IS THERE A FISCAL RESPONSE TO DOMESTIC AND INTERNATIONAL TRANSFERS IN NICARAGUAN MUNICIPAL GOVERNMENTS?

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ABSTRACT

Since 1960 over $2.5 trillion has been spent on development assistance, often seemingly without any significant improvement in the development outcomes of recipient countries. A possible reason for this failure is that donor funds cause recipient governments to divert revenue from expenditures that citizens desire to expenditures that donors desire. This paper analyzes the effects of foreign aid flows and central government transfer payments on municipal government expenditure patterns and tax revenue in Nicaragua from 2000 to 2004. I hypothesize that increased aid transfers from foreign donors and transfers from the central government lead municipal governments to (a) substitute transfer payments for tax revenue, leading to a decline in taxes collected; and (b) shift spending from consumption expenditures to investment expenditures, preferred by donors. Using a data from the Nicaraguan central government, I examine the fungibility of transfers across municipalities and compare the effects of national versus international transfers.

The results demonstrate that aid and central government transfers have a minimal effect, albeit negative, on tax revenue; and that aid from international donors and transfers from the central government both cause a shift in expenditures from consumption to investment. This shift is stronger in the case of central government
transfers, implying that revenue received from foreign donors is more fungible than revenue received from the central government.
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Introduction:

Between 1960 and 2005, the developed countries of the world spent just over $2.7 trillion (measured in constant 2004 dollars) on official development assistance (ODA) to under-developed countries (OECD, 2006). To evaluate if this money was well spent or not, results should be measured relative to the goals of foreign aid programs. During the Cold War a substantial portion of development assistance was provided to American allies to strengthen strategic alliances, not to enhance development. More recently, however, the primary goal of aid programs has been to promote economic development. Given this focus on poverty reduction and the large sums of money that continue to flow between rich and poor countries, the question that naturally arises is: “Is aid working?”.

Some of the forces that may constrain aid effectiveness include: exchange rate appreciation, an increase in fiscal uncertainty, limited recipient country administrative capacity, and changes in recipient government behavior that may be induced by aid flows (Heller and Gupta, 2002).

The analysis in this paper examines this final, potential constraint to aid effectiveness by looking at the effects that development assistance has on domestic tax revenue and the composition of government spending. I hypothesize that increased aid flows lead recipient governments to (a) substitute transfer payments for tax revenue, leading to a decline in taxes collected; and (b) shift spending from consumption
Why is this important? Foreign assistance programs, particularly in the United States, are coming under increased pressure to demonstrate results (The New York Times Editorial, 2005). Measuring the effectiveness of aid becomes more difficult, though, if transfers cause changes in the fiscal behavior of recipient governments. Knowing the extent to which these behavioral responses occur is essential in determining the effectiveness of foreign assistance programs (Heller and Gupta, 2002). A brief example may be illustrative.

Suppose a donor provides money to a developing country government to fund a road rehabilitation project. This transfer could be considered a good investment if, among other factors, the project was high on the list of the recipient government’s priorities but was not going to be funded because of the government’s resource constraints. However, if the recipient country had planned to use a portion of their limited resources to fund this project anyway, the money provided by the donors will allow the recipient government to free up the resources they were prepared to commit to road rehabilitation to be used elsewhere. This “freed” money could be (a) spent in another productive area, (b) re-directed to expenses less likely to produce positive development outcomes, or (c) used to reduce the amount of revenue generated through taxes. In all three cases, the return on the investment of the donors should not be

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1 Investment expenditures refer to purchases of machinery and equipment, public construction works, and “social investment” including institutional strengthening. Consumption expenditures refer to administrative fees, salaries, purchases of services and products, interest payments, and transfers and donations. For a more thorough discussion of the disaggregation of these data, see Government of Nicaragua, 2006b.
measured by the return on the investment in the road, but rather the return on the marginal spending by the recipient – the spending that would not have occurred without the donor’s funds.

From this example an important lesson about aid effectiveness can be drawn: if donors and recipients have exactly the same preferences, then the fiscal response to the aid inflows is to increase spending exactly as donors hoped. Whichever project represents the marginal spending in which the recipient wants to invest would be the same project the donor wishes to fund. However, the reality is almost always quite different from this. When the fiscal response of a recipient government is not to increase spending “dollar for dollar” equivalent to the where the aid inflow is directed, the result is referred to as aid fungibility. If studies can demonstrate that aid fungibility occurs – that the provision of aid tends to alter government tax and/or expenditure patterns in a way unintended by donors – it brings into question the ability to measure the effectiveness of aid. Additionally, if studies of this nature can identify governments that have a greater (or lesser) propensity to more closely align their spending with donor interests, donors will be better able to target assistance to governments most likely to produce the expected return on the funded investment.

There is an extensive literature on aid fungibility, surveyed below, that examines how aid transfers are used. Studies focusing on the effects of aid on tax revenue are divided, with some studies showing aid reducing revenues, and others demonstrating either no effect or an increase in revenue – making the net result of this research
inconclusive. Studies examining the effects of aid on government expenditures generally show that aid is fungible to an extent, but the amount varies substantially on a study by study basis.

However, most of these studies suffer from similar problems with their data. The conclusiveness of the research on single countries using time-series data is limited by the small number of observations. On the other hand, studies that use panel or cross-section data from various countries suffer from data incompatibility and the missing variable bias inevitable in cross-country regression analyses.

This paper fills a gap in the existing literature by analyzing the fiscal response to aid flows using panel data from within a single country at the municipal level – greatly reducing both the cross-country omitted variable biases and the problems with small sample sizes. Using data from the Nicaraguan Institute of Public Works, this analysis examines the fiscal response to aid flows in 152 municipalities in Nicaragua annually from 2000 through 2004. It looks at the effects of aid on both tax revenue and the composition of government spending disaggregated between investment and consumption expenditures. By using these data, this analysis draws more conclusive results regarding the effects of aid transfers on public sector fiscal behavior in Nicaragua. However, because this analysis involves only data from Nicaragua, it faces the common tradeoff between internal and external validity: the results are less-generalizable to other countries than cross-country analyses, but more accurate regarding the effects of aid fungibility within Nicaraguan municipal governments.
Literature Review:

The literature regarding the effects of aid on public sector behavior can be divided into studies which examine (a) how aid is allocated by recipients between different categories of government spending, (b) the tax response of recipient governments to aid, and (c) a more complete “fiscal response” of recipient governments to aid. Papers in this final category look jointly at the total effects of aid on both the expenditure and revenue sides of government. Within each of these categories of studies some authors use single-country, time series data to examine the effects of changes in aid flows over time, while others use pooled, cross-section or panel data to do cross-country comparisons.

