>11,505</td>
<td>0.0194</td>
<td>248</td>
<td>15</td>
<td>-32</td>
<td>-32</td>
<td>-32</td>
</tr>
<tr>
<td>Sonora</td>
<td>682</td>
<td>13,638</td>
<td>0.0493</td>
<td>-211</td>
<td>-157</td>
<td>-148</td>
<td>-191</td>
<td>-191</td>
</tr>
<tr>
<td>Tabasco</td>
<td>483</td>
<td>6,191</td>
<td>0.0781</td>
<td>-13</td>
<td>405</td>
<td>411</td>
<td>489</td>
<td>489</td>
</tr>
<tr>
<td>Tamaulipas</td>
<td>800</td>
<td>13,393</td>
<td>0.0597</td>
<td>-329</td>
<td>124</td>
<td>209</td>
<td>209</td>
<td>209</td>
</tr>
<tr>
<td>Tlaxcala</td>
<td>75</td>
<td>7,529</td>
<td>0.0100</td>
<td>396</td>
<td>307</td>
<td>16</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Veracruz</td>
<td>438</td>
<td>9,570</td>
<td>0.0458</td>
<td>33</td>
<td>157</td>
<td>68</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>Yucatán</td>
<td>106</td>
<td>7,044</td>
<td>0.0151</td>
<td>365</td>
<td>343</td>
<td>48</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Zacatecas</td>
<td>132</td>
<td>8,978</td>
<td>0.0148</td>
<td>338</td>
<td>200</td>
<td>12</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

a. Own calculations based on data from National Institute of Statistics, Geography and Informatics (INEGI).
subsidies. This fact is also reflected in Table 1-3 below which shows the ideal per capita subsidies for each income group.

Plan 3, which equalizes fiscal potentials, and as is apparent from Table 1-3, consideration of own fiscal effort in the allocation of transfers across states results in higher subsidies for states with higher own tax rates and lower per capita income. Thus, Baja California Sur, Federal District and Nuevo Leon will be heavily taxed while states such as Campeche, Chiapas, Guerrero, Queretaro, Tabasco and Puebla will be heavily subsidized.

Also, under this plan, the Federal District and Nuevo Leon with a fiscal effort close to the average and high per capita incomes, will bear high per capita taxes.

Plan 4 introduces an additional element to the allocation of intergovernmental transfers: a measure of need for each state. As shown in Table 1-3, implementation of this equalization plan results in higher per capita transfers for states with higher tax effort, higher index of need, and lower per capita income. This combination of factors applies in Guerrero, Queretaro, Tabasco and Chiapas who would be the main beneficiaries from a hypothetical implementation of Plan 4. In contrast, a combination of a lower tax effort, lower measure of need, and high income found in the Federal District, Baja California Sur, and Nuevo Leon would make these states the highly taxed states under this program.

| Table 1-3. Required per capita subsidies in 1994 by income group. Figures in current pesos |
|-----------------------------------|-------------|-------------|-------------|-------------|
| **Group**                        | **Plan 1**  | **Plan 2**  | **Plan 3**  | **Plan 4**  |
| Average                          | 0           | 0           | 0           | 0           |
| Federal District                 | -526        | -962        | -603        | -714        |
| High income states               | 5           | -156        | -113        | -141        |
| Medium income states             | 26          | 124         | 41          | 49          |
| Low income states                | 116         | 348         | 243         | 296         |
In short, Table 1-2 and Table 1-3 indicate some interesting insights as to the effects of different plans. Starting with Plan 1, which heavily favors those states with lower per capita state and local revenues and punishes those states with higher per capita own revenues, we move to Plan 2 which favors states with lower per capita income. With adoption of Plan 3 we can observe that even though income is still an important factor in determining the allocation of net subsidies across states, own tax effort is now taken into account so that for any given level of per capita income lower tax effort will translate into lower subsidies (or higher federal taxes). Note that even some of the poorest states like Durango, Hidalgo, Morelos, Nayarit, Oaxaca, Tlaxcala and Yucatan are all receiving relatively low subsidies as a consequence of low own tax rates. Finally, we can see how a higher measure of need (Table 1-7) translates into higher subsidies (or lower taxes) in Table 1-3 when moving from Plan 3 to Plan 4.

1.5 Framework for Contrasting Actual to Simulated Subsidies

My objective is to compare the observed flow of federal block grants to states relative to an ideal hypothetical flow of federal funds determined on the basis of principles of fiscal equalization. Each of the four different plans described in the third section of this essay is an hypothetical point of reference against which the actual flow of funds can be compared.

We have calculated four ideal simulated per capita subsidies, $s_i$, one for each state and each one computed for a specific definition of fiscal equalization. And we also have an observed flow of block grants, $G_i$, flowing from the federal government to each state. But can we directly compare per capita block grants, $g_i$, to $s_i$ in looking for discrepancies
between observed subsidies and our simulated ones? In answering this question several problems inherent to the direct comparison between \( g_i \) and \( s_i \) should be pointed out.

**Observed Grant is not a Net Subsidy.** State \( i \)'s per capita subsidy has been implicitly defined as a net (of federal taxes) subsidy (positive or negative) in the sense that if state \( i \)'s subsidy is greater than zero then state \( i \) is a net recipient of federal funds, but if state \( i \)'s subsidy is smaller than zero then state \( i \) is a net payer in the federal system. However, the observed per capita subsidy, \( g_i \), is not a net subsidy. Each state receives \( g_i \) from the federal government, but it also pays a set of federal taxes to the central government. Hence, the observed net per capita subsidy for state \( i \) can be written as

\[
s_i^* = g_i - \text{federal per capita taxes paid by state } i \quad \forall \ i = 1, 2, \ldots, n \tag{27}
\]

**Head Tax vs. Proportional Tax.** The specific form for equation (27) will differ depending on whether we assume the federal government is raising its revenues with a head tax or a proportional tax. Thus, in the case of a head tax, \( v_i \), the observed net per capita subsidy for state \( i \) can be written as

\[
s_i^* = g_i - v_i \quad \forall \ i = 1, 2, \ldots, n \tag{28}
\]

In the case of a proportional federal tax it may be written as

\[
s_i^* = g_i - t_f b_i \quad \forall \ i = 1, 2, \ldots, n \tag{29}
\]

where \( t_f \) is a constant federal income tax rate.
The Balanced Central Budget Problem. In obtaining our ideal subsidies, \( s_i \), a balanced central budget is assumed; thus, requiring condition 6 (or 16, 19, or 24) to be met. For each of the hypothetical alternative scenarios considered here it was assumed that the aggregate subsidy, \( \sum_{i=1}^{n} h_i s_i^* \), equals zero. But that is not necessarily true for observed net subsidies, \( s_i^* \). The point here is that if we are to compare \( s_i \) to \( s_i^* \) we can do so only if

\[
\sum_{i=1}^{n} h_i s_i^* = 0
\]  

(30)

The observed net per capita subsidy, \( s_i^* \), of the \( i \)th state corresponds to a balanced central budget situation. Since this is not the case it will be necessary to make some adjustments to our observed net per capita subsidies before we can proceed to compare \( s_i \) to \( s_i^* \).

1.5.1 The Adjusted Actual Net Subsidy (AANS)

Given the actual flow of gross per capita subsidies, \( g_i \), how can the observed net per capita subsidies, \( s_i^* \), be adjusted so that they reflect a balanced central budget situation? The answer will depend on how the central government finances this transfer of resources toward the states. In the interest of simplicity, it will be assumed the central government collects revenues by one of two ways: either by imposing a head tax by resident or by taxing per capita income tax base, \( b_i \), at a proportional rate, \( t_f \).
1.5.1.1 Head Tax Case

For the case in which the central government finances the subsidies to the states by means of a head tax that is constant across states, we can rewrite equation 28 as

\[ s_i^* = g_i - v \quad \forall \ i = 1, 2, \ldots, n \]  (31)

The adjusted actual net subsidy (AANS), \( s_i^a \), is defined as

\[ s_i^a = g_i - v^a \quad \forall \ i = 1, 2, \ldots, n \]  (32)

such that

\[ \sum_{i=1}^{n} h_i s_i^a = 0 \]  (33)

Hence, given \( g_i \), \( v^a \) may be read as the head tax which assures condition 32 is met. In other words, \( v^a \) is the head tax the central government imposes to just cover the gross subsidies paid to states.

Multiplying equation 32 by the number of inhabitants in the \( i \)th state, \( h_i \), and aggregating the result across states, we can solve for \( v^a \) to obtain

\[ v^a = \frac{\sum_{i=1}^{n} h_i g_i}{\sum_{i=1}^{n} h_i} \]  (34)

Now, if we rearrange equation 32 so that
\[ g_i = s_i^a + v^a \quad \forall \; i = 1, 2, ..., n \] (35)

we can interpret the gross per capita subsidy of the \( i \)th state, \( g_i \), as the sum of two components: a purely redistributive element represented by \( s_i^a \), and a neutral-in-redistribution fraction represented by \( v^a \). The term \( v^a \) is thought to be neutral in redistribution in the sense that if \( s_i^a = 0 \), then \( g_i = v^a \) and state \( i \) receives a gross per capita subsidy which exactly offsets the federal head tax imposed to residents of the state.

1.5.1.2 Proportional Tax Case

Alternatively, if the central government imposes a proportional income tax rate, \( t_f \), equation 29 is rewritten to define the adjusted actual net subsidy, \( s_i^a \), which for this case is equal to

\[ s_i^a = g_i - t_f^a b_i \quad \forall \; i = 1, 2, ..., n \] (36)

where \( t_f^a \) is the federal proportional tax rate which satisfies the condition for a balanced central budget (given by equation 33), and which value is given by

\[ t_f^a = \frac{\sum_{i=1}^{n} h_i g_i}{\sum_{i=1}^{n} h_i b_i} \] (37)

Similarly as before, we can rearrange equation 36 so that
\[ g_i = s_i^a + f_i^a b_i \quad \forall \quad i = 1, 2, \ldots, n \quad (38) \]

and, once again, the actual gross per capita subsidy, \( g_i \), may be interpreted as the sum of a purely redistributive element, \( s_i^a \), and a neutral-in-redistribution fraction now represented by \( f_i^a b_i \).

Given the transformations applied to the observed gross per capita subsidies, \( g_i \), it follows that the adjusted version of these subsidies, \( s_i^a \), is a net subsidy which is consistent with a balanced central budget situation. Moreover, \( s_i^a \) may be considered as a purely redistributive transfer of resources between states, which is the case for our ideal simulated per capita subsidies, \( s_i \), calculated in Section 1.4. Hence, the comparison should be between \( s_i \) and \( s_i^a \).

### 1.6 Comparison to Actual Federal Block Grants

We are now ready to analyze the differential between our ideal simulated subsidies calculated in Section 1.4 and the adjusted observed values. Before proceeding, it is useful to briefly describe the revenue sharing system.

#### 1.6.1 The National System of Fiscal Collaboration (NSFC)

Described as a revenue-sharing agreement between the three levels of government, under which the state and local governments assign the use of certain tax bases in favor of the central government, which in turn agrees to provide the state and local governments resources in the form of block grants.
As of 1994 the pool to distribute to state and municipalities was integrated by two different funds: the **Fondo General de Participaciones** (General Fund of Revenue Sharing or GFRS hereinafter) and the **Fondo de Fomento Municipal** (Fund for Municipal Development or FMD).

Although the source of funding for these two components comes from a given fixed percentage\(^{18}\) of what is known as "distributable federal revenue,"\(^{19}\) they differ from each other in the criteria for distributions to lower levels of government. Both are allocated by means of coefficients of distribution which differ between the two funds. The details of the distribution formulas are outside the scope of this study.

The General Fund is distributed to the states in the following way: (1) a first fraction (45.17%) of the available resources is distributed in direct proportion to the number of inhabitants in each state; (2) a second fraction (45.17%) is allocated on the basis of federal tax collections in each state;\(^{20}\) and finally, (3) a last portion (9.66%) of the resources is distributed in inverse proportion to the per capita grants received from the first two fractions of the General Fund.

Although government officials often justify the distribution formulas on the basis of operational feasibility, it is clear that the federal government places some weight on fiscal equalization. These considerations notwithstanding, the present paper focuses on whether the grant system effectively promotes fiscal equalization in any form, and not on the specific design of the grant system.

---

18. About 20% for the GFRS and 1% for the FMD.
19. Which basically includes all federal taxes and fees over oil and mining, excluding trade tariffs and certain fees over petroleum direct derivatives.
20. Not all federal taxes are taken into account for this matter. The taxes considered are a tax on tenancy of motor vehicles, the excise tax on new motor vehicles, and the excise taxes on beer, tobacco, alcoholic beverages, and petroleum products.
1.6.2 Differentials between Equalizing and Actual Per Capita Subsidies

As of 1994, federal transfers distributed to states and municipalities through the General Fund accounted for more than 84 percent of total revenue-sharing grants or participaciones assigned to them by the central government. This General Fund will be used in this study to represent observed gross subsidies; hence, the observed gross per capita subsidy received by the \( i \)th state, denoted by \( g_i \), represents the per capita amount of resources received by state \( i \) from the General Fund described above.

As noted, it is necessary to make some adjustments to the data for observed subsidies to account for how the subsidies are financed. A proportional income tax is considered as it seems much closer to Mexican reality relative to a head tax situation.

As gross per capita subsidies, \( g_i \), and the per capita tax base, \( b_i \), are known only, the federal proportional tax rate, \( t_f \), needs to be calculated in order to obtain net per capita subsidies, \( s_i^* \), from equation 29. The observed net per capita subsidies represents what is left of federal block grants for each state after deducting the taxes paid to the central government. In this sense the observed net per capita subsidies are kind of an after-tax per capita subsidy. But even after this adjustment, these net per capita subsidies would not correspond to a balanced central budget situation. If the federal government is retaining some of the federal tax revenue for its own use, then even if our observed net per capita subsidies, \( s_i^* \), are the ones which correspond to a perfectly equalizing (according to a given definition) allocation of grants in the real world, we can expect to observe non-zero
differentials between $s^*_i$ and our ideal equalizing per capita subsidies, $s_i$, calculated in Section 1.4.

This is the reason the original data described in Section 1.5 were adjusted. The adjusted per capita subsidies, $s^a_i$, which result from considering an adjusted federal proportional tax rate, $t^a_f$, equal to 3.3% in equation 36 in place of the unadjusted rate used in equation 29, are shown in the third column of Table 1-4.

The adjusted actual per capita subsidies, $s^a_i$, are net of taxes and are consistent with a balanced budget situation, so we can go on to calculate the observed differential between $s^a_i$ and our ideal equalizing per capita subsidies, $s_i$. We will calculate four differentials, $s_i - s^a_i$, one for each of our four plans described in Section 1.3. They are presented in Table 1-5 below.

The differential $s_i - s^a_i$ represents the additional per capita subsidy (tax) state $i$ must receive in order to attain fiscal equalization such as defined by the specific plan being considered. Thus, based on the results of Table 1-5, in order to attain fiscal equalization under Plan 2 the state of Chiapas should receive 182 pesos per inhabitant in additional grants. Similarly, under the same plan the state of Nuevo Leon should be taxed 210 additional pesos per inhabitant.

1.6.3 Ideal Simulated and Observed Patterns of Equalization Subsidies

Graphs are developed to examine the implications of this analysis. Figures 1-4 show a comparison between the ideal simulated per capita subsidies (white bars) and the actual
Table 1-4. Observed per capita subsidies in 1994. Figures in current pesos^a

<table>
<thead>
<tr>
<th>State</th>
<th>Per capita grants received from the General Fund of Revenue Sharing</th>
<th>Net subsidies adjusted for a balanced budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$g_i$</td>
<td>$s_i^a$</td>
</tr>
<tr>
<td>National average</td>
<td>390</td>
<td>0</td>
</tr>
<tr>
<td>Aguascalientes</td>
<td>449</td>
<td>65</td>
</tr>
<tr>
<td>Baja California</td>
<td>400</td>
<td>-122</td>
</tr>
<tr>
<td>Baja California Sur</td>
<td>603</td>
<td>5</td>
</tr>
<tr>
<td>Campeche</td>
<td>693</td>
<td>437</td>
</tr>
<tr>
<td>Coahuila</td>
<td>391</td>
<td>-7</td>
</tr>
<tr>
<td>Colima</td>
<td>532</td>
<td>194</td>
</tr>
<tr>
<td>Chiapas</td>
<td>404</td>
<td>177</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>375</td>
<td>-30</td>
</tr>
<tr>
<td>Federal District</td>
<td>578</td>
<td>-247</td>
</tr>
<tr>
<td>Durango</td>
<td>362</td>
<td>66</td>
</tr>
<tr>
<td>Guanajuato</td>
<td>314</td>
<td>-3</td>
</tr>
<tr>
<td>Guerrero</td>
<td>295</td>
<td>103</td>
</tr>
<tr>
<td>Hidalgo</td>
<td>310</td>
<td>114</td>
</tr>
<tr>
<td>Jalisco</td>
<td>357</td>
<td>-114</td>
</tr>
<tr>
<td>México</td>
<td>344</td>
<td>-107</td>
</tr>
<tr>
<td>Michoacán</td>
<td>280</td>
<td>16</td>
</tr>
<tr>
<td>Morelos</td>
<td>370</td>
<td>47</td>
</tr>
<tr>
<td>Nayarit</td>
<td>431</td>
<td>192</td>
</tr>
<tr>
<td>Nuevo León</td>
<td>453</td>
<td>-59</td>
</tr>
<tr>
<td>Oaxaca</td>
<td>277</td>
<td>40</td>
</tr>
<tr>
<td>Puebla</td>
<td>297</td>
<td>90</td>
</tr>
<tr>
<td>Querétaro</td>
<td>422</td>
<td>209</td>
</tr>
<tr>
<td>Quintana Roo</td>
<td>413</td>
<td>39</td>
</tr>
<tr>
<td>San Luis Potosí</td>
<td>312</td>
<td>61</td>
</tr>
<tr>
<td>Sinaloa</td>
<td>396</td>
<td>13</td>
</tr>
<tr>
<td>Sonora</td>
<td>461</td>
<td>0</td>
</tr>
<tr>
<td>Tabasco</td>
<td>901</td>
<td>695</td>
</tr>
<tr>
<td>Tamaulipas</td>
<td>375</td>
<td>-71</td>
</tr>
<tr>
<td>Tlaxcala</td>
<td>406</td>
<td>155</td>
</tr>
<tr>
<td>Veracruz</td>
<td>345</td>
<td>26</td>
</tr>
<tr>
<td>Yucatán</td>
<td>353</td>
<td>119</td>
</tr>
<tr>
<td>Zacatecas</td>
<td>352</td>
<td>53</td>
</tr>
</tbody>
</table>

^a. Own calculations based on data from Ministry of Finance (SHCP).

adjusted subsidies received by the states through the General Fund of Revenue Sharing (black bars). Each figure shows the corresponding comparison for each of the four
Table 1-5. Per capita subsidy correction required to attain fiscal equalization in 1994. Figures in current pesos a

<table>
<thead>
<tr>
<th>State</th>
<th>Equalization of per capita outlays</th>
<th>Equalization of fiscal capacity</th>
<th>Equalization of fiscal potentials</th>
<th>Equalization of fiscal potentials and need</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plan 1</td>
<td>Plan 2</td>
<td>Plan 3</td>
<td>Plan 4</td>
</tr>
<tr>
<td>National average</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aguascalientes</td>
<td>-283</td>
<td>-52</td>
<td>-90</td>
<td>-67</td>
</tr>
<tr>
<td>Baja California</td>
<td>144</td>
<td>-170</td>
<td>-40</td>
<td>-96</td>
</tr>
<tr>
<td>Baja California Sur</td>
<td>-529</td>
<td>-464</td>
<td>-407</td>
<td>-448</td>
</tr>
<tr>
<td>Campeche</td>
<td>-746</td>
<td>-141</td>
<td>-52</td>
<td>-39</td>
</tr>
<tr>
<td>Coahuila</td>
<td>-286</td>
<td>-12</td>
<td>-34</td>
<td>-47</td>
</tr>
<tr>
<td>Colima</td>
<td>-536</td>
<td>-79</td>
<td>-100</td>
<td>-107</td>
</tr>
<tr>
<td>Chiapas</td>
<td>-217</td>
<td>182</td>
<td>168</td>
<td>266</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>-258</td>
<td>-4</td>
<td>-37</td>
<td>-116</td>
</tr>
<tr>
<td>Distrito Federal</td>
<td>-278</td>
<td>-715</td>
<td>-355</td>
<td>-466</td>
</tr>
<tr>
<td>Durango</td>
<td>289</td>
<td>164</td>
<td>69</td>
<td>101</td>
</tr>
<tr>
<td>Guanajuato</td>
<td>58</td>
<td>164</td>
<td>69</td>
<td>101</td>
</tr>
<tr>
<td>Guerrero</td>
<td>-317</td>
<td>334</td>
<td>587</td>
<td>753</td>
</tr>
<tr>
<td>Hidalgo</td>
<td>279</td>
<td>314</td>
<td>-55</td>
<td>-44</td>
</tr>
<tr>
<td>Jalisco</td>
<td>309</td>
<td>-64</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>México</td>
<td>214</td>
<td>-29</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>Michoacán</td>
<td>-22</td>
<td>283</td>
<td>188</td>
<td>241</td>
</tr>
<tr>
<td>Morelos</td>
<td>241</td>
<td>100</td>
<td>-39</td>
<td>-45</td>
</tr>
<tr>
<td>Nayarit</td>
<td>162</td>
<td>140</td>
<td>-140</td>
<td>-135</td>
</tr>
<tr>
<td>Nuevo León</td>
<td>-121</td>
<td>-210</td>
<td>-144</td>
<td>-197</td>
</tr>
<tr>
<td>Oaxaca</td>
<td>402</td>
<td>296</td>
<td>-44</td>
<td>-41</td>
</tr>
<tr>
<td>Puebla</td>
<td>-22</td>
<td>314</td>
<td>246</td>
<td>308</td>
</tr>
<tr>
<td>Querétaro</td>
<td>-430</td>
<td>182</td>
<td>348</td>
<td>426</td>
</tr>
<tr>
<td>Quintana Roo</td>
<td>-85</td>
<td>-5</td>
<td>-52</td>
<td>-74</td>
</tr>
<tr>
<td>San Luis Potosí</td>
<td>-196</td>
<td>246</td>
<td>251</td>
<td>308</td>
</tr>
<tr>
<td>Sinaloa</td>
<td>235</td>
<td>2</td>
<td>-45</td>
<td>-45</td>
</tr>
<tr>
<td>Sonora</td>
<td>-211</td>
<td>-157</td>
<td>-148</td>
<td>-191</td>
</tr>
<tr>
<td>Tabasco</td>
<td>-708</td>
<td>-290</td>
<td>-284</td>
<td>-206</td>
</tr>
<tr>
<td>Tamaulipas</td>
<td>-258</td>
<td>-53</td>
<td>-71</td>
<td>-138</td>
</tr>
<tr>
<td>Tlaxcala</td>
<td>240</td>
<td>152</td>
<td>-137</td>
<td>-131</td>
</tr>
<tr>
<td>Veracruz</td>
<td>7</td>
<td>131</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Yucatán</td>
<td>246</td>
<td>224</td>
<td>-70</td>
<td>-78</td>
</tr>
<tr>
<td>Zacatecas</td>
<td>285</td>
<td>147</td>
<td>-41</td>
<td>-28</td>
</tr>
</tbody>
</table>

a. Own calculations based on data from National Institute of Statistics, Geography and Informatics (INEGI).
different equalization plans considered here. To facilitate comparisons states have been ordered according to their level of per capita income.

The set of dark bars in Figures 1-4 is a representation of the allocation pattern of actual adjusted per capita subsidies in 1994, shown in Table 1-5. This set of bars shows the actual distribution of the General Fund of Revenue-Sharing across states (after adjusting the actual flow of transfers as explained in Section 1.5). The white set of bars in these figures represent possible alternative patterns for allocating transfers, one pattern for each one of the four alternative equalization models included here.

As is apparent from Figure 1, which corresponds to the expenditure equalizing Plan 1, the actual pattern and the ideal simulated pattern of subsidies are very dissimilar from each other. For a program of equalization of per capita spending the simulated allocation of subsidies does not seem to be systematically connected to per capita income. Whereas the actual allocation of net subsidies given by the dark set of bars are more closely related to per capita income. In other words, the central government seems to be effectively taxing the higher income states in order to finance subsidies for the lower income states.²¹

---

²¹Actually the pattern of observed subsidies seems to be related to income not only in terms of the direction of the subsidy, but also in terms of the magnitude since apparently the lower its income the higher the net subsidy per resident a state is able to obtain.
The results of Plan 2, the more realistic and interesting case in which the central government equalizes fiscal capacity, are shown in Figure 2 which displays again the actual pattern of subsidies, but now compared to the simulated pattern of subsidies that would arise if the central government implemented Plan 2, the equalization of fiscal capacity.
The pattern of ideal subsidies implied by Plan 2 is more closely related to the actual pattern of net subsidies. Nevertheless, from Figure 2 it is evident that the main difference between actual subsidies and ideal subsidies from Plan 2 is found in the magnitude of these subsidies.
The pattern followed by the actual net subsidies is also similar to the ideal subsidies resulting from Plan 3 and Plan 4, which account for own fiscal effort and an index of need. Figures 3 and 4 suggest that the difference in magnitude between ideal and actual subsidies is smaller when own fiscal effort and need are introduced to the design of ideal subsidies.
Since it is difficult to formulate clear conclusions on the basis of visual analysis of the results, it is useful to develop a more precise measure of the correspondence between ideal and observed subsidies.

1.6.4 Correlation Analysis

A simple correlation analysis can be used in order to evaluate how close the allocation of actual per capita subsidies comes to emulate each of the four alternative simulated
allocations. This will be done by calculating the simple linear correlation coefficients between the ideal net subsidies proposed under each equalization plan and the actual net subsidies. The higher the correlation coefficient between the distribution of actual subsidies and the distribution of ideal subsidies from a particular equalization scheme or plan, the closer the allocation of actual subsidies is to the allocation of subsidies proposed by that particular plan. The calculation of simple correlation coefficients has been widely used in the literature of fiscal equalization, especially in the context of education finance.\textsuperscript{22}

In addition to calculating correlation coefficients between actual and ideal subsidies to study how close they are, I calculate the correlation coefficients between per capita subsidies and per capita income and state and local own revenues. This will allow us to investigate whether or not a linear relationship exists between the allocation of per capita (actual and ideal) subsidies and the level of per capita income in the states, as well as the level of state and local tax revenue collections. We will be able to empirically identify whether or not the allocation of actual net subsidies and the simulated allocations of ideal subsidies are fiscally neutral with respect to per capita income and state and local own revenues.

\begin{table}
\centering
\caption{Correlation coefficients of per capita net subsidies in 1994}
\begin{tabular}{l|cccc|c}
\hline
Correlation to variable & Ideal simulated subsidies & & & & Actual subsidies \\
 & Plan 1 & Plan 2 & Plan 3 & Plan 4 & \\
\hline
Per capita income & -0.61 & -1.00 & -0.91 & -0.90 & -0.77 \\
Per capita state and local own revenues & -1.00 & -0.61 & -0.35 & -0.35 & -0.31 \\
Per capita actual subsidies & 0.31 & 0.77 & 0.76 & 0.75 & 1.00 \\
\hline
\end{tabular}
\end{table}

\textsuperscript{22}For instance, Odden and Picus (1992) use correlation analysis to evaluate fiscal neutrality in alternative plans for financing of schools. Berne and Stiefel (1984) discuss the use of additional statistics in assessing fiscal neutrality.
Table 1-6 displays the estimated correlation coefficients. In calculating these coefficients I have weighed each state value by the number of residents in the state. Thus, the values for a highly populated state like the Federal District contribute more to the measure of the correlation coefficient than the values for Baja California Sur, a state with a lower population.

From the last row in the table we observe that the distribution of per capita actual net subsidies across states is much closer to the simulated distribution of subsidies resulting from the application of equalization plans 2, 3, and 4, than to the pattern of subsidies arising from Plan 1. This result confirms what was found in the previous subsection.

Moreover, with positive correlation coefficients ranging between values of 0.75 and 0.77 when comparing actual subsidies to ideal subsidies from plan 2, 3, and 4, the similarity between the patterns of actual and ideal subsidies in these cases are quite substantial. A positive correlation coefficient equal to unity (the highest possible value) would imply that the distributions (though not necessarily the absolute amounts) of actual and simulated per capita subsidies across states are the same.

In contrast, the allocation of actual subsidies is far from resembling the allocation of subsidies resulting from applying Plan 1. In this case the correlation coefficient between actual and simulated subsidies presented a value of 0.31.

As expected from the construction of our equalization models in Section 1.2, ideal per capita subsidies from plans 2, 3, and 4 are highly and negatively correlated with per capita income, with complete coefficients ranging between -0.90 and -1.00. This last extreme case corresponding to Plan 2, which implies equalization of per capita tax base across states.
At the other extreme, simulated per capita subsidies from Plan 1 are perfectly and negatively correlated to per capita state and local own revenues, reflecting this plan's objective of equalizing per capita outlays across states.

Actual per capita net subsidies are negatively correlated with per capita income with a coefficient of -0.77. Thus, in general, the higher the per capita income in a state, the lower the net per capita subsidy the state receives from the central government. Meanwhile, with a correlation coefficient of -0.31, per capita state and local revenues do not seem to be an important determinant in the way actual transfers are allocated to states.

1.7 Conclusions and Policy Implications

The actual allocation of net transfers to the states through the General Fund of Revenue-Sharing does not correspond to a hypothetical grant scheme which equalizes per capita outlays. The actual allocation of net transfers through this fund more closely resembles the distribution of transfers which would result from implementation of either the equalization of fiscal capacity or the equalization of fiscal potentials. Thus, the actual allocation of net subsidies resulted to be a lot more equalizing when per capita income, own tax effort, and need are accounted for in the determination of fiscal equalization.

The allocation of actual net per capita subsidies is negatively correlated to the level of per capita income. Hence, to some extent, it appears that the central government is effectively taxing higher income states in order to finance fiscal transfers made to lower income states.

We have identified the potential losers and beneficiaries of a move toward a literal implementation of any of the studied equalization plans. For instance, the Federal District, as well as the two oil-states, Campeche and Tabasco, would receive considerably lower
net subsidies than they currently do, regardless of which of the equalization plans is chosen by the central government.

There exist wide room for improving the present study. Ideally, the tax base of each state should be approximated by estimations of personal income or wages by state. The construction of our index of need could be significantly improved to incorporate essential services like public safety and transit, as well as pollution control. In addition, it would be interesting to expand the analysis to incorporate other important sources of federal funding for the states, particularly federal financing of education and federal physical investment in the states.
Appendix A: Description of Variables

A.1 Input Data

$A_i$: State and local own expenditures. Equals the sum of state own expenditures and local own expenditures for all municipalities located in the state.

State own expenditures. It is obtained by removing federal grants passed to municipalities, outlays from third party accounts, debt payments and remaining cash from total state expenditure.

Local own expenditure. It is obtained by removing outlays from third party accounts, debt payments, and remaining cash from total municipal expenditure.

$R_i$: State and local own revenues. Equals the sum of state own revenues and local own revenues for all municipalities in the state.

State own revenues. It is obtained by removing federal transfers received, receipts in third party accounts, income by indebtedment, and remaining cash carried out from the previous year from total state revenues.

Local own revenues. It is obtained by removing federal and state transfers received, receipts in third party accounts, income by indebtedment, and remaining cash carried out from the previous year from total municipal revenues.

$B_i$: State tax base. State $i$’s share of total (monetary and non-monetary) household income (obtained from ENIGH) is multiplied by the national disposable income (obtained from INEGI) of the household sector in order to calculate disposable income of the $i$th state.
\( h_i \): **Population.** Number of inhabitants according to estimation by *Consejo Nacional de Población* (CONAPO) for 1994.

\( m \): **Subsistence level of performance.** It is a target level of performance as set by the central government. For this paper it has been assumed \( m = \tilde{r} + \tilde{g} \).

\( t_i \): **State own tax rate.** Equals the ratio of state and local own revenues, \( A_i \), to the state tax base, \( B_i \).

\( x_i \): **Index of need.** It is the standardized (according to equation 23 in Section 1.2) version of an index accounting for population between 6 and 14 years old in every state.

\( g_i \): **Observed per capita block grants.** It is the per capita amount of resources received by the \( i \)th state through the General Fund of Revenue Sharing.

\( t_f \): **Federal proportional tax rate.** Equals the ratio of the sum of federal government’s revenue from income taxation, value added tax, and an excise tax on several goods and services, to the national tax base.

**A.2 Derived Variables**

\( S_i \): Total subsidies received by the \( i \)th state.

\( a_i \): Per capita outlays of state \( i \) or \( A_i / h_i \).

\( r_i \): Per capita revenues of state \( i \) or \( R_i / h_i \).

\( s_i \): Per capita subsidies received by the \( i \)th state or \( S_i / h_i \).

\( a \): Target per capita outlays for any state.