The effect of aid on recipient government expenditures

A review of the studies regarding the effects of aid in changing the allocation of government expenditures shows that aid is fungible to some extent, but these results vary markedly across studies. One of the first serious empirical analyses was performed by Heller (1975) who finds using pooled, time-series, cross-section data for Sub-Saharan Africa (SSA) that an increase in ODA is associated with a shift in government expenditures from consumption to investment. However, in another pooled, time-series, cross-section analysis, Boone (1996) finds that changes in public sector investment are not associated with an increase in aid, but public sector consumption is. In a panel data analysis, Devarajan, Rajkumar, and Swaroop (1999) examine 18 SSA countries and find that an increase in ODA is correlated with an increase in both consumption and investment expenditures in equal amounts. Feyzioglu, Swaroop, and Zhu (1998) use
panel data for fourteen countries and conclude that aid is not fungible between sectors, but after increasing the sample size they find evidence of aid fungibility in three of the five sectors analyzed. Kahn and Hoshino (1992) find that increased aid is correlated with an increase in government consumption, and that loans are correlated with more spending in public investment than grants. Remmer (2004) also finds that increased aid is associated with an increase in government spending. In an analysis that examines aid fungibility from a different perspective, Hagen and Hattlebakk (2003) find that aid is least fungible from donors that are the most generous – defined as the amount of aid as a percentage of donor GDP. Finally, Sanz and Velazquez (2002) find that aid is not an important determinant of the patterns of government expenditure when included in an analysis with income, price levels, institutional quality, population density, age structure, and other variables.

The findings of the single-country case studies also consistently demonstrate the fungibility of aid, although again the extent is variable across studies. Franco-Rodriguez, Morrissey, and McGillivray (1998) find that in Pakistan about half of all aid money is allocated to government consumption instead of capital investment. In another analysis of aid fungibility in Pakistan, Khilji and Zampelli (1991) find that U.S. military aid is nearly fully fungible, probably because of the relatively small size of U.S. aid in the Pakistani military budget. In studying Tanzania and Zambia, Hoffman and Gibson (2005) find that external funds (including transfers from the central government) are associated with a shift in the use of locally-generated revenue towards consumption
expenditures and away from investment. McGillivray (2002) finds that in the Philippines increased aid is correlated with a reduction in public sector investment. Two separate studies by Pack and Pack (1990, 1993) find that aid actually augments investment expenditures and that categorical aid is spent where it is intended in Indonesia (the sole non-fungible finding in the group), but in the Dominican Republic, increased aid is associated with major shifts in expenditure away from development and into deficit reduction and debt service. Finally, using data from India, Swaroop, Jha, and Rajkumar (2000) find that “the central government converts most foreign funds, including those earmarked for state governments, into fungible monies.”

The effect of aid on recipient government tax revenue

The existing literature regarding aid fungibility in tax revenue is less conclusive. Two panel data analyses – Devarajan, Rajkumar, and Swaroop (1999), and Teera and Hudson (2004) – and three case study analyses, performed on Indonesia (Pack and Pack, 1990), Uganda (Fagernas and Roberts, 2004), and Malawi (Fagernas and Roberts, 2004), show no correlation or a positive correlation between increased aid and revenue generation through taxes. On the other hand, Brautigam and Knack (2004), Heller (1975), and Remmer (2004) all use pooled, cross-country analyses and find a negative correlation between aid and tax revenue. Fagernas and Roberts (2004) studying Zambia; Franco-Rodriguez, Morrissey and McGillivray (1998) studying Pakistan; Hoffman and Gibson (2005) studying Tanzania and Zambia; McGillivray (2002) studying the
Philippines, and Pack and Pack (1993) studying the Dominican Republic also find a negative correlation between aid and tax revenue.

**Conceptual Models:**

The primary hypothesis of this analysis is that aid flows affect the revenue generation and expenditure patterns of municipal governments in Nicaragua. Specifically, I hypothesize that revenue from central government transfers or official development assistance tends to replace revenue from taxes; and that increases in revenue from transfers cause government spending to shift from consumption to investment.

**Revenue Model**

To analyze a government’s revenue response to aid, I assume that policymakers maximize their utility by setting annual targets for expenditure categories subject to revenue constraints, as in Franco-Rodriguez, Morrissey, and McGillivray (1998) and Devarajan, Rajkumar, and Swaroop (1999). Given the expenditure targets assumption, receiving transfers from the central government or development assistance has the effect of reducing the amount of revenue needed to be collected in taxes to achieve these expenditures targets. The equation to represent this relationship is:

\[ T_{it} = \gamma_0 + \gamma_1 \cdot ODA_{it} + \gamma_2 \cdot CGT_{it} + \gamma_3 \cdot E_{it} + \nu_{it} \]

where \( T_{it} \) is tax revenue per capita in municipality \( i \) in time period \( t \), \( ODA_{it} \) is official development assistance per capita in municipality \( i \) in time period \( t \), \( CGT_{it} \) is central government transfers per capita in municipality \( i \) in time period \( t \), \( E_{it} \) is total expenditures per capita in municipality \( i \) in time period \( t \), the \( \gamma \)'s are constants that do not vary over
time or municipalities, \( \nu \) is an error term, and the unit of analysis is the municipality. If the revenue target assumption holds, \( \gamma_1 \) and \( \gamma_2 \) will both be negative, as increasing aid and central government transfers reduces taxes collected. This assumption is incorrect, however, if \( \gamma_1 \) and \( \gamma_2 \) are non-negative. If aid and central government transfers increase and tax revenues do not decrease, policymakers are trying either to maximize revenue or find a middle ground between these two extremes.

**Expenditure Models**

To analyze a government’s expenditure response to official development assistance and central government transfers, I assume that changes in the primary source of municipal government funding change the pattern of accountability between the government and its citizens, and that donors have a stronger preference for investment than local governments do. I hypothesize that these changes in accountability make Nicaraguan municipal governments more likely to use the transferred resources in a manner aligned with donor priorities, rather than with the priorities of local citizens – i.e. to transfer spending from consumption expenditures to capital investment where it is primarily targeted.\(^2\)

For example, assume a municipality receives no funding from transfers and spends 20% of its revenue on consumption for expenses such as teacher and police salaries. Presumably, because of the high level of accountability between a municipal government and its citizens, this would approximately represent the amount of

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\(^2\) In 2004 only 5.4% of transfers from the central government and foreign donors to Nicaraguan municipalities were targeted for non-investment expenditures (Government of Nicaragua, 2006b).
consumption expenditures that the municipalities’ citizens desire. If this municipal
government began receiving transfers from official development assistance, the
accountability hypothesis suggests that the municipality would increase the overall
amount of revenues spent on investment.

I also hypothesize that the extent to which municipal governments become
accountable to donors depends on the size of the transfers. If only a small amount of total
revenue is from donors, municipal governments are likely to use a portion of these funds
in a fungible manner to increase consumption spending since the degree to which the
municipal government is accountable to the donor is minimal. This “route of
accountability” hypothesis is demonstrated in Figure 1.