\( p_i \): Performance level of the \( i \)th state or \( a_i / x_i \).
\[ \bar{x} : \text{Population-weighted average index of need or } \frac{1}{n} \sum_{i=1}^{n} h_i x_i \text{ Equals unity by definition.} \]

\[ \bar{b}_i : \text{Per capita tax base of the } i \text{th state or } B_i / h_i. \]

\[ \frac{1}{n} \sum_{i=1}^{n} h_i b_i \]

\[ \bar{b}_i : \text{Population-weighted average tax base or } \frac{1}{n} \sum_{i=1}^{n} h_i b_i. \]

\[ t_c : \text{Central proportional tax rate.} \]

\[ v_i : \text{Federal head tax rate enforced in state } i. \]

\[ s_i^* : \text{Observed net (of taxes) per capita subsidies received by the } i \text{th state.} \]

\[ v : \text{Constant-across-states federal head tax rate.} \]

\[ v^a : \text{Constant-across-states adjusted federal head tax rate. It is the rate which assures a balanced central budget.} \]

\[ t_f^a : \text{Adjusted federal proportional tax rate. It is the rate which assures a balanced central budget.} \]

\[ s_i^q : \text{Adjusted actual net (of taxes) per capita subsidy (AANPS) received by the } i \text{th state and equal to either } g_i - v^a, \text{ in the case of a federal head tax, or } g_i - t_f b_i, \text{ in the case of a proportional tax rate.} \]
## Appendix B: Data Tables

### Table 1-7. Population and index of need, 1994.

<table>
<thead>
<tr>
<th>State</th>
<th>Index of need $x_i$</th>
<th>Population (Number of inhabitants) $h_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>National average</td>
<td>1.00</td>
<td>87,286,143</td>
</tr>
<tr>
<td>Aguascalientes</td>
<td>0.74</td>
<td>823,626</td>
</tr>
<tr>
<td>Baja California</td>
<td>0.84</td>
<td>1,969,978</td>
</tr>
<tr>
<td>Baja California Sur</td>
<td>0.93</td>
<td>352,842</td>
</tr>
<tr>
<td>Campeche</td>
<td>1.08</td>
<td>612,694</td>
</tr>
<tr>
<td>Coahuila</td>
<td>0.83</td>
<td>2,120,047</td>
</tr>
<tr>
<td>Colima</td>
<td>0.82</td>
<td>472,583</td>
</tr>
<tr>
<td>Chiapas</td>
<td>1.46</td>
<td>3,338,614</td>
</tr>
<tr>
<td>Chihuahua</td>
<td>0.86</td>
<td>2,691,838</td>
</tr>
<tr>
<td>Distrito Federal</td>
<td>0.69</td>
<td>8,457,296</td>
</tr>
<tr>
<td>Durango</td>
<td>0.98</td>
<td>1,409,442</td>
</tr>
<tr>
<td>Guanajuato</td>
<td>0.92</td>
<td>4,234,445</td>
</tr>
<tr>
<td>Guerrero</td>
<td>1.41</td>
<td>2,791,371</td>
</tr>
<tr>
<td>Hidalgo</td>
<td>1.26</td>
<td>2,042,729</td>
</tr>
<tr>
<td>Jalisco</td>
<td>0.78</td>
<td>5,747,996</td>
</tr>
<tr>
<td>México</td>
<td>0.87</td>
<td>11,201,842</td>
</tr>
<tr>
<td>Michoacán</td>
<td>0.97</td>
<td>3,751,004</td>
</tr>
<tr>
<td>Morelos</td>
<td>1.00</td>
<td>1,371,856</td>
</tr>
<tr>
<td>Nayarit</td>
<td>1.11</td>
<td>877,076</td>
</tr>
<tr>
<td>Nuevo León</td>
<td>0.74</td>
<td>3,415,531</td>
</tr>
<tr>
<td>Oaxaca</td>
<td>1.84</td>
<td>3,056,641</td>
</tr>
<tr>
<td>Puebla</td>
<td>1.10</td>
<td>4,388,148</td>
</tr>
<tr>
<td>Querétaro</td>
<td>0.94</td>
<td>1,191,136</td>
</tr>
<tr>
<td>Quintana Roo</td>
<td>1.51</td>
<td>638,045</td>
</tr>
<tr>
<td>San Luis Potosí</td>
<td>1.07</td>
<td>2,129,107</td>
</tr>
<tr>
<td>Sinaloa</td>
<td>0.99</td>
<td>1,994,281</td>
</tr>
<tr>
<td>Sonora</td>
<td>0.87</td>
<td>2,011,262</td>
</tr>
<tr>
<td>Tabasco</td>
<td>1.12</td>
<td>1,673,111</td>
</tr>
<tr>
<td>Tamaulipas</td>
<td>0.95</td>
<td>2,449,373</td>
</tr>
<tr>
<td>Tlaxcala</td>
<td>0.96</td>
<td>849,975</td>
</tr>
<tr>
<td>Veracruz</td>
<td>1.25</td>
<td>6,413,593</td>
</tr>
<tr>
<td>Yucatán</td>
<td>1.01</td>
<td>1,503,986</td>
</tr>
<tr>
<td>Zacatecas</td>
<td>1.01</td>
<td>1,304,680</td>
</tr>
</tbody>
</table>
Redistribution and Welfare Dominance: An Analysis of Subsidies for Education in Mexico

When planning a tax/subsidy reform, a government considers the expected change of the excess burden of the tax system, the expected net effect on governmental revenues, and the expected effect on the distribution of household income (and, of course, the ultimate effect of the policy change on social welfare if the government is a social welfare maximizer). These different effects are usually interrelated, and it is not unusual to observe a tax/subsidy reform which significantly affects efficiency and/or government's revenues, even though its primary aim is to modify income distribution. Or conversely, secondary effects over the distribution of income may be affected by tax/subsidy policies designed to increase public revenues and/or overall efficiency.

The study of the redistributive effects of fiscal policy is not limited to cases in which the policy-maker's objective explicitly targets income distribution. Intended or unintended redistributive effects of public policy may be seen in almost every tax/subsidy reform, and concerns about those redistributive effects may be decisive when a reform is publicly debated. Thus, a policy maker should always be aware of any intended or unintended effects that a tax/subsidy reform may have on income distribution. This essay uses currently available data to evaluate the potential redistributive effects of alternative fiscal policies related to the financing of public education.
Explicitly and implicitly, public spending on education has been viewed in Mexico as an instrument for influencing income distribution.\(^1\) In 1999, federal government's spending\(^2\) on education was 26% of total federal outlays.\(^3\) Thus, given this relatively high level of federal spending on education, the room for significant increases in public education spending is limited. Hence, public policy regarding education financing has been aimed toward improving the allocation of public funds already available.

In recent years, increased interest in studying the allocation of public expenditures in Mexico has stimulated a discussion on two aspects of the financing of education. First, the general issue of fiscal decentralization and the allocation of federal direct expenditures and federal grants designated for education across states is an important contemporary policy issue. Second, the distribution of educational public spending across different levels of education has become an issue on both efficiency and equity grounds. This chapter will deal with the latter issue.

In 1996, about 72% of federal and state spending on public schools was allocated to basic education,\(^4\) and the shares of total expenditure allocated to upper secondary education and higher education were 13% and 15% respectively.\(^5\) Nevertheless, when considering the number of students enrolled at each level, public spending per student in upper secondary school is considerably higher than the corresponding figure for basic

---

1. The Gini coefficient calculated from the distribution of income among households was 0.46 in 1996, according to the Survey of Income and Expenditure of Households (ENIGH) published by the Instituto Nacional de Estadística, Geografía e Informática (INEGI).
2. As it will be explained later in section 2, most of public expenditure for education is financed by federal funds, either through federal direct spending or through targeted federal grants allocated to the state governments.
3. When total federal expenditure is defined as total programmable or budgeted expenditure.
4. Basic education includes preschool, elementary, and lower secondary.
5. These figures do not consider public spending in graduate schools or work training.
education, while public spending per student in higher education is almost four times per student spending on basic education.

The allocation of public expenditure for education across levels is relevant for the study of inequality since the question of who benefits from this public expenditure will depend on who has effective access, as opposed to statutory access, to each level of education. Effective access to educational services may vary across different levels of household income because of the monetary and non-monetary costs associated with the use of educational services. A member of a low-income family will demand less educational services than a member of a high-income family because of differences in income and the opportunity cost of not being in the job market. Thus, a student from a low-income household will dropout of school at an earlier stage than a student member of a high-income household. 6

The present study will analyze the incidence of educational subsidies by looking at variations of per student educational subsidies across households grouped by level of income. Educational services will be classified into three categories: basic education, upper secondary education, and higher education.

The evaluation of the progressivity or regressivity of educational subsidies will require the assessment of the effect that changes in the allocation of educational subsidies across school levels will have on overall measures of income inequality and ultimately over social welfare. To this end, I will use the approach of decomposing inequality by factor components. Yitzhaki and Slemrod (1991) have illustrated the use of this approach in a

---

6. Székely (1998), using data for 1984, 1989 and 1992, calculates that a typical household head from the lowest income decile has 2.09 years of education, while a household head from the highest income decile averages 10.13 years of education.
commodity taxation application. More specifically, they obtain unambiguous welfare implications from marginal, revenue-neutral variations in tax-subsidy combinations for different pairs of commodities. I will build on this literature to predict the marginal welfare improvements from revenue-neutral changes in the allocation of subsidies across school levels. Moreover, potential welfare improvements from marginal shifts in subsidies from educational services toward school transportation and vouchers for school supplies are also explored.

This work will rely mainly on two sources of data. First, the Household Income and Expenditure Survey (INEGI, 1996), a survey for 14,042 households, will be used in order to classify households by income level and to identify the number of users of educational services at each school level by income group. This source will also allow us to calculate households' private spending for each level of education, an essential input for our welfare analysis. Second, data on public expenditure on education is obtained from the General Directorate of Planning, Programming and Budget (DGPPP) of the Secretariat Of Public Education (SEP).

2.1 The Incidence of Educational Subsidies

To motivate the present study I shall first present some basic facts on educational public expenditures in Mexico. This section deals with the general questions of who benefits the most from public spending on education, and what income groups receive the subsidies that the federal government devotes to public education for different educational levels.

Despite universal statutory access to public education,\(^7\) household's decisions about sending children to school are affected by the monetary and non-monetary costs
associated with schooling. Even though families do not have to pay for tuition or textbooks\textsuperscript{8} fees for children attending public schools, they still have to face other monetary costs like school supplies and home-school transportation. In addition, financial consideration in lower income households often induces school-age members from lower income households to drop out of school early so as to become a supplementary source of income for their families. Furthermore, in a country with over ten million indigenous people, ethnic minorities frequently face additional restrictions whenever native-tongue/Spanish bilingual education is not available.

Thus, the answer to the question of which income groups are receiving gross subsidies to public education will ultimately depend on which groups are actually or effectively sending their children to public schools.\textsuperscript{9} The Household Income and Expenditure Survey (ENIGH, 1996) provides information about which household members are currently attending school, whether these members are attending public or private schools, and the level of educational achievement of each household member. From these data it is possible to obtain a relationship between effective access to the public education system and the level of income attached to households by the same survey (Table 2-1). A method commonly used to analyze the incidence of public expenditures on household income is to

\textsuperscript{7} Basic and upper secondary public education is free of charge for all residents, while higher public education typically involves no charges other than usually-low registration fees which may be waived for low income students. Moreover, elementary education has been mandatory for decades, while lower secondary education became compulsory since 1993, yet the effect of this is unclear because of the absence of enforcement instruments.

\textsuperscript{8} Textbooks are provided free of charge for elementary and lower secondary education by the federal government.

\textsuperscript{9} Polacheck and Siebert (1993) call this class of subsidies "in kind" subsidies in the sense that instead of giving money to households, the government subsidizes schools. Households may either send their children to school or they do not, in which case they do not receive any subsidy.
Table 2-1. Percentage share of students attending public schools by educational level and income group

<table>
<thead>
<tr>
<th>Decile by Level</th>
<th>Basic Education</th>
<th>Upper Secondary</th>
<th>Higher Education</th>
<th>All Educational Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>of Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>8.1</td>
<td>1.6</td>
<td>0.2</td>
<td>7.0</td>
</tr>
<tr>
<td>II</td>
<td>10.9</td>
<td>3.3</td>
<td>1.0</td>
<td>9.5</td>
</tr>
<tr>
<td>III</td>
<td>11.2</td>
<td>5.8</td>
<td>1.9</td>
<td>10.1</td>
</tr>
<tr>
<td>IV</td>
<td>12.6</td>
<td>7.6</td>
<td>2.1</td>
<td>11.5</td>
</tr>
<tr>
<td>V</td>
<td>11.4</td>
<td>10.4</td>
<td>6.7</td>
<td>11.0</td>
</tr>
<tr>
<td>VI</td>
<td>11.0</td>
<td>12.4</td>
<td>6.4</td>
<td>10.9</td>
</tr>
<tr>
<td>VII</td>
<td>11.0</td>
<td>13.4</td>
<td>12.4</td>
<td>11.3</td>
</tr>
<tr>
<td>VIII</td>
<td>9.8</td>
<td>16.0</td>
<td>19.5</td>
<td>11.0</td>
</tr>
<tr>
<td>IX</td>
<td>8.4</td>
<td>14.9</td>
<td>22.0</td>
<td>9.9</td>
</tr>
<tr>
<td>X</td>
<td>5.6</td>
<td>14.6</td>
<td>27.8</td>
<td>7.7</td>
</tr>
<tr>
<td>All Income</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Source: Own calculations from the Household Income and Expenditure Survey (ENIGH), INEGI 1996.

approximate the subsidy received by each income group by calculating per-pupil expenditures at each educational level. 10

Table 2-2 and Figure 2-1 show some well defined relationships between educational subsidies and household incomes. For basic education it is observed that the relationship resembles an inverted u-shaped curve, implying that the income groups located around the middle of the distribution are appropriating the largest shares of federal subsidies to basic education, while the poorest and richest households are receiving the smallest fractions of the subsidies. For example, the fourth income deciles received a basic educational subsidy that is about 1.6 times the size of the subsidy received by the lowest income decile. Interestingly, beyond the middle portions of the income distribution the subsidy received

---

10. Székely (1998) uses this method to study the incidence of educational public expenditures without distinguishing between levels of income. He finds that individuals who reached only preschool and elementary education, had access to 8.3% of educational subsidies, while individuals reaching university had access to 34.6% of the subsidies. Selden and Wasylenko (1995) includes an application for the incidence of educational expenditures in Peru.
declines for higher income households. The subsidy received by the richest income group is slightly more than half of the subsidy obtained by the poorest group.

Private monetary and non-monetary costs of school enrollment which effectively restrict access to the public education system, partially explain the negative relationship between the size of appropriated subsidy and household income observed in the first half of the income distribution. Also, a lower pattern of subsidies at higher income levels is observed as higher income households can afford to send their children to private schools.

Table 2-2. Public expenditures in educationa by educational level and income group in 1996. b Millions of current pesos.

<table>
<thead>
<tr>
<th>Decile by Level of Income</th>
<th>Basic Education</th>
<th>Upper Secondary</th>
<th>Higher Education</th>
<th>All Educational Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4,606.0</td>
<td>170.3</td>
<td>37.1</td>
<td>4,813.4</td>
</tr>
<tr>
<td>II</td>
<td>6,166.9</td>
<td>340.5</td>
<td>166.7</td>
<td>6,674.1</td>
</tr>
<tr>
<td>III</td>
<td>6,342.9</td>
<td>609.6</td>
<td>333.5</td>
<td>7,286.0</td>
</tr>
<tr>
<td>IV</td>
<td>7,150.1</td>
<td>790.8</td>
<td>370.5</td>
<td>8,311.5</td>
</tr>
<tr>
<td>V</td>
<td>6,442.3</td>
<td>1,081.9</td>
<td>1,167.2</td>
<td>8,691.5</td>
</tr>
<tr>
<td>VI</td>
<td>6,224.3</td>
<td>1,296.1</td>
<td>1,111.6</td>
<td>8,632.0</td>
</tr>
<tr>
<td>VII</td>
<td>6,243.4</td>
<td>1,395.0</td>
<td>2,167.6</td>
<td>9,806.0</td>
</tr>
<tr>
<td>VIII</td>
<td>5,554.8</td>
<td>1,675.1</td>
<td>3,390.4</td>
<td>10,620.2</td>
</tr>
<tr>
<td>IX</td>
<td>4,785.9</td>
<td>1,559.7</td>
<td>3,835.0</td>
<td>10,180.6</td>
</tr>
<tr>
<td>X</td>
<td>3,163.8</td>
<td>1,521.3</td>
<td>4,835.5</td>
<td>9,520.5</td>
</tr>
</tbody>
</table>

| All Income Groups         | 56,680.4       | 10,440.3       | 17,415.1        | 84,535.8             |

a. Public expenditures figures here are defined as federal public spending in education inclusive of labeled transfers to states and municipalities. State and local own expenditures in education are not included.


The relationship between incomes and educational subsidies has a different pattern for both upper secondary and higher education for which a positive relationship between subsidies received and household income is observed. Nevertheless, at the upper secondary level of education the subsidies received seem to increase at a generally decreasing rate as income rises, while higher education subsidies increase exponentially
with higher incomes. The subsidy for upper secondary education received by the highest income decile is twelve times the size of the subsidy captured by the poorest income group. The subsidy received for higher education by the top income decile is 139 times the subsidy received by the lowest decile.

The data may reflect the fact that private monetary and non-monetary costs of education increase at higher educational levels. For example, for a college student the opportunity cost of not being in the labor market will be substantially higher than that of a student in elementary school. In addition, increased monetary costs include larger housing costs (upper secondary and higher education schools are frequently non-existent in smaller communities), more expensive textbooks, and higher home-school transportation costs.

The response of low income households to higher private costs of education typically involves a decision between either keeping their children in school or dropping out. In contrast, high income families typically substitute public education for private education. Hence, higher private costs of education translate into a strongly positive relationship between subsidies received and household income as can be observed as we move upward in the educational ladder.
Figure 2-1. Subsidy received when attending public schools. Ratio with respect to lowest income decile.\(^a\)

The propensity of high income households to send their children to private schools is confirmed by Table 2-3 which displays the proportion of total students attending school who are enrolled into private schools. Except for some irregularities at lower middle deciles, higher income groups are more inclined to send their children to private schools than lower income households.

Table 2-3. Propensity to enroll children into private schools by educational level and income group in 1996.\(^a\)

Percentages.\(^b\)

<table>
<thead>
<tr>
<th>Decile by Level of Income</th>
<th>Basic Education</th>
<th>Upper Secondary</th>
<th>Higher Education</th>
<th>All Educational Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.1</td>
<td>0.0</td>
<td>33.3</td>
<td>0.2</td>
</tr>
<tr>
<td>II</td>
<td>0.5</td>
<td>8.8</td>
<td>18.2</td>
<td>0.9</td>
</tr>
<tr>
<td>III</td>
<td>0.4</td>
<td>5.9</td>
<td>10.0</td>
<td>0.9</td>
</tr>
<tr>
<td>IV</td>
<td>0.4</td>
<td>10.6</td>
<td>13.0</td>
<td>1.3</td>
</tr>
<tr>
<td>V</td>
<td>1.0</td>
<td>10.9</td>
<td>6.0</td>
<td>2.3</td>
</tr>
<tr>
<td>VI</td>
<td>1.5</td>
<td>10.6</td>
<td>6.3</td>
<td>2.9</td>
</tr>
<tr>
<td>VII</td>
<td>2.2</td>
<td>18.1</td>
<td>10.7</td>
<td>5.0</td>
</tr>
<tr>
<td>VIII</td>
<td>3.6</td>
<td>17.1</td>
<td>14.9</td>
<td>7.1</td>
</tr>
<tr>
<td>IX</td>
<td>9.7</td>
<td>20.9</td>
<td>27.4</td>
<td>14.1</td>
</tr>
<tr>
<td>X</td>
<td>30.4</td>
<td>36.3</td>
<td>37.3</td>
<td>33.1</td>
</tr>
<tr>
<td>All Income Groups</td>
<td>4.2</td>
<td>18.6</td>
<td>23.9</td>
<td>7.2</td>
</tr>
</tbody>
</table>

\(^a\) This propensity is defined as the proportion of total students enrolled in private schools.

\(^b\) Source: Own calculations from the Household Income and Expenditure Survey (ENIGH), INEGI 1996.

As the children of middle and higher income families are more likely to continue in school through the upper secondary and higher levels of education, and public expenditures per student increases with the level of education, it is not surprising that these households are effectively capturing higher shares of public subsidies for education.

2.1.1 Educational Subsidies and Income Redistribution

The government employs educational spending as a redistributive tool since education is generally believed to increase lifetime income for the individual acquiring it, either
through an increase in her human capital and/or because of the value of education as a signal of an individual’s qualifications.

Schultz (1988), who abstracts from distributive considerations, approaches the issue of allocating educational subsidies across levels of schooling by looking at education as an investment, and points out that even though the rate of return to schooling is larger for higher levels of education, the social rate of return to schooling is higher at lower educational levels.\textsuperscript{11} The socially optimal allocation of educational resources should equalize the social rate of return across levels of schooling.

The fact pupils from higher income households receive higher public subsidies for education because they effectively attend school longer than students from lower income groups does not necessarily imply that the federal government should decrease subsidies for higher levels of education.

As discussed above, the private monetary and non-monetary costs of education impose a restriction on effective access to education. Hence “in kind” educational subsidies will tend to benefit higher income households as pupils from these households will have the money to enter the educational system and they will be able to stay in school longer to capture the larger subsidies provided at higher levels of schooling. Consequently, we should expect any redistributive policy to direct subsidies not only to the actual provision of education, but it should also include subsidies intended to facilitate effective access to the educational system.

\textsuperscript{11} Another way to say this is that at higher levels of schooling individuals are able to capture or internalize most of the benefits of education, thus limiting positive social externalities.
2.2 Decomposing Inequality

An extensive literature on the decomposition of inequality measures has argued in favor of breaking down a given inequality index into several components so that total inequality may be explained by the sum of each component's contribution to the aggregate index. This literature may be divided into two separate branches. One consists of decomposing inequality by population subgroups in order to evaluate the influence of predetermined characteristics (geographical location, level of urbanization, sector of activity, etc.) on the measure of total inequality. The second branch decomposes income by factor components in order to assess the influence of each income source over the allocation of income. This paper focuses on applying the second approach because it will allow us to carry out a welfare analysis which is the main objective of this essay.

2.2.1 Decomposing the Gini Coefficient

In order to determine the marginal impact of various income sources on overall income inequality Lerman and Yitzhaki (1985) showed that each source's contribution to the Gini coefficient may be viewed as the product of the source's own Gini, its share of total income, and its correlation with the rank of total income. The same approach is applicable to a study of expenditure inequality. They define the conventional Gini coefficient as

\[ G = \frac{2\text{cov}[x,F(x)]}{m} \]  

(39)

where \( x \) represent expenditure, \( m \) is the mean expenditure, and \( F \) represent the cumulative distribution of expenditures and is uniformly distributed between \([0, 1]\).
Let $x_1, \ldots, x_k$ be components of household expenditure such that $x = \sum_{k=1}^{K} x_k$, then from equation (39) we obtain the relative Gini

$$G = \frac{\sum_{k=1}^{K} \text{cov}(x_k, F)}{m}$$ (40)

where $\text{cov}(x_k, F)$ represents the covariance of expenditure component $k$ with the cumulative distribution of expenditure. Multiplying and dividing equation (40) by $\text{cov}(x_k, F_k)$ and by $m_k$ we obtain the decomposition by source of the Gini coefficient

$$G = \sum_{k=1}^{K} \left[ \frac{\text{cov}(x_k, F)}{\text{cov}(x_k, F_k)} \right] \left[ \frac{2\text{cov}(x_k, F_k)}{m_k} \right] \left[ \frac{m_k}{m} \right]$$ (41)

or equivalently

$$G = \sum_{k=1}^{K} R_k G_k S_k$$ (42)

where $R_k$ represents the "Gini correlation"\(^{12}\) between expenditure component $k$ and total expenditure, $G_k$ is the relative Gini coefficient of expenditure component $k$, and $S_k$ represents component’s $k$ share of total expenditure.

As Lerman and Yitzhaki (1985) explain, one of the advantages of this approach is that it allows for the analysis of the effects that marginal changes in particular taxes or

---

12. This is the term used by Lerman and Yitzhaki (1985). See this reference for a description of the properties of Gini correlation.
subsidies would have on the distribution of income, and it does so without the ambiguities resulting from the application of the common approach of comparing inequality with and without the income or expenditure category under consideration.\textsuperscript{13}

In order to demonstrate this, Lerman and Yitzhaki (1985) use equation (42) to derive the partial derivative of the aggregate Gini with respect to a small percentage change, $e_k$, in expenditure category $k$. Namely,

$$\frac{\partial G}{\partial e_k} = S_k(R_k G_k - G)$$  \hfill (43)

It is now possible to obtain expenditure category's marginal effect relative to the overall Gini by dividing equation (43) by $G$ to yield

$$\frac{(\partial G)/(\partial e_k)}{G} = \frac{S_k G_k R_k}{G} - S_k$$  \hfill (44)

which may be rewritten as

$$\frac{(\partial G)/(\partial e_k)}{G} = S_k \left( \frac{G_k R_k}{G} - 1 \right)$$  \hfill (45)

The sum of the relative marginal effects across all expenditure categories is zero. Yitzhaki (1987) interprets the first term inside the brackets as the weighted average income elasticity of expenditure category $k$.\textsuperscript{14}

This elasticity may be rewritten as

\textsuperscript{13}For instances of applications of this traditional approach see Danziger (1980) and Reynolds and Smolensky (1977).

\textsuperscript{14}Since the present study is using current consumption as a proxy for lifetime income, in our context this must be reinterpreted as the elasticity of total spending on expenditure category $k$ with respect to total aggregate expenditures.
\[ \eta_k = \frac{b_k}{S_k} \]  

(46)

where \( b_k \) is a nonparametric estimator of the slope of the regression line of \( x_k \) on \( x \),\(^{15}\) and is defined as

\[ b_k = \frac{\text{cov}(x_k, F)}{\text{cov}(x, F)} \]  

(47)

In the context of this work, \( b_k \) is the weighted mean of the marginal propensity to spend on category \( k \).

### 2.2.2 Consumption Inequality in Mexico

In order to carry out an empirical evaluation of consumption inequality in this context it is first necessary to decompose aggregate household consumption into relevant expenditure categories.

As the present work focuses on studying the marginal shifts in the structure of educational spending, aggregate household consumption will be divided into eight expenditure categories. Spending on educational services is broken into three educational levels and one residual category: basic education, upper secondary, higher education, and other educational services.\(^{16}\) Non-services educational spending is disaggregated into expenditures on school uniforms, school supplies (including textbooks), and home-school transportation. Finally, the last category consists of all non-educational spending.

---

16. Examples of what is included as other educational services are expenditures in job training, adult education programs, and special education.
Current expenditures of households are employed as a proxy for lifetime income. The use of total annual consumption or expenditures was first proposed by Poterba (1989), who argues that since household consumption fluctuates less from year to year than income, consumption is likely to provide a better measure of household well-being than total annual income.\textsuperscript{17} Nevertheless, as Metcalf (1997) comments, current consumption may not be a very good proxy for lifetime income as current consumption is not in fact constant over the lifetime, though it does not fluctuates as much as current income.

In this essay, both monetary and non-monetary spending are included for a sample of 12,815 households in 1994, and 14,042 households in 1996. Both urban and rural households are included in the sample.

Table 2-4 shows that the share of household expenditures in education as a percentage of total spending increased to 6.9% in 1996, up from 6.0% in 1994. Most educational expenditures correspond to payments for educational services (including basic education, upper secondary, higher education, and other educational services) with a joint share of 3.4% and 3.8% out of total expenditures in 1994 and 1996 respectively. The school supplies component also increased its share of total spending to 2.8% in 1996, up from 2.1% in 1994.

Although subsidized education in Mexico has been extended, educational private expenditures still represent an important component of the total spending of households.\textsuperscript{18}

\textsuperscript{17} Other authors using consumption as a proxy for lifetime income include Metcalf (1993), and Feenberg, Mitrusi and Poterba (1996).
\textsuperscript{18} Linares (2000), working at a different disaggregation level, reports household spending in education to be similar to spending in other components like households utilities and apparel, and higher to spending in categories like health care and entertainment.
Table 2-4. Private household spending by category. Shares of total expenditures, 1994-1996.\textsuperscript{a}

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>1994</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-educational expenditures</td>
<td>94.0%</td>
<td>93.1%</td>
</tr>
<tr>
<td>Basic education</td>
<td>1.5%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Upper secondary</td>
<td>0.9%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Higher education</td>
<td>0.8%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Other educational services</td>
<td>0.2%</td>
<td>0.4%</td>
</tr>
<tr>
<td>School supplies</td>
<td>2.1%</td>
<td>2.8%</td>
</tr>
<tr>
<td>School uniforms</td>
<td>0.4%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Home-School transportation\textsuperscript{b}</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Gini coefficient for aggregate expenditures</td>
<td>0.45</td>
<td>0.42</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Source: Own calculations from the Household Income and Expenditure Survey (ENIGH), INEGI 1994, 1996.

\textsuperscript{b} Though not absolutely zero, the shares for school transportation amount for less than 0.05% in both years.

The Gini coefficient calculated from aggregate expenditures decreased to 0.42 in 1996, down from 0.45 in 1994.\textsuperscript{19}

As a first step, I use the model described in Subsection 2.2.1 to decompose consumption inequality by expenditure components. The results are displayed in Table 2-5. Only the results for 1996 are presented as the results for 1994 are very similar.

This table indicates that while all educational expenditures represent 6.1% of total household expenditures, educational spending accounts for 10.5% of aggregate consumption inequality. In contrast, non-educational expenditures, with a share of 93.1% of total household spending, contribute with only 89.5% of total inequality.

This finding may be explained by the relatively high Gini measures for all the individual components of educational spending. All educational expenditure categories present higher inequality measures than those for non-educational spending, with Gini

\textsuperscript{19} These numbers are slightly lower than those calculated by Linares (2000) for the same years. I use a sample of urban and rural households, while Linares (2000) considered only non-rural households. Moreover, he defined income to include only monetary income, whereas I include both monetary and non-monetary income.
coefficients of 0.47 for school uniforms and school supplies, and a Gini of 0.87 for expenditures on higher education services. In contrast, the relative Gini for non-educational expenditures is 0.41.

Table 2-5. Consumption inequality effects by expenditure category in 1996

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Gini Correlation ($R_k$)</th>
<th>Relative Gini ($G_k$)</th>
<th>Share of Total Expenditures ($S_k$)</th>
<th>Share of Consumption Inequality $b_k = \frac{R_kG_kS_k}{G}$</th>
<th>Income Elasticity of Expenditure Category $k$ $\eta_k = \frac{b_k}{S_k}$</th>
<th>Relative Marginal Effect on $G$ $b_k - S_k$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-educational expenditures</td>
<td>1.0021</td>
<td>0.4072</td>
<td>0.9309</td>
<td>0.8948</td>
<td>0.9612</td>
<td>-0.0361</td>
</tr>
<tr>
<td>School uniforms</td>
<td>0.9490</td>
<td>0.4730</td>
<td>0.0033</td>
<td>0.0036</td>
<td>1.0669</td>
<td>0.0002</td>
</tr>
<tr>
<td>School supplies</td>
<td>0.9643</td>
<td>0.4707</td>
<td>0.0282</td>
<td>0.0304</td>
<td>1.0788</td>
<td>0.0022</td>
</tr>
<tr>
<td>Basic education</td>
<td>1.0817</td>
<td>0.8324</td>
<td>0.0138</td>
<td>0.0224</td>
<td>1.6260</td>
<td>0.0086</td>
</tr>
<tr>
<td>Home-School transportation</td>
<td>0.9978</td>
<td>0.6880</td>
<td>0.0003</td>
<td>0.0004</td>
<td>1.6316</td>
<td>0.0002</td>
</tr>
<tr>
<td>Upper secondary</td>
<td>1.0646</td>
<td>0.6739</td>
<td>0.0100</td>
<td>0.0171</td>
<td>1.7053</td>
<td>0.0071</td>
</tr>
<tr>
<td>Other educational services</td>
<td>1.0996</td>
<td>0.7606</td>
<td>0.0038</td>
<td>0.0076</td>
<td>1.9880</td>
<td>0.0038</td>
</tr>
<tr>
<td>Higher education</td>
<td>1.1802</td>
<td>0.8731</td>
<td>0.0097</td>
<td>0.0237</td>
<td>2.4490</td>
<td>0.0140</td>
</tr>
<tr>
<td>Total household expenditures</td>
<td>1.0000</td>
<td>0.4207</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
<td>-</td>
</tr>
</tbody>
</table>

Spending on school supplies, higher education services, and basic education services are among the top contributors to inequality, providing 3.0%, 2.4%, and 2.2% of total consumption inequality respectively. Spending on school uniforms and home-school transportation contribute little to overall consumption inequality as their shares in total spending are quite low.

The marginal effect on the overall Gini, shown in the last column of Table 2-5, is negative for non-educational expenditures and is positive for each one of the components of educational spending. Consequently, increasing taxes (or reducing subsidies) to

---

20. For those interested in a further disaggregation of non-educational spending, see Linares (2000).
educational goods and services will have the effect of lowering total consumption inequality. For example, an increase in taxes on higher education services (e.g. imposing a value added tax on tuition payments) which yields a 1% reduction in household spending on this category, has the effect of reducing inequality by 0.014%. A reduction in the VAT rate on school supplies resulting in a 1% increase in spending on this component, results in a 0.002 increase in inequality.

It is possible to make some inferences about the effects of alternative tax/subsidy policies on inequality, as measured by the Gini coefficient. However, further analysis is needed in order to draw conclusions about the effects of alternative particular policies on social welfare. Moreover, as explained in Section 2.1, my objective is to predict marginal welfare improvements from revenue-neutral changes in the allocation of tax/subsidies across different school levels.

In the next section, the necessary and sufficient conditions for welfare dominance among different expenditure categories will be analyzed in order to be able to draw further conclusions about alternative fiscal policies concerning education.