If the first case is the dominant resource generating model, municipal
governments are most responsive to their citizens through taxation and voting. If the
accountability assumption holds, the local government will be likely to use a higher
proportion of its revenue for consumption. In the second case where the primary source
of revenue is central government transfers, the primary accountability relationship is now
with the central government. As central government transfers earmarked for investment
expenditures increase, the amount of expenditures used for investment will increase, with
a subsequent decrease in consumption. In the third case, the addition of international
donors to the equation adds another step in the route of accountability between citizens
and municipal governments, making the local government even less responsive to its
citizens and more likely to shift from consumption to investment expenditures.
To be clear, all of these mechanisms are occurring simultaneously in all the municipal governments, but the extent to which one is the dominant form of revenue generation varies across municipalities. As Moss, Pettersson, and van de Walle (2006, pg. 14-15) discuss, transfers from donors and the central government “can result in a reduction in government accountability because governing elites no longer need to ensure
the support of their publics…when they do not need to raise revenues from the local economy”.

The first equation used to test this accountability relationship is:

\[ PropE^C_{it} = \alpha_0 + \alpha_1*ODA_{it} + \alpha_2*CGT_{it} + \alpha_3*T_{it} + \varepsilon_{it} \]

where \( PropE^C_{it} \) is consumption expenditures as a proportion of total expenditures in municipality \( i \) in time period \( t \), the \( \alpha \)'s are constants that do not vary over time or municipalities, \( \varepsilon_{it} \) is an error term, and the other variables are the same as in the revenue equation above. The unit of analysis is the municipality. If the route of accountability assumption holds, then as aid and central government transfers increase in this model, government consumption as a proportion of total expenditures will decrease, and \( \alpha_1 \) and \( \alpha_2 \) will be negative.

Two additional equations are used to examine the accountability relationship and the effect of aid and transfers on expenditures:

\[ E^C_{it} = \beta_0 + \beta_1*ODA_{it} + \beta_2*CGT_{it} + \beta_3*T_{it} + \mu_{it} \]
\[ E^I_{it} = \lambda_0 + \lambda_1*ODA_{it} + \lambda_2*CGT_{it} + \lambda_3*T_{it} + \eta_{it} \]

where \( E^C_{it} \) is consumption expenditures per capita in municipality \( i \) in time period \( t \), \( E^I_{it} \) is investment expenditures per capita in municipality \( i \) in time period \( t \), the \( \beta \)'s and \( \lambda \)'s are constants that do not vary over time or municipalities, \( \mu_{it} \) and \( \eta_{it} \) are error terms, and the other variables are the same as described above. The unit of analysis is again the municipality. I hypothesize that an increase in official development assistance or central government transfers will lead to an increase in the level of both consumption expenditures (necessary to manage the new revenue and maintain old levels of
consumption spending) and investment expenditures. Therefore, I posit that both $\beta_1$ and $\beta_2$ in the first model and $\lambda_1$ and $\lambda_2$ in the second model will be positive. However, the benefit of examining the effects of aid and central government transfers through these models is that the magnitudes of the coefficients on ODA and CGT will demonstrate to what degree consumption and investment expenditures vary with a change in transfers.

**Analysis Plan:**

To test these hypotheses, I examine the four equations above with a number of different modifications and using different econometric models. Typically equations such as these are estimated with logged dependent and independent variables to estimate elasticities, since running these models using a level-level specification does not often produce interesting results. However, since the ODA variable takes the value of zero in more than 100 of the 690 observations, using logs with these models reduces the sample size by approximately 15%. To produce estimates comparable to elasticities without reducing the sample size, the models are estimated with standardized coefficients.

The first analysis estimates these equations with pooled OLS. However, the problem with this estimation technique in all of these models is that there is the potential for significant bias in the estimators due to endogeneity from both simultaneity and reverse causation. In the model with tax revenue as the dependent variable, for example, the equation as written implies that the amount of aid and transfers received affects the amount of taxes collected. However, the amount of taxes a government collects may also be a determinant of the amount of aid received if the central government and international
donors direct their transfers to municipalities with weaker tax capacity. This same logic can be applied to the other equations.

Addressing Simultaneity Bias

The first step in addressing the endogeneity bias is to minimize simultaneity bias by controlling for other municipal characteristics that are likely to be correlated with both the dependent variables (tax revenue, consumption expenditures, and investment expenditures) and independent variables (official development assistance and central government transfers). The control variables used in this analysis are:

- \( Ag_i \): Proportion of households that participate in agricultural activities in municipality \( i \);
- \( FormEmp_i \): Proportion of the population employed in the formal sector in municipality \( i \);
- \( Health_i \): Proportion of the population that lives within five kilometers of a health center in municipality \( i \);
- \( Literacy_i \): Literacy rate of the population in municipality \( i \);
- \( PopDen_i t \): Population density of municipality \( i \) in time \( t \);
- \( PropMale_i \): Proportion of the population that is male in municipality \( i \);
- \( SecEd_i \): Proportion of the population with at least a secondary education in municipality \( i \);
- \( Water_i \): Proportion of the population with access to an improved water source in municipality \( i \); and
- \( WorkAge_i \): Proportion of the population between the ages of 14 and 65 in municipality \( i \).

Four of these variables (\( Literacy, SecEd, Water, \) and \( Health \)) are combined in an index as a proxy for municipal income per capita using a principal components analysis. For the sake of this discussion, the array of these control variables is represented by \( X_i \).

Adding these variables to the models previously developed, the second set of equations estimated (again with pooled OLS) is:

1. \( PropE^C_{it} = \alpha_0 + \alpha_1 ODA_{it} + \alpha_2 CGT_{it} + \alpha_3 T_{it} + \alpha_4 X_i + \varepsilon_{it} \)
2. \( E^C_{it} = \beta_0 + \beta_1 ODA_{it} + \beta_2 CGT_{it} + \beta_3 T_{it} + \beta_4 X_i + \mu_{it} \)
3. \( E'_{it} = \lambda_0 + \lambda_1 ODA_{it} + \lambda_2 CGT_{it} + \lambda_3 T_{it} + \lambda_4 X_i + \eta_{it} \)

4. \( T_{it} = \gamma_0 + \gamma_1 ODA_{it} + \gamma_2 CGT_{it} + \gamma_3 E_{it} + \gamma_4 X_i + \nu_{it} \)

It is reasonable to assume that other municipality characteristics exist that are correlated with both the dependent and independent variables in this equation, suggesting that these control variables alone will not be enough to completely eliminate the simultaneity bias. To control for the omission of municipality characteristics that do not change over time and omitted year effects that do not change across municipalities, the equations are estimated using one- and two-way fixed effects models. By controlling for any time-invariant and municipality-invariant characteristics, the only types of missing variables that could still bias the coefficient estimates are those time-varying, contemporaneous effects that are not included in the array of control variables discussed above. Therefore, if the estimates of the effects of the independent variables do not change between the OLS models and the fixed-effects models, it is unlikely that simultaneity bias is affecting the results.