2.3 Welfare Improving Shifts in Educational Subsidies

Slemrod and Yitzhaki (1991) developed a methodology aimed at evaluating the effect on social welfare resulting from a revenue-neutral marginal increase in the tax on one commodity, accompanied by a decrease in the tax of a second commodity. For this end they adapt the concept of stochastic dominance, widely used in financial theory to design optimal portfolios. The resulting concept of welfare dominance implies the use of comparisons of concentration curves to identify the superiority or dominance of one commodity over another under a static equilibrium analysis.
We are interested in the question of whether a marginal decrease in the subsidy to one level of education (by example, higher education), accompanied with the use of the resulting saved funds in a different school level (basic education), will generate an increase or a decrease in social welfare. Also, we are interested in assessing the effect on social welfare of a revenue-neutral marginal shift of public funds out of educational services and into subsidizing home-school transportation or for the financing of vouchers for school supplies.

2.3.1 The Conditions for Welfare Dominance

Yitzhaki and Slemrod (1991) assume that the social evaluation of the marginal utility of income is positive and declining. They assume also that tax policies are evaluated under an additively separable social welfare function of the form

$$ W = \sum_{h} w[u^h(y_h, P_1, \ldots, P_n)] $$

(48)

where $w$ is the social evaluation if individual $h$'s utility, and $u^h$ represent the indirect utility function of individual $h$ with income, $y$, and prices of commodities, $P$, as arguments.

Additionally, the authors assume that if $y_i = y_j$ then

$$ w[u^i(y, P_1, \ldots, P_n)] = w[u^j(y, P_1, \ldots, P_n)] $$

(49)

and that $\beta$, representing the social evaluation of the marginal utility of income, is a function of income and prices only. Then we have that
\[ \beta(y) = \frac{\partial w}{\partial u^n} \cdot \frac{\partial u^n}{\partial y} > 0 \] (50)

is a function decreasing in income.

Following Yitzhaki and Slemrod (1991), consider a revenue-neutral change in tax policy combining a small increase in the tax of commodity \( t \) with a small decrease in the tax of commodity \( s \). Let \( x_i^h \) represent consumption of commodity \( i \) by individual \( h \), where individuals are arranged in non-decreasing order of income. Let \( X_i \) be total consumption of commodity \( i \), such that \( X_i = \sum_h x_i^h \). If there are \( K \) taxed (subsidized) commodities, and assuming that producer prices are normalized to unity, then total tax revenue may be written as

\[ R = \sum_k \tau_k X_k \] (51)

where \( \tau_k \) is the tax (or subsidy, if negative) rate imposed on commodity \( k \). The revenue-neutrality assumption implies that there exist a link between the price of commodity \( t \) and the price of commodity \( s \). Specifically, from equation (51) we obtain that

\[ dR = dP_t X_t \alpha_t + dP_s X_s \alpha_s = 0 \] (52)

where \( \alpha_t \) is defined by

\[ \alpha_t = 1 + \sum_k \tau_k \frac{\partial X_k}{X_t} \] (53)
and represents the revenue effect of a change in $\tau_i$, with a similar definition for $\alpha_s$.\footnote{This term is interpreted by Wildasin (1984) and Mayshar (1988) as the marginal social cost of increasing taxes on the $i^{th}$ commodity in order to increase revenues by $\$1$.}

Equation (52) may be rewritten as

$$dP_i = -\frac{X_i}{X_i'} \alpha_{st} dP_s$$

(54)

where $\alpha_{st} = \alpha_s / \alpha_i$. Yitzhaki and Slemrod (1991) interpret $\alpha_{st}$ as the ratio of the marginal costs of public funds, and they assume that $\alpha_{st} > 0$.

Now, the change in utility for the $h^{th}$ individual induced by a change in tax rates is

$$du = u_s dP_s + u_t dP_t$$

(55)

where $u_s$ and $u_t$ are the derivatives of $u$ with respect to $P_s$ and $P_t$ respectively. By Roy's identity, the last equation becomes

$$du = -u_y (x_s dP_s + x_t dP_t)$$

(56)

Substituting equation (54) into (56) we obtain that

$$du = -u_y \left[ \frac{X_i}{X_i'} - \alpha_{st} \frac{X_j}{X_j'} \right] X_s dP_s$$

(57)

Clearly, the $h^{th}$ individual will gain from the tax reform only if

$$\frac{X_i}{X_i'} - \alpha_{st} \frac{X_j}{X_j'} > 0$$

(58)
If the last expression is nonnegative for each and every individual, then a Pareto improvement is assured for the tax reform.

The tax reform should not reduce the utility of the poorest individual if it is to be welfare-increasing for all additive concave social welfare functions, it is needed that this tax reform does not reduce the utility of the poorest individual. If the poorest individual is worse off after the reform it would be possible, given a sufficiently large social evaluation of the utility of this individual, to find a social welfare function which measures the reform as welfare-decreasing. The poorest individual is at least as well as before the reform only if

\[ \left( \frac{x^1_t}{X^t} \right) - \alpha_{st} \left( \frac{x^1_s}{X^s} \right) \geq 0 \]  

(59)

Equation (59) describe a necessary condition for all additive concave social welfare functions to judge the tax reform as welfare-increasing. Namely, the poorest individual’s share of expenditure in commodity s must be higher than his share of expenditure on commodity t multiplied by \( \alpha_{st} \).

The last expression considers only the poorest individual. Since a decreasing marginal utility of income has been assumed, a necessary condition is that the gain in utility for the poorest individual is higher than any loss for the next-to-poorest individual. In consequence, we have that

\[ \left( \frac{x^1_s + x^2_s}{X^s} \right) - \alpha_{st} \left( \frac{x^1_t + x^2_t}{X^t} \right) > 0 \]  

(60)

And generalizing for each grouping of individuals from 1 to N, we obtain
\[
\left[ \sum_{h=1}^{k} \frac{x_t^h}{X_t} \right] - \alpha_{st} \left[ \sum_{h=1}^{k} \frac{x_t^h}{X_t} \right] \geq 0 \quad \text{for } k = 1, \ldots, N
\]

The expression inside the brackets represent the difference between the concentration curve of commodity \(s\) and the concentration curve of commodity \(t\) multiplied by the constant \(\alpha_{st}\). A necessary and sufficient condition for commodity \(s\) to dominate\(^{22}\) commodity \(t\) is that the concentration curve of \(s\) with respect to income is at least as high as the concentration curve of \(t\) multiplied by \(\alpha_{st}\) at each point of the income distribution.

That the last condition must hold at each point of the income distribution implies that the concentration curves of commodities \(s\) and \(t\) are not allowed to intersect with each other. If these curves intersect, then it is not possible to guarantee dominance.

Yitzhaki and Slemrod (1991) referred to this set of rules as "marginal conditional stochastic dominance" rules (or MCSD rules). As the authors explain, this set of rules do not necessarily yield a complete ordering over the full set of commodities. Nevertheless, the ordering resulting from applying MCSD rules is transitive in the sense that if commodity \(A\) dominates commodity \(B\) and simultaneously commodity \(B\) dominates commodity \(C\), then commodity \(A\) dominates \(C\).

However, a procedure that ensures a complete ordering across all commodities is achieved involves the use of the Gini coefficient and the construction of what the authors

\(^{22}\)Hereafter, whenever one commodity exhibit marginal conditional stochastic dominance over another, it will be said that the first commodity dominates the second.
call "difference in concentration curves" curves (or DCC curves). A DCC curve measure the distance between the concentration curves of any pair of commodities. In the context of this essay, the area between the concentration curve of commodity $s$ and that of commodity $t$ is given by

$$
\int_0^1 DCC_{st}(F)dF = \left[ \frac{b_s}{S_s} - \alpha_{st}\frac{b_t}{S_t} \right] G
$$

(62)

where, as noted in Subsection 2.2.1, $b_k$ is the weighted mean of the marginal propensity to spend on category $k$, $S_k$ represents component's $k$ share of total expenditure, and $G$ is the overall Gini coefficient.

From equation (46) we know that the term $\frac{b_k}{S_k}$ is interpreted as the weighted income elasticity of commodity $k$. Thus equation (62) implies that a necessary condition for commodity $s$ to dominate commodity $t$ is that the income elasticity of $s$ must be lower than the income elasticity of $t$.

In Subsection 2.2.2 income elasticities for noneducational household spending and for each of several categories of educational expenditures were calculated in the process of decomposing expenditure inequality. Relative Gini coefficients were obtained for each of the different expenditure categories. However, the conventional Gini measure is just a member of a more general family of inequality measures. In particular, the use of the conventional Gini implies the adoption of a specific social welfare function with a specific weighting scheme, which in turn presuppose a given level of governmental aversion to inequality.
2.3.2 The Extended Gini Coefficient

In an effort to allow the weighting scheme to vary when measuring inequality and at the
same time maintaining the basic properties of the Gini coefficient, Yitzhaki (1983)
developed the extended Gini coefficient which is defined as a weighted integral of the area
between the Lorenz curve and the 45° line. When measuring expenditure inequality, the
extended Gini is given by

\[ G(v) = \frac{-v \text{Cov}(X(1 - F(X))^{v-1})}{m} \quad \text{for } v > 1 \tag{63} \]

where \( v \) is an arbitrary parameter which value provides a measure of the government’s
aversion to inequality. The higher the value of \( v \), the greater the aversion to inequality.
The conventional Gini is a special case of the extended Gini with \( v = 2 \).

Yitzhaki (1983) also showed that a decrease in the after-tax price of commodity \( s \)
financed by an increase in the after-tax price of commodity \( t \), lowers the extended Gini
only if

\[ \int_0^1 [\Theta_s(F) - \alpha_{st}\Theta_t(F)](1 - F)^{v-2} dF > 0 \tag{64} \]

where \( \Theta_s \) and \( \Theta_t \) represent the concentration curves of commodities \( s \) and \( t \) respectively.

Thus our \( DCC_{st} \) curve defined in the previous section is given by \( \Theta_s - \alpha_{st}\Theta_t \). Equation
(64) imply that if the \( DCC_{st} \) curve is above the horizontal axis at every point of the
income distribution, then a revenue-neutral tax reform which reduces the tax (or increases
the subsidy) on commodity \( s \) at the expense of heavier taxation (or reduced subsidization)
on commodity \( t \) must necessarily lower the extended Gini measure for any value of \( v \). In other words, if \( s \) dominates \( t \) the analyzed tax reform must decrease the extended Gini for all \( v \). Therefore, the extended Gini has provided us with an additional set of necessary, though not sufficient, conditions for welfare dominance.

2.4 Welfare Improving Shifts in Educational Subsidies in Mexico

To identify marginal welfare improvements in tax/subsidy policy for the educational sector in Mexico this section continues the empirical analysis of Subsection 2.2.2. The use of the extended Gini coefficient to evaluate the cross-sectional data over our eight household expenditure categories will allow us to carry out the required analysis.

For the given number of expenditure categories, a total of 28 pairs of concentration curves\(^{23}\) have to be plotted in order to check for welfare dominance. However, as it was noted in the last section, the comparison of weighted income elasticities for each component of household expenditures allows the identification of necessary, but not sufficient conditions. After that, all that is needed is to compare concentration curves for a reduced number of expenditure categories in order to empirically identify the necessary and sufficient conditions for welfare dominance.

2.4.1 Identifying the Necessary Conditions for Welfare Dominance

Table 2-6 displays the weighted income elasticities for each of eight expenditure components for different values assigned to \( v \), the parameter measuring government’s aversion to inequality. The third column of the table includes the elasticities for the case at

\(^{23}\)For \( n \) expenditure categories, a total of \( \frac{n(n-1)}{2} \) pairs of concentration curves are needed.
which \( \nu = 2 \) and, since this is the case of the conventional Gini coefficient, they are the same as those previously included in Table 2-5.

The results show that all of the educational spending categories present weighted income elasticities higher than unity, hence these components (and aggregate spending in education as a whole) are considered as luxuries, whereas non-educational spending, with positive income elasticity less than unity is classified as a necessity. As an increase in \( \nu \) increases the weight attached to the bottom of the income distribution, it follows that the weighted income elasticity of expenditures on higher educational services increases as income rises. In contrast, the income elasticity of spending on school supplies decreases as income declines.

Expenditure categories in Table 2-6 have been arranged in ascending order with respect to their weighted income elasticities when \( \nu = 2 \). Since a necessary condition for one component to dominate another is that the weighted income elasticity of the first one must be lower than the same elasticity of the second one for all \( \nu \), it is impossible for any category in the table to dominate another one located in an upper row. For example, expenditures on school supplies dominates spending on basic educational services; but it is not possible for basic education to dominate school supplies.

Hence, we conclude that if welfare dominance is present between all the possible pairs of expenditure categories, then the ordering or ranking of components must be the one provided by the first column of the previous table.

This does not mean that any expenditure component will necessarily dominate another category located in a lower row. Spending on school supplies will never be found to dominate expenditures on school uniforms; but it is impossible for expenditures on school
Table 2-6. Weighted income elasticity by expenditure category for alternative values of \( v \)^{a}

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Government's aversion to inequality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( v = 1.5 )</td>
</tr>
<tr>
<td>Non-educational expenditures</td>
<td>0.9560</td>
</tr>
<tr>
<td>School uniforms</td>
<td>1.0237</td>
</tr>
<tr>
<td>School supplies</td>
<td>1.0487</td>
</tr>
<tr>
<td>Basic education</td>
<td>1.7049</td>
</tr>
<tr>
<td>Home-School transportation</td>
<td>1.5837</td>
</tr>
<tr>
<td>Upper secondary</td>
<td>1.8067</td>
</tr>
<tr>
<td>Other educational services</td>
<td>2.0825</td>
</tr>
<tr>
<td>Higher education</td>
<td>2.7923</td>
</tr>
<tr>
<td><strong>Total household expenditures</strong></td>
<td><strong>1.0000</strong></td>
</tr>
</tbody>
</table>

^{a} Calculations based on data from the Household Income and Expenditure Survey (ENIGH), INEGI 1996

uniforms to dominate expenditures on school supplies because the weighted income elasticity of spending on school uniforms is higher than that of expenditures in school supplies for values of \( v \) higher than 2. Therefore, the necessary conditions from equation (64) are not met for all values of \( v \) when evaluating this pair of components.

By the same rationale, it is possible to determine whether each pair of components meets the necessary conditions for welfare dominance. The results are displayed by Table 2-7 below. In this table, an arrow facing rightward (\( \rightarrow \)) denotes that it is possible for an expenditure component in the first column to dominate a corresponding category listed in the first row of the table. This symbol indicates that necessary, not sufficient, conditions for welfare dominance are met. It will be necessary to check pairs showing this characteristic for compliance with necessary and sufficient conditions. An arrow facing downward (\( \downarrow \)) indicates that necessary conditions for welfare dominance are not met by the corresponding pair of categories. It is impossible to identify dominance for pairs displaying this mark, and hence they will not be further evaluated.
Table 2.7. Compliance with necessary, not sufficient conditions

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Non-educational expenditures</th>
<th>School uniforms</th>
<th>School supplies</th>
<th>Basic education</th>
<th>Home-school transportation</th>
<th>Upper secondary</th>
<th>Other educational services</th>
<th>Higher education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-educational expenditures</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>School uniforms</td>
<td></td>
<td>↓</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>School supplies</td>
<td></td>
<td></td>
<td>↓</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>Basic education</td>
<td></td>
<td></td>
<td></td>
<td>↓</td>
<td>→</td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>Home-School transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>↓</td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>Upper secondary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>Other educational services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>Higher education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>→</td>
</tr>
</tbody>
</table>

a. Where an arrow facing rightward (→) indicates that necessary, though not sufficient, conditions for welfare dominance are met for the corresponding pair of categories; whereas an arrow facing downward (↓) indicates that necessary conditions are not met.

For instance, from Table 2.7 we observe that home-school transportation could potentially be found to dominate higher education and other educational services, but it does not dominate upper secondary education. Similarly, it is possible that non-educational expenditures dominate all of the educational spending categories, but it is not possible for non-educational expenditures to be dominated by any of the other components.

2.4.2 Checking for Marginal Conditional Stochastic Dominance

Up to this point only necessary conditions for welfare dominance have been empirically examined. Pairs of components for which dominance is possible have been identified. Next, we evaluate these selected pairs for compliance with both necessary and sufficient conditions; specifically, we need to identify those pairs for which equation (61) holds at every point of the income distribution.
As explained in Section 2.3, a necessary and sufficient condition for component $s$ to dominate component $t$ is that the concentration curve of $s$ with respect to income is at least as high as the concentration curve of $t$ multiplied by a constant, $\alpha_{st}$, at each point of the income distribution. This implies that concentration curves of commodities or expenditure components $s$ and $t$ do not intersect with each other. And this in turn implies that the "difference in concentration curves" curve ($DCC_{st}$) must not fall below the x-axis (crossing the y-axis at zero). We referred to this set of conditions as "marginal conditional stochastic dominance" rules (or MCSD rules).

Figure 2-2 exhibits the $DCC$ curve between household expenditures in school supplies and expenditures in basic educational services. For these and the remaining calculations it has been assumed that $\alpha_{st} = 1$, which implies that there is no efficiency gain or loss as a result of the tax/subsidy reform here being analyzed. This assumption is standard in the literature of welfare dominance and allow us to concentrate exclusively on the evaluation of social welfare marginal improvements resulting solely from any redistribution of welfare among individuals, and not from changes in the excess burden of the tax system.

It can be observed from Figure 2-2 that the $DCC$ between school supplies and basic educational services lies above the x-axis at each point of the income distribution. Hence, it is concluded that school supplies dominate basic education. A marginal increase in the subsidy (or decrease in taxes) to school supplies financed by a marginal decrease in the subsidy to basic educational services will yield a social welfare improvement for all concave social welfare functions.
In a similar way, as Figure 2-3 shows, basic educational services are found to dominate higher educational services since the difference between the concentration curves for these two expenditure categories is always positive. Therefore a small increase of the subsidy to basic educational services at the expense of higher educational services will improve social welfare.

We know from Section 2.3 that the ordering of components resulting from the MCSD rules is transitive. Since it was already found that school supplies dominate basic education and that basic education dominates higher education, we use the transitivity property to conclude that school supplies dominate higher educational services. Because of transitivity, it is not necessary to draw a DCC curve between school supplies and higher education.
Figure 2-3. Difference between concentration curves of basic and higher education

![Diagagram showing the difference in concentration curves for basic and higher education.]


Figure 2-4 presents a case different from those previously analyzed. It may be observed that the DCC curve between basic educational services and upper secondary educational services does not always lies above the x-axis. The DCC curve falls below zero for most of the households in the highest two deciles of the income distribution. Hence, for these households the income elasticity of upper secondary education, as calculated by the Gini coefficient, is lower than the income elasticity of basic education. Thus, a concave social welfare function over this subset of the income distribution would generate a prescribed tax/subsidy policy which subsidizes more heavily upper secondary education at the expense of basic education.
Figure 2.4. Difference between concentration curves of basic education and upper secondary

Since the income elasticity of basic education is lower than the income elasticity of upper secondary education for over 80% of households, we conclude that basic education does not dominate upper secondary education and a welfare-improving tax/subsidy policy cannot be formulated on the basis of welfare dominance conditions. (Of course, it is also impossible for upper secondary education to dominate basic education).

These are just examples of the evaluation performed for a number of pairs of expenditure components. The rest of feasible pairs are examined in a similar fashion in order to determine if conditions for welfare dominance are met, with the results displayed in Table 2-8 below.

As explained in Subsection 2.4.1, the categories in the first column of this table have been arranged in ascending order with respect to their income elasticities calculated from
the Gini coefficient. This implies that any given expenditure component can only dominate components located in lower rows than its own. So the question is whether or not each of the components listed on the first column actually dominate each of the components given by the first row of the table.

Table 2-8. Compliance with necessary and sufficient conditions^a^

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Non-educational expenditures</th>
<th>School uniforms</th>
<th>School supplies</th>
<th>Basic education</th>
<th>Home-school transportation</th>
<th>Upper secondary</th>
<th>Other educational services</th>
<th>Higher education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-educational expenditures</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
</tr>
<tr>
<td>School uniforms</td>
<td>↓</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
</tr>
<tr>
<td>School supplies</td>
<td>↓</td>
<td>↓</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
</tr>
<tr>
<td>Basic education</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
</tr>
<tr>
<td>Home-School transportation</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↔</td>
</tr>
<tr>
<td>Upper secondary</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↔</td>
</tr>
<tr>
<td>Other educational services</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↔</td>
</tr>
<tr>
<td>Higher education</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
</tbody>
</table>

^a^ Where a double arrow facing rightward (⇒) indicates that both necessary and sufficient, conditions for welfare dominance are met for the corresponding pair of categories; a bidirectional arrow (↔) implies that dominance is not present between the pair since only necessary conditions were met; and an arrow facing downward (↓) indicates that not even necessary conditions are met.

Dominance had already been ruled out for the pairs of categories marked with an arrow facing downward (↓) as not even necessary conditions are met when analyzing these pairs. All of the other pairs in Table 2-8 have been checked for necessary and sufficient conditions, with a double arrow facing rightward (⇒) indicating that the expenditure component in the first column of the table has been found to dominate the corresponding component in the first row of the table. A bidirectional arrow (↔) is used to represent pairs for which dominance was not found as only necessary conditions were satisfied.
From Table 2-8 we conclude that school supplies dominate the four categories of educational services. Thus, a small increase in the subsidy (or decrease in taxes) to school supplies financed by a small decrease in the subsidy to either basic, upper secondary, higher, or other educational services will produce a social welfare improvement for all concave social welfare functions.

Moreover, the same small decrease in the subsidy to any of these four categories of educational services will yield an improvement in social welfare if used to finance a small decrease in the tax to either school uniforms or non-educational expenditures.

Similarly, basic educational services dominate only expenditures on higher education. Consequently, a welfare-improving outcome will be generated by a marginal increase in the subsidy to basic educational services which is financed by a marginal decrease in the subsidy to higher education.

Home-school transportation, upper secondary educational services, and other educational services are found to dominate higher education. Also, interestingly, higher educational services are dominated by each of the other expenditure components. Hence, a small decrease in the subsidy to higher educational services, accompanied by an small increase in the subsidy (or decrease in taxes) to any of the other categories, will generate a welfare-improving outcome.

Even though a complete ordering of all categories is not possible since welfare dominance cannot be established for each and every pair, the analysis has been able to yield a partial ordering of components as summarized by Table 2-9.
2.4.3 Subsidies Financed by Increasing the Income Tax

We have studied revenue-neutral fiscal reforms which involve the funding of additional resources for a given expenditure component by reducing the resources available for some other spending category. By using the same methodology it is possible to analyze the social welfare effects of financing spending on educational categories through an increase in the income tax.

Figure 2-5. Difference between the Lorenz curve and the concentration curve of basic education expenditures

---

Table 2-9. Partial ordering of expenditure categories

<table>
<thead>
<tr>
<th>Group</th>
<th>Expenditure Category</th>
<th>Observations</th>
</tr>
</thead>
</table>
| A     | Non-educational expenditures  
       | School uniforms  
       | School supplies  | Any of the categories in group A dominates any of the categories included in groups B or C. |
| B     | Basic education  
       | Upper secondary  
       | Other educational services  | Any of the categories in group B dominates higher education (group C). In addition, any of the components in this group is dominated by any of the categories included in group A. |
| C     | Higher education  | Spending in higher education is dominated by any other expenditure category. |

---

a. Calculations based on data from the Household Income and Expenditure Survey (ENIGH), INBGI 1996.
From Figure 2-5 we observe that the DCC curve between total income and spending on basic education is always above the x-axis for each level of income. This implies that total income dominates expenditure in basic education and thus a social welfare improvement can be obtained by marginally reducing the income tax at the expense of reducing the subsidies for basic educational services. Figure 2-7, presented in Appendix C, shows all the results for the different components of educational spending.

Briefly, a marginal reduction in income taxation will improve social welfare if it is financed at the expense of subsidies for all different categories of educational services. No dominance is found with respect to school uniforms, school supplies, or home/school transportation. The DCC curves between total income and spending on upper secondary educational services, spending on higher education, and spending on other educational services is always above the horizontal axis. A marginal reduction in income taxation financed by a decrease in subsidies for upper secondary, higher education, or other educational services will yield a social welfare improvement.

2.5 Policy Implications and Concluding Remarks

It has been found that a marginal increase in the subsidization of basic education, upper secondary, or other (non-higher) educational services at the expense of a marginal decrease in subsidies for higher education will generate a social welfare improvement for all concave social welfare functions. In addition, a marginal increase in subsidies (or reduction in taxes) for school uniforms or school supplies will yield a higher level of social welfare if is financed by a marginal decrease in subsidies for any level of educational services.
These results are primarily explained by differences in the distribution of expenditure components across households. Household expenditures on higher education are distributed more unequally across levels of income than spending in all of lower educational services which, in turn, is more unevenly distributed than expenditures on school uniforms and school supplies.

The potential gains in social welfare arises as the result of only the redistributive effects of the alternative tax/subsidy reforms analyzed. There is no account of the potential effects on efficiency which could arise from these reforms. For this reason, the policy implication of the analysis must be put forward tentatively, especially as the benefits of additional spending will accrue over a very long period.

But this does not mean that the redistributive effects of changes in public policies toward education should not be considered, and is not clear whether the inclusion of efficiency considerations would yield conclusions contrary to those developed here.

For example, Schultz (1988) considered spending on education as an investment and studied alternative allocations of educational subsidies across levels of schooling. He found that, even though investment on higher levels of education exhibits a higher rate of return to schooling, the social rate of return to schooling is higher at lower educational levels. Therefore, from a social point of view, it would be best to invest an additional dollar at lower educational levels than to invest it in higher levels of schooling.

The present study could be improved in a number of ways. First of all, since foregone income for not being in the labor market is an important element of the private cost of education, the inclusion of an estimate for this opportunity cost would be an improvement. A further improvement could be made by using data which differentiates between
expenditures on public education and spending on private education. This will allow the study of the effects of substituting a value added tax for the income tax.
Appendix C: Difference in Concentration Curves

Figure 2-6. Difference between concentration curves of selected expenditure categories
Figure 2-6. Difference between concentration curves of selected expenditure categories
Figure 2-6. Difference between concentration curves of selected expenditure categories

Cumulative distribution of income
Figure 2-7. Difference between the Lorenz curve and the concentration curves of educational spending components.
The Impact of Federal Grants for Basic Education in Mexico

Traditional models of local fiscal response typically predict that federal categorical non-matching grants induce only an income effect on the local demand for public expenditures. It is usually assumed that categorical non-matching grants are equivalent to revenue-sharing or block grants and that converting a categorical non-matching program to a revenue-sharing grant program would have no consequences for either the composition or the level of local public expenditures. Moreover, local expenditure demand is expected to respond to an increase in grants of these types in the same way it would respond to an equivalent increase in private incomes.

In the first part of this essay, a sample of pooled cross-sectional data for 31 state governments in Mexico, from 1996 to 1999, will be used to show that federal non-matching grants for basic education have a stimulative effect on state public expenditures. This suggests that more than a pure income effect is involved in explaining the impact of educational grants on state demand for public expenditures. The possibility of a price effect from educational grants implies that conversion of the grant mechanism from a categorical non-matching grant to a revenue-sharing grant, would not be inconsequential for the composition or the level of state public expenditures.

In the second part of this essay, I will use a model first developed by McGuire (1975) to decompose the impact of educational grants into income and price effects.
If state governments use the full amount of federal grants to supplement their own resources the categorical grant mechanism is equivalent to a block or revenue-sharing grant system. In contrast, these two grant mechanisms are not equivalent if state governments perceive the grants to lower the price of the educational expenditures.

The following section provides a general description of educational grants in Mexico. Section 3.2 obtains a first approximation of the impact of educational grants on state expenditures, by estimating the "flypaper effect" of grants with data for 31 Mexican state governments. Section 3.3 presents a basic model to decompose the impact of grants into its income and price components. Section 3.4 estimates the relevant parameters of the basic model. Finally, Section 3.6 concludes.

### 3.1 Grants for Basic Education in Mexico

Public education provision in Mexico has been highly centralized at the federal level of government.\(^1\) In 1992, as a result of the National Agreement for the Modernization of Basic Education the federal government handed over operation of preschool, elementary, and lower secondary educational services to state governments.\(^2\) However, the federal government is still responsible for the design of the academic programs. Also, the central government agreed to provide additional federal resources to the states to pay for some of the cost of basic education in the form of categorical non-matching grants.\(^3\)

---

1. The Ministry of Public Education estimates that state spending in education was about 16% of total public expenditures in 1999. The remaining 84% of educational public funding is provided by the federal government as municipalities do not devote resources for financing education. See SEP (1999).
2. This agreement did not include the Federal District. Operation of schools at the basic level of education remain as a responsibility of the federal government.
3. Up to 1997 the grant was transferred through the Ministry of Public Education as part of Aggregate 25 of federal spending. Since 1998 the grant is part of Aggregate 33, and is transferred to the states without passing through the Ministry of Public Education.
Federal grants for basic education financed about 70% of state expenditures in education in 1998. This is a closed end grant which does not require matching educational funding by the states. The amount of federal resources allocated to each state government is determined prior to the beginning of each calendar year. Local fiscal response of state governments to this grant mechanism will be analyzed in the following sections.

3.2 The Impact of Educational Grants on State Expenditures

Regressions for state expenditures on basic education with grants and private income as explanatory variables yield relatively large coefficients for educational grants. The sample used for these regressions is pooled cross-section data for the period 1996-1999 and 31 states in Mexico.

These results contradict the predictions of theoretical analysis based on individual's utility maximization, which indicates that state and local governments will respond to an increase in federal lump-sum grants in the same way they would respond to an increase in private income. In particular, if a $1 increase in private income leads a state government to tax away 10 cents of that amount to finance public expenditures, then a $1 increase in federal lump-sum grants is expected to result in a 10 cent increase in public expenditures, while the remaining 90 cents are returned to resident taxpayers in reduced state taxes.  

Although federal grants for basic education in Mexico are not unconditional block grants, the fact that state governments are not required to match these grants with local resources suggests that state governments may treat these additional revenues as

---

4. Hence, lump-sum grants are often said to be a veil for a federal tax cut to individuals.
unconditional revenue-sharing grants, and there will be only an income effect associated with these grants.\textsuperscript{5}

The stimulative effects of federal educational grants on state expenditures implied by the results in Table 3-1 below indicate that a reduction in state taxes is relatively modest. The results are consistent with the literature on the "flypaper effect" of grants, a body of empirical studies in the seventies, which report large and significant coefficients for the effect of grants on local expenditures for U.S. data.\textsuperscript{6} The main result of these studies is that federal lump-sum grants increase lower level governments’ expenditures more than equivalent increases in private income.

3.2.1 The Flypaper Effect

The flypaper effect represents the idea that "money sticks where it hits." In other words, money received in the public sector stays in the public sector, while money received in the private sector remains in the private sector.

Several explanations have been given for the flypaper effect. Fisher (1982) summarizes the most common interpretations and divides them into four categories. Explanations based on (i) some form of fiscal illusion, (ii) characteristics of particular political institutions, (iii) the income effects resulting from tax substitution among different levels of governments, and (iv) statistical problems surrounding interpretation of grants.

\footnotesize{
5. Actually this is the case only if the amount state governments spend in education is larger than the size of the educational non-matching grant, as they can only reduce own expenditures in education up to zero. This does not appear to be a binding restriction for our sample, since these grants account for about 70% of total state spending in education in our sample, and educational expenditures from own resources are positive for all observations in the sample.
}
First, the fiscal-illusion argument asserts that if local bureaucrats perceive the price of local public expenditure as an average rather than a marginal price, then lump-sum grants may have a substitution as well as an income effect, since an increase in federal grants reduces the average price of local public expenditures. Thus, an increase in grants should be expected to induce a larger increase in local public expenditures than an equivalent increase in private income.

Second, the individual’s utility-maximization and budget constraint framework, typically used to explain local bureaucrats allocative decisions, exclude important features of political institutions which could play a significant role in the decision-taking process. Some budget-maximization models may be better suited to explain observed effects of increases in grants and increases in private income.

Third, because most of the empirical studies evaluating the effects of grants in local public expenditures do not consider federal taxes, the estimated effect of grants could include the income effect that results from substituting the federal tax system for the local tax system. Even if the grant received by a jurisdiction just equals the amount of federal taxes raised from the jurisdiction to pay for the grant program, this tax substitution can be expected to induce some degree of income redistribution within the jurisdiction, thus producing individual income effects. In particular, if the median voter’s local tax share is larger than her federal tax share, then a $1 increase in federal taxes combined with a $1 increase in lump-sum grants would result in an increase in local public expenditures.

Finally, there may be a number of statistical problems associated with the empirical studies of local expenditure demand. Some grants may have been classified as lump-sum

grants by these studies, even though those grants may effectively include significant price effects. For example, if a categorical non-matching grant is allocated by the federal government in such a way that it rewards local effort in the aided category, an effective, though not statutory, matching ratio will be involved in local allocative decisions. The same point applies if an unconditional revenue-sharing grant effectively rewards local fiscal effort. Thus, the incorrect classification of a grant as lump-sum may generate a statistically measured income effect from the grant, which is larger than the income effect from an increase in private income. Moreover, in the case of the mentioned example, a simultaneous equations bias will be present as grants should not be treated as exogenously determined.

### 3.2.2 Empirical Evaluation of the Impact of Educational Grants

Pooled cross-section data for 31 states for the years 1996 to 1999 is used to evaluate the impact of educational categorical grants on state public expenditure demand. The Federal District will be excluded from the sample because of important structural differences in the way local and external educational resources are administered for this jurisdiction.\(^8\) Eleven observations from the remaining states were discarded because some states failed to report educational expenditures for some years. The total number of usable observations equal 113.