Addressing Reverse Causation Bias

Suggestive evidence against reverse causation is that aid flows and central government transfers fluctuate widely within municipalities, but the dependent variables – tax revenue, consumption expenditures, and investment expenditures – have much less variance. The within-municipality standard deviation for tax revenue per capita is 31.87 Córdobas, while for ODA per capita and CGT per capita it is 94.29 Córdobas and 101.84 Córdobas, respectively. If tax revenue were a principal determinant of aid flows, one would expect to find less within-municipality variance in aid flows and central
government transfers than in tax revenue, as it is unlikely that a variable with relatively 
low variance is determining outcomes in variables with relatively high variances. 
Similarly, the within-municipality variance for consumption expenditures per capita is 
37.69 Córdobas. However, the within-municipality variance for investment expenditures 
per capita is 117.17 Córdobas, signifying the importance of using other methods to rule 
out the effects of reverse causation.

The primary method of ruling out reverse causation in this analysis is to estimate 
the models restricting all effects to a one-year lag. Any of the contemporaneous effect 
due to reverse causation is eliminated in a model where the independent variables are 
lagged, assuming no foresight on the part of policymakers. For example, if estimates are 
biased because tax revenue is partially causing the amount of aid and central government 
transfers received, how would tax revenue in the current period be the cause of the 
amount of aid and central government transfers in the previous period? This could only 
occur if policymakers deciding on the amount of aid to provide were doing so based on 
predictions of the level of tax revenue in the next period. Therefore, if the estimate of the 
effect of ODA does not change between the contemporaneous model and the lagged 
model, it is unlikely that there is any reverse causation biasing the estimates in the OLS 
model. To test this effect, $ODA_{it}$, $CGT_{it}$, and $T_{it}$ are replaced with $ODA_{i,t-1}$, $CGT_{i,t-1}$, and $T_{i,t-1}$ in the expenditure models, and $ODA_{it}$, $CGT_{it}$, and $E_{it}$ are replaced with $ODA_{i,t-1}$, $CGT_{i,t-1}$, and $E_{i,t-1}$ in the tax revenue model.
In a final attempt to overcome both forms of endogeneity bias, the equations are re-estimated using Granger causation models. In these models, the lag of the dependent variable is added as a regressor to the lagged model to completely control for all factors that caused the dependent variable in the previous time period:

1. $\text{PropEC}_i t = \alpha_0 + \alpha_1 \text{ODA}_{i,t-1} + \alpha_2 \text{CGT}_{i,t-1} + \alpha_3 \text{T}_{i,t-1} + \alpha_4 \text{PropEC}_{i,t-1} + \varepsilon_{it}$
2. $\text{EC}_i t = \beta_0 + \beta_1 \text{ODA}_{i,t-1} + \beta_2 \text{CGT}_{i,t-1} + \beta_3 \text{T}_{i,t-1} + \beta_4 \text{EC}_{i,t-1} + \mu_{it}$
3. $\text{EI}_i t = \lambda_0 + \lambda_1 \text{ODA}_{i,t-1} + \lambda_2 \text{CGT}_{i,t-1} + \lambda_3 \text{T}_{i,t-1} + \lambda_4 \text{EI}_{i,t-1} + \eta_{it}$
4. $\text{T}_i t = \gamma_0 + \gamma_1 \text{ODA}_{i,t-1} + \gamma_2 \text{CGT}_{i,t-1} + \gamma_3 \text{E}_{i,t-1} + \gamma_4 \text{T}_{i,t-1} + \nu_{it}$

The upside of these models is that they have the potential to provide more accurate estimates of the effects of the independent variables since only fixed and strictly contemporaneous effects remain in the error term. Additionally, reverse causation is ruled out through the use of lags in the other independent variables (assuming no policymaker foresight, as above). The downside is twofold: First, any cross-section variance that would have made the estimates more robust is lost. Second, as noted above, all contemporaneous effects are contained in the error terms. Because all the current effects (i.e. in time period $t$) of the independent variables are omitted from the equation, the model assumes that any effects of aid or central government transfers on expenditures and tax revenue come from the previous period. This assumption is not unrealistic in the world of aid delivery, as there is some evidence of a lag in aid delivery relative to the timing of commitments.

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3 For a complete discussion of Granger causation, see Granger (1969).
**Robustness Check**

In an attempt to check the robustness of these results, OLS equations 2-4 above will also be estimated with Zellner’s seemingly unrelated regressions (SUR) technique. This analysis is well-suited for the use of SUR since these models are not independent of one another, making the SUR estimates more efficient than OLS. In this process, all three equations are estimated simultaneously, taking into account the correlation between the error terms, to produce more efficient estimates of both the coefficients and the standard errors. For example, a weather event like a hurricane that may cause consumption, investment, and tax revenue to decrease in one year, and all increase in subsequent years as rebuilding occurs, will be captured in each equation’s error term since it is not a variable the models control for. However, by estimating the models using SUR, this correlation between the error terms is recognized, resulting in more efficient results.

This estimation technique will be performed twice: once with the basic OLS models augmented by the control variables, and once as two-way fixed effects models. The shortcoming of SUR is that the standard errors are no longer heteroskedasticity- and autocorrelation-robust. Thus, the standard errors will be more efficient due to considerations of cross-equation correlation in the error terms, but they will also be less-efficient due to the loss of important information in these estimates.
Data Description:

The models are estimated using two different datasets collected by the government of Nicaragua. The first dataset comes from the Nicaragua Institute of Public Works (INIFOM) and contains all of the observations regarding the dependent and independent variables of interest – the breakdown of municipal level revenues and expenditures, official development assistance, and central government transfers. The unit of analysis in this dataset is the municipality, and the data contain information for 152 of Nicaragua’s 153 municipalities from 2000 to 2004, for a total of 760 observations. See Appendix 1 for summary statistics.

Founded in 1990, INIFOM is the central government organization to which all the municipalities report required budgetary data. It functions as the channel through which these data reach the relevant ministries, including the Ministry of Finance. However, until the passage of Law 466 (Municipal Budgetary Transfers Law) in 2003 and Law 550 (Law of Financial Administration) in 2005, there were no consistent requirements for municipal level budget data reporting. Together, these laws delineate the roles and responsibilities of different municipal-level government entities regarding data collection and reporting. With the passage of these laws, INIFOM made available data from 2000 to 2004 containing municipality disaggregated revenue and expenditures, which are the data used in this analysis. The data were converted from nominal to real Córdobas using inflation information from the Central Bank of Nicaragua (Government of Nicaragua, 2006a).
It is probable that measurement error exists in these data since the laws regulating the exact nature of data reporting were not passed until after the data were collected. Classical measurement error in the dependent variables, however, do not bias the regression estimates, and measurement error in independent variables tends only to bias the coefficient estimates toward zero. Thus, the results of these regressions represent a lower bound to the true estimate as the bias causes the coefficients to be understated.

The control variables come from a separate dataset: the 2005 National Census, performed by the National Institute of Statistics and Census (INEC). These data contain information at the municipality level on over 80 variables in categories including general population statistics, employment statistics, education statistics, and characteristics of the home for all 153 municipalities. The data were collected by questionnaire under methods in accordance with international norms of the United Nations Population Foundation and the United States Census Bureau. Because these data are also collected by a Nicaraguan government agency, the municipalities share the same identification code as in the INIFOM dataset, enabling a straightforward combination of datasets.

**Results:**

*Proportional Expenditures Models*

The results shown in Table 1 are from the models with the proportion of total expenditures used for consumption expenditures as the dependent variable. Across all the models, holding tax revenue constant, official development assistance and central government transfers are both associated with a reduction in the proportion of
expenditures spent on consumption, as hypothesized in the conceptual model. In the basic OLS model, shown in column (1), a 100 Córdoba increase in ODA per capita\(^4\) coincides with a reduction in the proportion of expenditures used for consumption of 4.2 percentage points. An equivalent 100 Córdoba increase in CGT per capita coincides with a reduction in the proportion of expenditures used for consumption of 5.2 percentage points. The larger decrease in the proportion of expenditures used for consumption associated with an increase in CGT per capita rather than ODA per capita is consistent with the hypothesis that the more funding a municipality receives from an outside source, the more it is accountable to that source, as mean CGT per capita for all municipalities is 118.59 Córdobas and mean ODA per capita is 41.04 Córdobas.

To reduce any bias due to simultaneity in these estimates, the model is re-estimated after adding the aforementioned control variables for municipality characteristics.\(^5\) The coefficient estimates on the three variables of interest are not statistically significantly different from the first OLS model at the 5% level, as shown in column (2). The results of one- and two-way fixed effects models are shown in columns (3) and (4). In both models the estimates of the effect of CGT per capita are again not statistically significantly different from the basic OLS model at the 5% level, suggesting that it is unlikely there are omitted time-invariant municipal characteristics biasing the OLS estimates. However, the estimates of the ODA per capita coefficient are statistically

\(^4\) As a frame of reference, a 100 Córdoba increase in ODA per capita would represent an increase of 38.8% of average total expenditures per capita, or approximately 0.05% of 2004 Nicaraguan GDP per capita. This is equivalent to an increase of $6.49 in ODA per capita at 2004 exchange rates.

\(^5\) For a more thorough discussion of the estimates of the control variables, see Appendix 2.
<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS (1)</th>
<th>(2)</th>
<th>Fixed Effects (3)</th>
<th>(4)</th>
<th>Lagged OLS (5)</th>
<th>Granger (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODA per capita (thousands of Córdobas)</td>
<td>$-0.415^{***}$</td>
<td>$-0.332^{***}$</td>
<td>$-0.145$</td>
<td>$-0.205$</td>
<td>$-0.169^{**}$</td>
<td>$-0.128^{**}$</td>
</tr>
<tr>
<td></td>
<td>[-0.234]</td>
<td>[-0.188]</td>
<td>[-0.082]</td>
<td>[-0.116]</td>
<td>[-0.108]</td>
<td>[-0.076]</td>
</tr>
<tr>
<td></td>
<td>(0.124)</td>
<td>(0.113)</td>
<td>(0.142)</td>
<td>(0.126)</td>
<td>(0.070)</td>
<td>(0.062)</td>
</tr>
<tr>
<td>CGT per capita (thousands of Córdobas)</td>
<td>$-0.525^{***}$</td>
<td>$-0.456^{***}$</td>
<td>$-0.633^{***}$</td>
<td>$-0.534^{***}$</td>
<td>$-0.591^{***}$</td>
<td>$-0.314^{***}$</td>
</tr>
<tr>
<td></td>
<td>[-0.461]</td>
<td>[-0.401]</td>
<td>[-0.556]</td>
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<td>[-0.296]</td>
<td>[-0.153]</td>
</tr>
<tr>
<td></td>
<td>(0.143)</td>
<td>(0.126)</td>
<td>(0.113)</td>
<td>(0.112)</td>
<td>(0.116)</td>
<td>(0.098)</td>
</tr>
<tr>
<td>Taxes per capita (thousands of Córdobas)</td>
<td>$0.500^{***}$</td>
<td>$0.348^{***}$</td>
<td>$0.016$</td>
<td>$0.102$</td>
<td>$0.264^{**}$</td>
<td>$0.227^{***}$</td>
</tr>
<tr>
<td></td>
<td>[0.357]</td>
<td>[0.248]</td>
<td>[0.011]</td>
<td>[0.072]</td>
<td>[0.159]</td>
<td>[0.136]</td>
</tr>
<tr>
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<td>(0.087)</td>
<td>(0.092)</td>
<td>(0.180)</td>
<td>(0.161)</td>
<td>(0.100)</td>
<td>(0.069)</td>
</tr>
</tbody>
</table>

Additional Control Variables
- Yes
- Yes
- Yes
- Yes
- Yes

Lagged Independent Variables
- Yes
- Yes
- Yes
- Yes
- Yes

Municipality Fixed Effects
- Yes
- Yes
- Yes
- Yes
- Yes

Year Fixed Effects
- Yes
- Yes
- Yes
- Yes
- Yes

Observations
690 689 690 690 539 518

R-squared
0.25 0.30 0.62 0.64 0.24 0.30

* Denotes significance at 10% level; ** Denotes significance at 5% level; *** Denotes significance at 1% level
[ ] Denotes coefficients reported in standardized form
( ) Denotes heteroskedasticity- and autocorrelation-robust standard errors
† Control variables are: proportion of households agriculture based; proportion of population working age; population density; proportion of population formally employed; proportion of population male; and an index for income per capita.

insignificant and statistically different from those in the OLS models. This suggests that some time-invariant municipality characteristics exist that are correlated with both the proportion of expenditures used in consumption and ODA per capita that are not accounted for in the OLS models of columns (1) and (2). Therefore, it is likely that the OLS estimates of the ODA per capita coefficient are biased by simultaneity.
To reduce any bias due to reverse causation, ODA per capita and CGT per capita are replaced with their lagged values. In the results, shown in column (5), the coefficient on ODA per capita is reduced, although still statistically significant at 5%, but the coefficient on CGT per capita remains unchanged. This implies that ODA per capita either acts with important contemporaneous effects determining the proportion of expenditures used in consumption, or there is reverse causation in the contemporaneous model which is eliminated in the lagged model. With CGT per capita, because the estimates are unchanged in the lagged model, it is unlikely that there is reverse causation in the estimates in the OLS models in columns (1) and (2).