---

8. For instance, the Federal District does not receive grants for basic education through the specific fund studied in this chapter. Nevertheless, it receives funding for this category from some other transfer programs.
3.2.2.1 Description of the Data

Data for three main variables is required for this essay: state expenditures on education financed with own resources, federal educational grants to states, and state expenditures on all other categories not financed by educational grants.

State Expenditures on Education ($L_a$). The data for this variable, for the years 1996-1998, was obtained from the State Education Financial Survey, made available to the author by the General Directorate of Planning, Budgeting and Programming (DGPPP) of the Ministry of Public Education (SEP). The data for 1999 is from the same survey, and was obtained from the Federal Government Gazette published in January 25th, 2000. The figures exclude spending financed with federal grants for basic education.

Federal Grants for Education ($G$). The resources received by the states from the Basic and Teacher Education Contribution Fund (FAEB) will be used to represent this variable. This fund does not constitute the totality of federal grants for education provided to the states, but it accounts for most of it. Hence, any results obtained here must be interpreted as applying to the state fiscal response to this particular fund of grants. The data is published in the Federal Public Account, which is available from the Ministry of Finance (SHCP).

State Expenditures on other Categories ($L_n$). The National Institute of Statistics (INEGI) publishes total expenditure data for all states for the required years. Since $L_n$ must include only non-educational spending, it is necessary to subtract state expenditures in education, $L_a$, from the raw data, say $L$, obtained from INEGI. Furthermore, since
INEGI's data is inclusive of spending financed by educational grants, we also have to subtract \( G \) from the total expenditures figures. Then, we have that \( L_n = L - L_a - G \).

*Private Income* \((Y)\). This variable will be approximated by the state Gross Domestic Product as reported by INEGI.

All monetary variables were transformed to real terms through the use of an implicit GDP deflator for every state in the sample.

### 3.2.2.2 The Stimulative Effects of Educational Grants

As I noted above, regressions of state expenditures with educational grants and income as independent variables, indicate a large stimulative effect of grants for basic education on state expenditures. All of the variables are expressed in per capita amounts.

It is estimated that a $1 increase in educational grants induces an increase in total state expenditures, state expenditures on education, and state non-educational expenditures, of $2.08, $0.67, and $1.41 respectively. In contrast, a $1 increase in private income results in an increase of only 3 cents in state expenditures on education.\(^9\)

Total state expenditures on education, inclusive of expenditures financed by federal educational grants, were regressed on educational grants and private income. As Table 3-1 shows, a $1 increase in federal educational grants yield an increase of 67 cents in total state expenditures on education.

The regression of total state expenditures on all categories (education and non-education) on the same independent variables finds that a $1 increase in educational grants

---

9. Though these estimates are higher than most of flypaper effect estimates for the U.S., a survey by Gramlich (1976) reviews some estimates which are even higher than ours. Moreover, a possible explanation for our large estimates, on statistical grounds, will be provided later in this section.
Table 3-1. The impact of educational grants on state expenditures

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Coefficients of Independent variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Educational Grants</td>
</tr>
<tr>
<td></td>
<td>$G$</td>
</tr>
<tr>
<td>State expenditures in education: $L_a + G$</td>
<td>0.6672</td>
</tr>
<tr>
<td>Total state expenditures: $L_a + L_n + G$</td>
<td>2.0829</td>
</tr>
<tr>
<td>State own expenditures in non-educational categories:</td>
<td>1.4157</td>
</tr>
<tr>
<td>$L_n$</td>
<td></td>
</tr>
<tr>
<td>State own expenditures in all categories: $L_a + L_n$</td>
<td>1.0829</td>
</tr>
<tr>
<td>State own expenditures in education: $L_a$</td>
<td>-0.3328</td>
</tr>
<tr>
<td>Revenue-sharing grants: $C$</td>
<td>0.5385</td>
</tr>
</tbody>
</table>

a. All variables were entered in per capita amounts.

translates into a $2.08 increase in total spending by the state, an amount $1.08 higher than the increase in the grant.

The difference in magnitude between the two coefficients (2.08 - 0.67) for educational grants represents the impact of these grants on state own expenditures on all non-education categories. This result is confirmed by regressing state own expenditures on non-education categories against the same explanatory variables. Table 3-1 indicates that a $1 increase in educational grants increases state expenditures in non-education categories by $1.41.

This large coefficient may be explained in part by a statistical problem arising from the way non-educational own state expenditures are measured in the sample. This variable, represented by $L_n$ in our regression analysis, includes all state spending in non-
educational categories, regardless of whether this spending is financed by state taxes or revenue-sharing grants. If allocations of unconditional revenue-sharing grants are correlated with the allocations of grants for basic education, then a portion of the estimated change in state non-educational expenditures associated with an increase in educational grants, can be attributed to this correlation. I estimated the correlation coefficient between unconditional revenue-sharing grants and grants for basic education to be positive and equal to 0.3869.

A regression of (non-educational) revenue-sharing grants as the dependent variable, with educational grants and income as explanatory variables, yields a coefficient of 0.54 for educational grants. Thus, a $1 increase in educational grants is typically accompanied by a 54 cents increase in revenue-sharing grants, which in turn is expected to generate an income effect on local demand for public expenditures. This effect tends to magnify the measured response of state non-educational expenditures to an increase in educational grants.

The results of this section are fully consistent with the flypaper effect literature. The results indicate that the resources the states receive as educational grants are being kept in the public sector, with evidence of modest tax relief for individuals.

The previous analysis may appear to be an ad-hoc construction describing the fiscal decisions of lower level governments in response to federal grants.\textsuperscript{10} In the following section, I will use a model of fiscal local response to federal grants in order to further evaluate the effect of educational grants on state educational expenditures. In addition, the

\textsuperscript{10}See McGuire (1979)
model developed by McGuire (1975) is able to decompose the overall effect of grants into income and price effects.

3.3 A Model of Local Fiscal Response to Federal Grants

Most studies of the effects of federal transfer programs on local governments’ resource allocation among different public expenditure categories adopt a framework of a utility maximization by the local governments. McGuire (1975) proposed an econometric model intended to estimate the relevant parameters in order to decompose the local fiscal response to grants into income and price components. The next subsection summarizes this model.

3.3.1 The Post-Grant Local Budget Constraint

Let us assume that local bureaucrats behave as if they maximize the utility of their typical resident subject to a given budget constraint. We will assume that these bureaucrats respond consistently to changes in income and prices.

Figure 3-1 below illustrates a local government’s consumption choice between an aided public commodity or expenditure category, \( Q_a = L_a + G \), and a non-aided (aggregate) category, \( Q_n = L_n \), where \( L_a \) represents local government’s spending on non-aided commodities, \( L_a \) represents expenditures on the aided category, and \( G \) is used to designate grants received by the local government from a central authority and for use on the aided category. Both \( L_n \) and \( L_a \) represent expenditures financed with local resources.\(^{11}\)

---

\(^{11}\) Think of \( Q_a \) and \( Q_n \) as physical quantities, and of \( L_a \) and \( L_n \) as expenditure amounts.
Figure 3-1. Income and price components of federal grants

Assume the 45° line or line B in the figure depicts the budget constraint faced by the local government before the introduction of federal grants. Line C may be used to represent a new budget constraint after a unconditional transfer¹² is introduced for this government is introduced. Since an unconditional transfer is equivalent to a general increase in own local revenues, the result would be a pure income effect on local choices which will drive the local government from bundle $b$ to bundle $a$.

Since the preferences of the local bureaucrats are not observable, the choice of point $a$ could result from a series of alternative post-grant budget constraints. For example, a budget line such as $D$ in Figure 3-1, which does represent a pure price change from a conditional open-ended transfer, could also conceivably induce the local government to select bundle $a$. Moreover, combinations of income and price changes such as those depicted by lines $E$ and $F$ could potentially produce a local government's choice of $a$.

¹² For example a revenue-sharing grant of the type analyzed in Chapter 1, which is not restricted for use on any specific commodity and is considered by the local government as totally fungible resources.
As McGuire (1975) points out, not all alternative transfer schemes resulting in selection of bundle $a$ can be characterized as the combination of income and price changes. For example, provided that local fiscal effort is not reduced, a fixed-size non-matching categorical grant, which is effectively policed by the federal government, would yield a shift of local choice from bundle $b$ to bundle $a$ in Figure 3-2. Nevertheless, in this case the post-grant choice of the local government would not be the result of income and price changes.

However, the selection of bundle $a$ could arise from the application of an infinite number of potential multipart pricing schemes. For example, a fixed charge represented by segment $ed$ in Figure 3-2, combined with a price reduction for the aided category, $Q_a = L_a + G$, and represented by fragment $dca$, would also drive the local government to choose point $a$.

*Figure 3-2. Equivalence between a multipart pricing scheme and a highly policed grant*
Thus, for those transfer schemes which cannot be characterized as a sum of price and income changes, it is possible to identify these components through an equivalent scheme of multipart pricing.

3.3.2 Identifying the Effective Budget Constraint

The existence of an infinite number of multipart pricing schemes which could generate a given bundle choice by the local government implies a distinction between a nominal and an effective budget constraint.

For example, in the case of a categorical grant from the central government, a local government may be able to effectively convert a fraction of a categorical grant into fungible resources that may be used in the same way as own local resources. A local government which receives financial aid from the central government in order to subsidize the construction of a solid waste treatment plant, may eventually charge a user fee and thus obtain fungible resources. Or a local government receiving a federal grant for use in financing education could reduce the amount of its own local revenues devoted to this category, thus being able to convert a categorical grant back into fungible resources.

Since the local governments have numerous opportunities to circumvent the original purpose of categorical transfers, the effective change in the local budget constraint induced by a transfer will not necessarily be the same as the change expected on the basis of the statutory design of the grant mechanism. Hence, the need for identifying the effective change in the local budget constraint through the use of statistical methods.
3.3.3 A Model of Local Fiscal Response to Grants

If federal fiscal transfers to local governments can be characterized as a multipart pricing mechanism, then a fraction of a categorical grant to a local government will be considered by local bureaucrats either as a budget supplement or as fixed charge for receiving the transfer. The remaining fraction of the fiscal transfer will be perceived as a price subsidy for the aided category.

Figure 3-3 below illustrates the choice of bundle \( a \) by a local government. Assume that a fraction, \( G_1 \), of a categorical federal transfer is effectively perceived as budget supplement. Furthermore, assume that \( G_1 \) can be positive or negative.\(^{13}\) In other words, \( G_1 \) is the income component of the multipart price scheme. The local government receives a total categorical grant equal to \( G \), but a fraction equal to \( G_1 \) will be effectively treated by local bureaucrats in the same way they treat local own resources. This is, \( G_1 \) may potentially be used to cover public expenses on both aided and non-aided public goods.

\(^{13}\)A negative value for \( G_1 \) is interpreted as a fixed charge for the local government when receiving the grant.
Total post-grant fungible resources available to the local government are defined as

\[ B^* = L_a^* + L_n^* + G_1^* \] (65)

In selecting bundle \( a \), the local government is choosing to spend an amount equal to \( L_a^* + G_1^* \) out of its total budget in the aided or subsidized commodity. The effective price paid is

\[ p^* = \frac{L_a^* + G_1^*}{L_a^* + G^*} = 1 + \frac{G_1^* - G^*}{L_a^* + G^*} \] (66)

Thus, the local government spends \( L_a^* + G_1^* \) on an amount of the subsidized commodity with a value equal to \( L_a^* + G^* \).

If the income component of the received categorical grant is \( G_1 \), then the price component of the transfer will be equal to \( G - G_1 \). And since these components are not observable, it will be assumed that the grant mechanism works such that \( G_1 \) represents a fixed proportion \( \phi \) of \( G \). Hence, we can define
\[ G_1 = \phi G \]  

(67)

This assumption about the relation between \( G_1 \) and \( G \) is just one among several possible assumptions. For example, one could assume \( G_1 \) to be a constant; or one could assume \( \phi \) to be an increasing function of \( G \) on the basis that a larger categorical grant could be easier to convert to fungible resources. As McGuire (1978) explains, any assumption about \( \phi \) implies a particular bureaucratic process. Assuming \( \phi \) as constant across local governments imply that (1) the size of the categorical grant received is exogenous to the local government, (2) the local government is effectively able to convert a fraction \( \phi \) of the total grant into fungible resources, and (3) the federal government aims to maximize local provision of the aided good, \( Q_a \), with the remaining fraction, \((1 - \phi)\), of the grant.

The local budget constraint becomes

\[ B = L_a + L_n + \phi G \]  

(68)

and the price for local government consumption on the aided category is given by

\[ p = \frac{L_a + \phi G}{L_a + G} = 1 + \frac{G(\phi - 1)}{L_a + G} \]  

(69)

or

\[ p = 1 + (\phi - 1)q \]  

(70)

where
\[ q = \frac{G}{L_a + G} \quad (71) \]

The problem of decomposing a transfer into its income and price components rests on the statistical identification of parameter \( \phi \); McGuire (1975) has pointed out that only a limited number of functional forms allows for identification of the relevant parameters through the use of linear estimation techniques. In particular, since the parameter \( \phi \) is not observable, the expenditure function must take the form of a polynomial in budget and prices, or

\[ [\text{Expenditure on the aided commodity}] = \alpha_0 + \alpha_1 B + \alpha_2 p \quad (72) \]

In order to derive a function of this form, it will be assumed that the local bureaucrats maximize a utility function, \( U(Q_n, Q_a) \), subject to the local government’s budget constraint. This utility function is assumed to represent the preferences of local bureaucrats, which will not necessarily coincide with the preferences of the residents of the local jurisdictions.

Specifically, it is assumed that local bureaucrats maximize a utility function of the Stone-Geary form

\[ U(Q_n, Q_a) = (1 - \alpha_1) \log \left( Q_n + \frac{\alpha_0}{\alpha_1} \right) + \alpha_1 \log \left( Q_a - \frac{\alpha_2}{1 - \alpha_1} \right) \quad (73) \]

subject to

\[ B = Q_n + pQ_a \quad (74) \]
where $Q_n$ and $Q_a$ denote physical quantities of the non-aided and aided commodities respectively; $p$ represents the post-grant price of the aided commodity; and $\frac{\alpha_0}{\alpha_1}$ and $\frac{\alpha_2}{1 - \alpha_1}$ are interpreted as subsistence levels of $Q_n$ and $Q_a$ respectively. The price of the non-aided commodity has been assumed to be equal to unity.

The selection of a Stone-Geary utility function may appear to be arbitrary, but this functional form is one of the few which allows for proper identification of the key parameters. In addition, this functional form has been widely used in studies analyzing local fiscal response to grants.\(^{14}\)

First order conditions imply that

$$pQ_a = \frac{\alpha_0}{1 - \alpha_1} + \frac{\alpha_1}{1 - \alpha_1}Q_n + \frac{\alpha_2}{1 - \alpha_1}p$$ \hspace{1cm} (75)

and substituting the budget constraint (74) into equation (75) we obtain

$$pQ_a = \alpha_0 + \alpha_1 B + \alpha_2 p$$ \hspace{1cm} (76)

Assume the total cost of a physical unit of $Q_a$ is $\$1$, we have that

$$Q_a = L_a + G$$ \hspace{1cm} (77)

Using equations (65) and (66), equation (76) can be rewritten as

$$L_a + G_1 = \alpha_0 + \alpha_1 (L_a + L_a + G_1) + \alpha_2 \left(\frac{L_a + G_1}{L_a + G}\right)$$ \hspace{1cm} (78)

---

\(^{14}\)For a deeper illustration of the implications of using a Stone-Geary utility function in the context of the present work see McGuire (1975). Slack (1980) uses both a Stone-Geary and a trans-log utility functions, contrasting the results.
Substituting equation (67) into (78) we obtain the structural equation to estimate

$$L_a + \phi G = \alpha_0 + \alpha_1(L_a + L_n) + \alpha_1\phi G + \alpha_2\left(\frac{L_a + \phi G}{L_a + G}\right)$$  \hspace{1cm} (79)

Now, to this point we have been assuming that the whole fraction $\phi G$ of the categorical transfer which is perceived as a budget supplement by the local government is used to finance public expenditures. But there is the possibility that only a portion $\pi$ of the income component, $\phi G$, actually is used to finance public expenses on either education or non-aided goods, with the remaining fraction $(1 - \pi)\phi G$ being used to reduce local taxes. In this case, the structural equation (79) becomes

$$L_a + \phi G = \alpha_0 + \alpha_1(L_a + L_n + \pi\phi G) + \alpha_2\left(\frac{L_a + \phi G}{L_a + G}\right)$$  \hspace{1cm} (80)

which by substituting equations (70) and (71) may be rewritten as

$$L_a + \phi G = \alpha_0 + \alpha_2 + \alpha_1(L_a + L_n + \pi\phi G) + \alpha_2(\phi - 1)q$$  \hspace{1cm} (81)

Finally, solving for $L_a$, we obtain the reduced form equation

$$L_a = \frac{\alpha_0 + \alpha_2}{1 - \alpha_1} + \frac{\alpha_1}{1 - \alpha_1}L_n + \frac{(\alpha_1\pi - 1)\phi}{1 - \alpha_1}G + \frac{\alpha_2(\phi - 1)}{1 - \alpha_1}q + u$$  \hspace{1cm} (82)

where $q = \frac{G}{L_a + G}$ and $u$ represents an error term.

Figure 3-1 illustrates how alternative effective budget constraints can help to explain the choice of bundle $a$ by the local government. The effective budget constraint depends on the actual indifference curve crossing that bundle. But since we cannot directly observe
preferences we rely on observed allocations of local public expenditures, assuming that these observations reveal the local bureaucrats preferences. The model developed in this subsection assumes that all the variation across observations is the result only of differences in prices and budget size, and is not the result of differences in preferences. Nevertheless, preferences across local governments may vary because of differences in population size, level of aggregate income, population density, and so on.

3.3.4 Normalization of Preferences

In order to control for differences in preferences across observations, McGuire (1975) suggests the introduction of preference-normalizing variables, which will be added directly into the reduced form equation in order to control for differences in preferences across states. In this case, the reduced form equation (82) becomes

\[
L_a = \frac{\alpha_0 + \alpha_2}{1 - \alpha_1} + \frac{\alpha_1}{1 - \alpha_1}L_n + \frac{(\alpha_1, \pi - 1)\phi}{1 - \alpha_1}G + \frac{\alpha_2(\phi - 1)}{1 - \alpha_1}q + \frac{\sum \alpha_i N_i}{1 - \alpha_1} + u
\]

(83)

where \(N_i\) does represent preference normalizing variable \(i\), and all other variables are defined as before.

We estimate the structural parameters of equation (81) in order to analyze the empirical decomposition of federal grants for basic education received by state governments in Mexico.

3.4 Analyzing Federal Grants for Basic Education

Whether local governments view grants as a general budget supplement or as a price reduction for the subsidized category will depend on the estimated value for parameter \(\phi\).
A value of $\phi = 1$, combined with a value of $\alpha_2 = 0$, imply that local governments consider education grants only as a supplement for their fungible resources. On the other hand, a value of $\phi = 0$ will imply that education grants are perceived by local bureaucrats only as a price reduction for expenditures in the aided category.

The same sample used and described in Section 3.2 will be used to estimate the structural parameters in equation (81). Indirect least squares (ILS) will be used; the coefficients in the reduced form equation (83) will be estimated first, and we will then solve for the structural coefficients in equation (81).

In addition to the variables described in detail in Subsection 3.2.2.1, population, urbanization level, and other variables will be used as controls for any differences in preferences across states.

### 3.4.1 Test for Multipart Pricing in the Grant Mechanism

The appropriate equation to be estimated is expression (83), which may be rewritten as

$$L_a = \beta_0 + \beta_1 L_n + \beta_2 G + \beta_3 q + \sum_i \beta_i N_i + u$$  \hspace{1cm} (84)

As state population, as well as population density,\textsuperscript{15} will be used as a preference-normalizing variable, equation (84) becomes

$$L_a = \beta_0 + \beta_1 L_n + \beta_2 G + \beta_3 q + \beta_s S + \beta_d D + u$$  \hspace{1cm} (85)

As is apparent from equations (82) and (84), the structural parameter $\alpha_1$ is perfectly identified, while parameters $\alpha_0$, $\pi$, $\phi$, and $\alpha_2$ are underidentified. A solution to this

\textsuperscript{15}Number of residents per square kilometer.
problem is to assume a value for one of the underidentified parameters in order to be able to identify the remaining three.

Since $\phi$ and $\alpha_2$ are key parameters that we wish to estimate, and since we know that parameter $\pi$ can only take values between 0 and 1, it is assumed to take on a value of $\pi^*$. This will allow us to identify parameters $\alpha_0$, $\phi$, and $\alpha_2$ as a function of $\pi^*$.

The results presented in Table 3-2 below indicate that the fraction, $\phi$, which state governments transform into fungible resources is virtually zero. The estimated marginal propensity to spend fungible resources on educational services, $\alpha_1$, is very small. A $1 increase in fungible resources available to the state governments yields an increase of only 1.3 cents on state educational expenditures. This estimate implies that no resources are available for potential reductions of state taxes. Therefore, changes in the assumed value for $\pi$, the fraction of $\phi G$ which is used to finance additional public expenditures, have very small, almost negligible effect, on the estimated values for the rest of the structural parameters.

If the fraction of total costs of public educational services covered by state tax collections increases by 0.1 units, then the typical state government's spending in education will rise for about $450 million. This result is derived from the estimated value of 4,503.5 for $\alpha_2$, the price sensitivity of local resource allocations to public education.16

The overall effect of a $1 increase in educational grants on state own expenditures on education is calculated from the reduced form equation (85) as

16. From equation (80) and since $\rho = (L_a + \phi G)/(L_a + G)$, we have that $\partial(L_a + \phi G)/\partial \rho = \alpha_2$. 

Table 3-2. Results of test for a combination of income and price effects.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>COEFFICIENT</th>
<th>ESTIMATED VALUE</th>
<th>STD ERROR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>$\beta_0$</td>
<td>357.7830</td>
<td>231.327</td>
</tr>
<tr>
<td>$L_n$</td>
<td>$\beta_1$</td>
<td>0.013</td>
<td>0.008</td>
</tr>
<tr>
<td>$G$</td>
<td>$\beta_2$</td>
<td>0.008</td>
<td>0.059</td>
</tr>
<tr>
<td>$q$</td>
<td>$\beta_3$</td>
<td>-4598.107</td>
<td>291.648</td>
</tr>
<tr>
<td>$S$</td>
<td>$\beta_s$</td>
<td>291.648</td>
<td>52.517</td>
</tr>
<tr>
<td>$D$</td>
<td>$\beta_d$</td>
<td>1.887</td>
<td>0.441</td>
</tr>
</tbody>
</table>

IDENTIFICATION OF STRUCTURAL PARAMETERS

<table>
<thead>
<tr>
<th>STRUCTURAL PARAMETER</th>
<th>DEFINITION</th>
<th>VALUE AS FUNCTION OF $\pi$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\pi^* = 0$</td>
</tr>
<tr>
<td>$\alpha_0$</td>
<td>= $\beta_0/(1 + \beta_1) - \alpha_2$</td>
<td>-971.618</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>= $\beta_1/(1 + \beta_1)$</td>
<td>0.013</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>= $(\beta_3(1 - \alpha_1))/(\phi - 1)$</td>
<td>4503.533</td>
</tr>
<tr>
<td>$\phi$</td>
<td>= $\beta_2/[\beta_1(\pi^* - 1) - 1]$</td>
<td>-0.008</td>
</tr>
</tbody>
</table>

*a. $L_n$, $L_a$, and $G$ were measured in million pesos; $S$, in million of inhabitants; and $D$, in residents per square kilometer.*

$\partial L_a/(\partial G) = \beta_2 + \beta_3[L_a/(L_a + G)]^2$. For the typical state, a $1 increase in educational grants will decrease state own expenditures on education by 33 cents, or will increase total state expenditures on education (inclusive of educational grants) by 67 cents. Thus, 67% of educational grants are actually used to finance an increase in total

---

17. From equation (85) we have that $\partial L_a/(\partial G) = \beta_2 + \beta_3[\partial q/(\partial G)]$, and since $q = G/(L_a + G)$ then $\partial q/(\partial G) = L_a/(L_a + G)^2$. Therefore, $\partial L_a/(\partial G) = \beta_2 + \beta_3[L_a/(L_a + G)^2]$. In terms of the structural parameters, we have that $\frac{\partial L_a}{\partial G} = \frac{(\alpha_1 \pi - 1) \phi}{2 - \alpha_1} + \frac{\alpha_2 (\pi - 1)}{1 - \alpha_1} \left[ \frac{L_a}{(L_a + G)^2} \right]$. 
state spending in education. This estimation is fully consistent with the estimate of the flypaper effect obtained in Section 3.2.

The own price elasticity of local demand for educational spending, given by $\varepsilon_p = \{\alpha_2/(L_a + G)\} - 1$,\(^{18}\) has the wrong sign and is equal to 0.131 for the sample mean.

In the following subsection I will add one more preference-normalizing variable to provide additional control for differences in preferences across states. Moreover, if the federal government is effectively enforcing the application of the grant to ensure that local effort is not reduced by the states, then the observed expenditure allocations could be the result, not of mere price and income effects, but of a highly restricted grant strategy by the central government.

As there is virtually no income effect associated with educational grants I will test a special case of the basic model. Instead of obtaining an estimated value for the fraction, $\phi$, that state governments transform into fungible resources, it will be assumed \textit{a priori} that this fraction is equal to zero. This assumption implies \textit{a priori} only a pure price effect associated with grants. This assumption may help to improve the estimation of the price elasticity of state demand for public educational services.

### 3.4.2 Test for a Pure Price Effect

In order to test for a pure price effect of grants, I now assume \textit{a priori} that $\phi = 0$. The structural equation now becomes

\[^{18}\text{Since } \alpha_2 = \Delta(pQ_a)/(\Delta p) = (p\Delta Q_a + Q_a\Delta p)/(\Delta p), \text{ then } \varepsilon_p = (p\Delta Q_a)/(Q_a\Delta p) = (\alpha_2/Q_a) - 1.\)

From equation (77) we know that $Q_a = L_a + G$, hence $\varepsilon_p = \{\alpha_2/(L_a + G)\} - 1.$
\[ L_a = \alpha_0 + \alpha_2 + \alpha_1 (L_a + L_n) + \alpha_2 \left( \frac{L_a}{L_a + G} \right) \]  

(86)

For this particular case, the post-grant of expenditure on the aided category is given by

\[ p = \frac{L_a}{L_a + G} = 1 - q \]  

(87)

where \( q = \frac{G}{L_a + G} \), just as before. Then, solving for \( L_a \) and adding preference-normalizing variables, we obtain the reduced form equation

\[ L_a = \frac{\alpha_0 + \alpha_2}{1 - \alpha_1} + \frac{\alpha_1}{1 - \alpha_1} L_n + \frac{(-\alpha_2)}{1 - \alpha_1} q + \frac{i}{1 - \alpha_1} + v \]  

(88)

And since population, population density, and degree of urbanization will be used as preference-normalizing variables, equation (88) may be rewritten as

\[ L_a = \beta_0 + \beta_1 L_n + \beta_3 q + \beta_5 S + \beta_6 D + \beta_7 U + v \]  

(89)

Note that the structural parameter \( \pi \) now disappears from structural equation (88), since under this specification the states will not be able to turn any fraction of the grant into fungible resources. All of the structural parameters are now perfectly identified.

In this case, all of the regression coefficients are statistically significant. Once again, the estimated marginal propensity to spend fungible resources on educational services, \( \alpha_1 \) is very small. But this time, the estimated price elasticity of local demand for educational spending is negative, though very close to zero.
The results in Table 3-3 indicate that for each additional $1 of local fungible resources available to state governments, local bureaucrats decide to spend only 1.1 cents on educational expenditures, a result very similar to our previous estimation. Since the price sensitivity of local resource allocations to public education, $\alpha_2$, is now equal to 3856.3, if the fraction of total costs of public educational services covered by state tax collections increases by 0.1 units, then the typical state government’s spending in education will increase by $386 million. This implies a price elasticity of local demand for educational spending, $\varepsilon_p$, with a value of -0.031 for the typical state. The sign of this elasticity resulted as expected, though the magnitude appears to be very small.\(^{19}\)

The overall effect of a $1 increase in educational grants on state own expenditures on education is calculated now by \( \partial L_a/\partial G = \beta_3 [L_a/(L_a + G)]^2 \), as when a null income effect of grants is assumed the parameter $\beta_2$ is equal to zero. For the typical state, a $1 increase in educational grants will decrease state own expenditures on education by 29 cents, or will increase total state expenditures on education (inclusive of educational grants) by 71 cents. In this case 71% of educational grants are actually used to finance an increase in total state spending in education. Again, this is very close to the estimation we obtained in Section 3.2.

The results support the hypothesis of a pure price effect of educational grants. State governments perceive grants for basic education just as a pure price reduction of educational services.

\(^{19}\)Most estimates in the literature are low. McGuire (1979) estimates a price elasticity of demand for education equal to -0.02 for a sample of 48 U.S. states for the years 1996-71. In contrast, Feldstein (1975) reports this elasticity in a range between -0.94 and -1.599 depending of the sample and estimation method.
### Table 3.3. Results of test for a pure price effect of educational grants.

#### REDUCED FORM PARAMETERS

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>COEFFICIENT</th>
<th>ESTIMATED VALUE</th>
<th>STD ERROR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>$\beta_0$</td>
<td>2290.264</td>
<td>356.110</td>
</tr>
<tr>
<td>$L_n$</td>
<td>$\beta_1$</td>
<td>0.011</td>
<td>0.007</td>
</tr>
<tr>
<td>$q$</td>
<td>$\beta_3$</td>
<td>-3898.738</td>
<td>279.516</td>
</tr>
<tr>
<td>$S$</td>
<td>$\beta_4$</td>
<td>337.471</td>
<td>21.576</td>
</tr>
<tr>
<td>$D$</td>
<td>$\beta_d$</td>
<td>1.160</td>
<td>0.364</td>
</tr>
<tr>
<td>$U$</td>
<td>$\beta_u$</td>
<td>10.072</td>
<td>2.352</td>
</tr>
</tbody>
</table>

#### IDENTIFICATION OF STRUCTURAL PARAMETERS

<table>
<thead>
<tr>
<th>STRUCTURAL PARAMETER</th>
<th>DEFINITION</th>
<th>ESTIMATED VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_0$</td>
<td>$\frac{\beta_0}{(1 + \beta_1)} - \alpha_2$</td>
<td>-1591.247</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>$\beta_1/(1 + \beta_1)$</td>
<td>0.011</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>$-\beta_3(1 - \alpha_1)$</td>
<td>3856.318</td>
</tr>
</tbody>
</table>

---

3.5 Comparison of Results

We have evaluated the impact of educational grants on state educational expenditures using two different methods. First, a set of regressions of state educational expenditures with educational grants and private income as explanatory variables was investigated. Second, a model of local fiscal response was used to further analyze the impact of educational grants on state educational expenditures by decomposing the overall effect of grants into income and price effects.

Some of the results obtained by the second methodology are comparable with the results from the first set of regressions. The first method showed that educational spending
by state governments captures 67% of grant money designated for education. For each additional $1 a state receives as educational grants, 67 cents are actually used to finance educational expenditures.

The second method yields exactly the same conclusion when the overall effect of grants is decomposed into income and price effects. The second technique associates almost all of the impact of grants with a price reduction of expenditures on education. In an additional test, when a null income effect is assumed (rather than estimated), empirical evidence indicates that educational spending captures 71% of grants designated for education, attributing all of the overall impact of grants to a price reduction for educational spending.

3.6 Policy Implications and Concluding Remarks

Simple regressions of state expenditures with educational grants and income as independent variables, indicate a large stimulative effect of grants for basic education on state expenditures on this function.

It is estimated that a $1 increase in educational grants induces an increase in total state expenditures, state expenditures in education, and state non-educational expenditures, of about $2.08, $0.67, and $1.41 respectively. Though it is likely that a positive correlation between educational grants and revenue-sharing grants magnifies the impact of grants on non-educational state expenditures (and ultimately on total state expenditures), the results indicate that the resources the states receive as educational grants are kept in the public sector, with little evidence of state tax relief for individuals. This is consistent with the flypaper effect of grants, or the notion that “money sticks where it hits.”
The large stimulative effect of educational grants on state expenditures on education is confirmed through the use of a model of local fiscal response which decomposes the overall effect of educational grants into income and price effects. This large stimulative effect of grants, may be partially explained by empirical evidence showing that educational grants are effectively perceived by local bureaucrats as a pure price reduction for state expenditures on education. This implies that this grant mechanism is not effectively equivalent to a revenue-sharing grant system. Hence, if the federal government decided to move from the current categorical non-matching grant mechanism, toward a revenue-sharing (or block) grant mechanism for this particular transfer program,\(^{20}\) we should expect a modification in the current composition of public state expenditures.

Finally, some words of caution. The low estimated magnitude for the price elasticity of state demand for educational services indicates that state expenditures on education are not very responsive to changes in the effective matching ratio (not statutory) of educational grants. Thus, the observed allocations of state expenditures between different categories, may well be the result, not of pure income and price effects, but of a highly policed grant mechanism, enforced to avoid reductions of local fiscal effort. Unfortunately, the methodology here used does not allow to identify whether or not that is the case.

In addition, the results could be sensitive to the selection of one particular functional form to represent the local bureaucrats’s utility function.\(^{21}\) Thus, other functional forms capable of producing estimable structural equations could be tried in order to compare the results here presented.

\(^{20}\)Assuming each state would receive the same amount of grants.
\(^{21}\)See Slack (1980).
References