Because of the lack of bias in CGT per capita estimates in the first OLS model, those estimates are appropriate in interpreting the correlation between CGT per capita and the proportion of total expenditures used for consumption. However, because the additional models demonstrate the likelihood of both simultaneity bias and reverse causation in the OLS estimates of the effect of ODA, the most appropriate model for determining this correlation is the Granger causation model. The results of this model in column (6) show that an increase in ODA per capita, holding all other factors constant, is followed by a decrease in the proportion of cash expenditures. Specifically, a one standard deviation increase in ODA per capita Granger causes a 0.076 standard deviation decrease in the proportion of expenditures spent in recurrent expenditures. The difference in this coefficient from the OLS estimates in columns (1) and (2) reinforces the finding that ODA per capita is either partially driven by contemporaneous effects or there
is some reverse causation in the OLS model. The coefficient estimates of CGT per capita in the Granger causation model are statistically significantly different (at the 10% level) from those estimated in the OLS model. This suggests that there may also be some contemporaneous effects or reverse causation in the OLS estimates of CGT per capita, although not of the same magnitude as those associated with ODA per capita.

All of these findings support the hypothesis that increases in aid and central government transfers are associated with a decrease in the proportion of expenditures used for consumption. This outcome was expected, as increasing funding from donors and the central government increases a municipality’s accountability to those sources, causing a shift in expenditures to investment. These findings also support the hypothesis that municipal governments will be more accountable to larger sources of revenue, as the estimated effect on the proportion of expenditures used for consumption is greater for CGT per capita than for ODA per capita, and average CGT per capita is nearly three times greater than average ODA per capita.

*Consumption Expenditures Models*

Table 2 shows the results from the models estimated with consumption expenditures per capita as the dependent variable. The OLS estimates in column (1) suggest that, holding tax revenue constant, ODA per capita is not statistically significantly associated with a change in the level of government consumption even at the 10% level. Although the sign changes from positive to negative across some models, the lack of statistical significance is consistent across nearly all models, including the fixed
TABLE 2:
Dependent Variable: Consumption Expenditures Per Capita

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>OLS (1)</th>
<th>OLS Fixed Effects (2)</th>
<th>Lagged OLS (3)</th>
<th>Granger OLS (4)</th>
<th>OLS Fixed Effects with Lagged (5)</th>
<th>OLS Fixed Effects with Municipality (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODA per capita</td>
<td>-0.096</td>
<td>0.025</td>
<td>-0.124</td>
<td>-0.081***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-0.088]</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
<td>(0.046)</td>
<td>(0.076)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGT per capita</td>
<td>0.246***</td>
<td>0.063***</td>
<td>0.154</td>
<td>0.045*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.348]</td>
<td>[0.090]</td>
<td>[0.156]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.093)</td>
<td>(0.014)</td>
<td>(0.149)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxes per capita</td>
<td>0.593***</td>
<td>0.250***</td>
<td>0.490***</td>
<td>0.241***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.680]</td>
<td>[0.287]</td>
<td>[0.598]</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.043)</td>
<td>(0.047)</td>
<td>(0.120)</td>
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<td></td>
</tr>
<tr>
<td>Additional Control Variables†</td>
<td>--</td>
<td>Yes</td>
<td>--</td>
<td>Yes</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Lagged Independent Variables</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Yes</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Municipality Fixed Effects</td>
<td>--</td>
<td>Yes</td>
<td>Yes</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Year Fixed Effects</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>690</td>
<td>690</td>
<td>539</td>
<td>518</td>
<td>689</td>
<td>690</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.78</td>
<td>0.79</td>
<td>0.92</td>
<td>0.44</td>
<td>0.79</td>
<td>0.58</td>
</tr>
</tbody>
</table>

*Denotes significance at 10% level; ** Denotes significance at 5% level; ***Denotes significance at 1% level
[] Denotes coefficients reported in standardized form
() Denotes heteroskedasticity- and autocorrelation-robust standard errors
† Control variables are: proportion of households agriculture based; proportion of population working age; population density; proportion of population formally employed; proportion of population male; and an index for income per capita.

Effect models estimated in columns (3) and (4). This implies that the OLS estimates are not suffering from significant endogeneity bias, and that the correlation between ODA per capita and consumption expenditures per capita is negligible. However, after controlling for consumption in the previous period in the Granger Causation model in column (6), ODA per capita from the prior period is correlated with a statistically significant decrease in current period consumption expenditures at the 1% level. Specifically, a one standard deviation increase in ODA per capita in the prior period
Granger causes a 0.142 standard deviation decrease in consumption per capita in the current period. The fact that ODA per capita has a statistically significant negative correlation with consumption expenditures per capita when the lag of consumption is controlled for indicates that the other models may be missing control variables that account for time-varying municipal characteristics (not controlled for in the fixed effects models) that are correlated with consumption expenditures per capita as well as ODA per capita, causing simultaneity bias in those estimates. In addition, these estimates suggest that ODA per capita is either not correlated with consumption or has a negative correlation. This finding is unexpected, because the conceptual model hypothesized that the effect on consumption would be slightly positive, to account for spending necessary to manage the aid flows. However, this finding helps support the hypothesis that aid is not fungible between investment and consumption in Nicaraguan municipal governments as donor funds are being spent primarily in investment.

Unlike the estimates of the effects of ODA per capita, the coefficients on CGT per capita are positive and statistically significant at the 1% level in all models except those with lagged independent variables in columns (5) and (6). Interpreting the results from the basic OLS model in column (1), a one standard deviation increase in CGT per capita is correlated with a 0.348 standard deviation increase in consumption expenditures per capita, holding tax revenue per capita constant. In checking for simultaneity bias, this estimate is not statistically significantly different from the estimate obtained with the addition of control variables in column (2). However, the results of estimating these
models with one- and two-way fixed effects in columns (3) and (4) indicate that the
correlation between CGT per capita and consumption expenditure per capita, while still
statistically significant at the 1% level, is much reduced. In the one-way model (whose
results are not statistically significantly different from those in the two-way model), a one
standard deviation increase in CGT per capita is correlated with a 0.09 standard deviation
increase in consumption per capita, holding all else constant. This is statistically
significantly different from the estimate in the OLS model, and implies that there are
time-invariant municipality characteristics omitted from the OLS model correlated with
both CGT and consumption expenditures, causing simultaneity bias.

The lack of a statistically significant change in the coefficient estimates of CGT
per capita in the lagged OLS model in column (5) suggests that it is unlikely there is
reverse causation present in the OLS estimate of CGT per capita. Without reverse
causation, but considering the simultaneity bias that is present, the best estimates of the
correlation between CGT per capita and consumption expenditures per capita are from
the fixed-effects models. These suggest that, unlike ODA per capita, an increase in CGT
per capita is correlated with an increase in consumption per capita, but the increase is
minimal (approximately one-tenth of a standard deviation).

Investment Expenditures Models

Table 3 shows the results of estimating the different models with investment
expenditures per capita as the dependent variable. Looking at the basic OLS model in
column (1), a one standard deviation increase in ODA per capita is correlated with a
TABLE 3: Dependent Variable: Investment Expenditures Per Capita

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>OLS (1)</th>
<th>OLS (2)</th>
<th>Fixed Effects (3)</th>
<th>Fixed Effects (4)</th>
<th>Lagged OLS (5)</th>
<th>Granger (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODA per capita</td>
<td>0.543**</td>
<td>0.528**</td>
<td>0.440</td>
<td>0.467*</td>
<td>-0.016</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>[0.347]</td>
<td>[0.338]</td>
<td>[0.282]</td>
<td>[0.299]</td>
<td>[-0.012]</td>
<td>[-0.004]</td>
</tr>
<tr>
<td></td>
<td>(0.233)</td>
<td>(0.234)</td>
<td>(0.268)</td>
<td>(0.256)</td>
<td>(0.123)</td>
<td>(0.149)</td>
</tr>
<tr>
<td>CGT per capita</td>
<td>0.600***</td>
<td>0.603***</td>
<td>0.797***</td>
<td>0.754***</td>
<td>0.557***</td>
<td>0.399***</td>
</tr>
<tr>
<td></td>
<td>[0.597]</td>
<td>[0.601]</td>
<td>[0.793]</td>
<td>[0.751]</td>
<td>[0.334]</td>
<td>[0.238]</td>
</tr>
<tr>
<td></td>
<td>(0.095)</td>
<td>(0.085)</td>
<td>(0.067)</td>
<td>(0.082)</td>
<td>(0.097)</td>
<td>(0.119)</td>
</tr>
<tr>
<td>Taxes per capita</td>
<td>0.186**</td>
<td>0.189**</td>
<td>0.105</td>
<td>0.066</td>
<td>0.409***</td>
<td>0.231***</td>
</tr>
<tr>
<td></td>
<td>[0.150]</td>
<td>[0.153]</td>
<td>[0.085]</td>
<td>[0.053]</td>
<td>[0.295]</td>
<td>[0.169]</td>
</tr>
<tr>
<td></td>
<td>(0.073)</td>
<td>(0.079)</td>
<td>(0.193)</td>
<td>(0.194)</td>
<td>(0.095)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>Additional Control Variables†</td>
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<td>Yes</td>
<td>--</td>
<td>--</td>
<td>Yes</td>
<td>--</td>
</tr>
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<td>Lagged Independent Variables</td>
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<td>--</td>
<td>--</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Municipality Fixed Effects</td>
<td>--</td>
<td>--</td>
<td>Yes</td>
<td>Yes</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Year Fixed Effects</td>
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<td>--</td>
<td>--</td>
<td>Yes</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Observations</td>
<td>690</td>
<td>689</td>
<td>690</td>
<td>690</td>
<td>539</td>
<td>518</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.68</td>
<td>0.69</td>
<td>0.79</td>
<td>0.80</td>
<td>0.26</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*Denotes significance at 10% level; ** Denotes significance at 5% level; ***Denotes significance at 1% level
[] Denotes coefficients reported in standardized form
() Denotes heteroskedasticity- and autocorrelation-robust standard errors
†Control variables are: proportion of households agriculture based; proportion of population working age; population density; proportion of population formally employed; proportion of population male; and an index for income per capita.

0.347 standard deviation increase in investment expenditures per capita, holding CGT per capita and tax revenue per capita constant. Additionally, a one standard deviation increase in CGT per capita, holding ODA per capita and tax revenue per capita constant, is correlated with a 0.597 standard deviation increase in investment expenditures per capita.

The coefficient estimates for the effect of ODA per capita are not statistically significantly different across the OLS model in column (2) or the fixed-effects models in
columns (3) and (4) (although the increased standard error in the fixed effects models has caused the coefficients to become statistically insignificant). This implies that the OLS estimates of ODA per capita do not suffer from simultaneity bias due to omitted, time-invariant municipality characteristics correlated with both investment expenditures per capita and ODA per capita. However, the coefficient estimates change by a statistically significant amount in both the lagged OLS model in column (5) and the Granger causation model in column (6). This suggests that strictly contemporaneous effects are an important part of the OLS estimates, or there is reverse causation in the OLS models that is not being accounted for.

It is probable that both reverse causation and contemporaneous effects bias these estimates. Investment expenditures is the category of spending most likely to be impacted by reverse causation (due to donors not wanting to target their funds to municipalities that already have high levels of investment). However, it is likely that the true impact of ODA per capita on investment per capita is statistically significantly different from zero, as suggested by the two lagged models that correct for reverse causation. Rather, while the estimate of ODA per capita may be suffering from reverse causation to a degree, it is almost certain, given the large proportion of ODA per capita directed to investment spending, that an increase in ODA per capita leads to some increase in investment expenditures per capita that is not showing up in the lagged estimates due to the contemporaneous nature of the effect.
On the other hand, the coefficient estimates of CGT per capita in the OLS models are not statistically significantly different from the estimates in the lagged models in columns (5) and (6). This consistency suggests that the OLS estimates of CGT per capita do not suffer from substantial reverse causation. However, the estimates of the correlation between CGT per capita and investment expenditures per capita in the fixed-effects models in columns (3) and (4) are stronger than those for the OLS models. Compared with a 0.597 standard deviation increase in investment expenditures per capita in the OLS model, a one standard deviation increase in CGT per capita in the one-way fixed effects model in column (3) is associated with a much higher 0.793 standard deviation increase in investment expenditures per capita. This difference implies that the OLS model is missing some time-invariant municipality characteristics that are correlated with both CGT per capita and investment expenditures per capita that are causing simultaneity bias.

In sum, excluding the estimated impacts of ODA per capita on investment in the lagged OLS model, these results support the hypothesis that municipal governments are more accountable to donors and the central government as the proportion of their revenues from these sources grows. This is demonstrated by the shift in expenditures towards investment, which supports the assumption that donors desire more investment than local governments. These results also demonstrate that funds from the central government, because it is a larger source of revenue, are less fungible than funds from
foreign donors. However, determining the exact size of the fungibility effect of ODA is particularly difficult because of the reverse causation in this model.

**Tax Revenue Models**

Table 4 presents the results of the models estimated with tax revenue as the dependent variable. The correlation between ODA per capita and tax revenue per capita, holding CGT per capita and total expenditures per capita constant, is not statistically different from zero in any of the models except the Granger causation model in column (6). This model, however, shows that controlling for the level of tax revenue in the last period, a one standard deviation increase in ODA per capita in the last period Granger causes a 0.193 standard deviation decrease in taxes collected per capita in the current period. This is consistent with the hypothesis that aid may substitute for tax revenue in a model that accounts for all forms of endogeneity except the biases caused by omitting strictly contemporaneous effects.

Also consistent with this hypothesis are the findings of the correlation between CGT per capita and tax revenue per capita. While only statistically significant at the 10% level, the simple OLS regression in column (1) suggests that a one standard deviation increase in CGT per capita is associated with a 0.319 standard deviation decline in tax revenue per capita. This estimate is not statistically significantly different from the estimates of CGT per capita in the second OLS model in column (2). However, in the one- and two-way fixed effects models in columns (3) and (4), the estimates of the effect of CGT per capita are statistically different from the estimates in the OLS model, but not
TABLE 4: Dependent Variable: Tax Revenue Per Capita

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>OLS (1)</th>
<th>Fixed Effects (2)</th>
<th>Lagged OLS (3)</th>
<th>Lagged OLS (4)</th>
<th>Granger (5)</th>
<th>Granger (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ODA per capita</td>
<td>-0.171</td>
<td>0.101</td>
<td>-0.120</td>
<td>-0.180***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-0.135]</td>
<td>[0.080]</td>
<td>[-0.128]</td>
<td>[-0.193]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.239)</td>
<td>(0.183)</td>
<td>(0.087)</td>
<td>(0.047)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGT per capita</td>
<td>-0.259*</td>
<td>0.024</td>
<td>-0.179*</td>
<td>-0.157**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-0.319]</td>
<td>[0.029]</td>
<td>[-0.156]</td>
<td>[-0.137]</td>
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</tr>
<tr>
<td></td>
<td>(0.143)</td>
<td>(0.117)</td>
<td>(0.106)</td>
<td>(0.073)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Expenditures per capita</td>
<td>0.550***</td>
<td>0.143</td>
<td>0.342***</td>
<td>0.126**</td>
<td></td>
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<td>[1.020]</td>
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<td>[0.592]</td>
<td>[0.218]</td>
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<td>(0.116)</td>
<td>(0.102)</td>
<td>(0.065)</td>
<td>(0.059)</td>
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</tr>
<tr>
<td>Additional Control Variables†</td>
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<td>Yes</td>
<td>--</td>
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<td></td>
</tr>
<tr>
<td>Lagged Independent Variables</td>
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<td>--</td>
<td>--</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Municipality Fixed Effects</td>
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<td>Year Fixed Effects</td>
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<td>--</td>
<td>Yes</td>
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<td></td>
</tr>
<tr>
<td>Observations</td>
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<td>689</td>
<td>690</td>
<td>690</td>
<td>530</td>
<td>530</td>
</tr>
<tr>
<td>R-squared</td>
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<td>0.82</td>
<td>0.82</td>
<td>0.43</td>
<td>0.61</td>
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</tbody>
</table>

*Denotes significance at 10% level; ** Denotes significance at 5% level; ***Denotes significance at 1% level
[] Denotes coefficients reported in standardized form
() Denotes heteroskedasticity- and autocorrelation-robust standard errors
† Control variables are: proportion of households agriculture based; proportion of population working age; population density; proportion of population formally employed; proportion of population male; and an index for income per capita.

This finding suggests that there are omitted, time-invariant municipal characteristics associated with both CGT per capita and tax revenue per capita, biasing the OLS estimates. Additionally, the estimates of the effect of CGT per capita on tax revenue per capita from the lagged model in column (5) and from the Granger causation model in column (6) are not statistically significantly different from the OLS estimates. This implies that it is unlikely that reverse causation is biasing the OLS estimates.
These findings suggest that increases in both official development assistance and central government transfers are associated with a decline in municipal government tax effort. The magnitude of this decline is difficult to determine given the endogeneity bias, but the estimates from the Granger causation models are instructive. In these models a one standard deviation increase in ODA per capita Granger causes a 0.193 standard deviation decrease in tax revenue per capita, while a one standard deviation increase in CGT per capita Granger causes a 0.137 standard deviation decrease in tax revenue per capita. Neither of these effects is dramatic in absolute terms, however, given that the standard deviation of tax revenue is only 40.86 Córdobas per capita.

**Robustness Check**

The results of the seemingly unrelated regressions (SUR) models, estimated to take advantage of information contained in cross-equation correlation of the error terms, are presented in Table 5. Comparing these results to the estimates obtained from the other models for consumption, there is very little change in the estimated coefficients, either in the OLS or fixed-effects models. In the SUR estimations of the investment models, the estimated effects of CGT per capita and ODA per capita remain unchanged (although the effect of tax revenue per capita has increased dramatically in the SUR analysis). However, the estimates of the effect of ODA per capita and CGT per capita on tax revenue per capita are statistically significantly different in the both the OLS and fixed-effects SUR models from the previous models estimated. Specifically, the OLS results in the SUR estimation of the tax model suggest that ODA per capita and CGT per
TABLE 5: Seemingly Unrelated Regressions Analysis

<table>
<thead>
<tr>
<th>Independent Variables (per capita)</th>
<th>Dependent Variables</th>
<th>OLS with Controls</th>
<th>Two-Way Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consumption</td>
<td>Investment</td>
<td>Tax Revenue</td>
</tr>
<tr>
<td>ODA</td>
<td>-0.092***</td>
<td>0.469***</td>
<td>-0.205***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.035)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>CGT</td>
<td>0.225***</td>
<td>0.494***</td>
<td>-0.394***</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.025)</td>
<td>(0.031)</td>
</tr>
<tr>
<td>Tax Revenue</td>
<td>0.649***</td>
<td>0.466***</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.031)</td>
<td>--</td>
</tr>
<tr>
<td>Expenditures</td>
<td>--</td>
<td>--</td>
<td>0.680***</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>--</td>
<td>(0.021)</td>
</tr>
<tr>
<td>Observations</td>
<td>689</td>
<td>689</td>
<td>689</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.78</td>
<td>0.66</td>
<td>0.57</td>
</tr>
</tbody>
</table>

*Denotes significance at 10% level; ** Denotes significance at 5% level; ***Denotes significance at 1% level
() Denotes standard errors
†Control variables are: proportion of households agriculture based; proportion of population working age; population density; proportion of population formally employed; proportion of population male; and an index for income per capita.

capita are associated with larger, more statistically significant reductions in tax revenue per capita than the previous models. The two-way fixed effects results in the SUR estimation of the tax model are notable because they also represent statistically significant changes from the previous models. In particular, the effect of CGT per capita on tax revenue per capita in this model is statistically significant and negative, whereas in the previous fixed effects estimates, the effects were not statistically significantly different from zero.

Not surprisingly, the standard errors in the SUR analysis are much smaller than those in the previous analyses. The reasons for this are two-fold. First, SUR is likely to produce smaller standard errors than uncorrected standard errors that do not account for
correlations in the error terms. Second, the standard errors in the previous analyses were corrected (typically upward) for heteroskedasticity and autocorrelation. Therefore, the very small standard errors presented in the table above should not be considered the most efficient, and inferences should not be made from them exclusively.

**Discussion:**

The results provide some support, albeit weak, for the hypothesis that intergovernmental transfers substitute for municipal tax revenue in Nicaragua. The estimates presented by the SUR model and the Granger causation models both demonstrate a negative correlation between CGT per capita and tax revenue per capita and ODA per capita and tax revenue per capita that is statistically significantly different from zero. However, the estimates in the SUR model are not corrected for heteroskedasticity or autocorrelation. In all the other models estimated, few results are statistically significantly different from zero.

The second hypothesis tested was that increased aid and central government transfers tend to reduce a municipal government’s accountability to its citizens, causing expenditures to shift from consumption to investment. As a municipal government becomes more accountable to either the central government or foreign donors, the extent to which those resources are fungible and will be used for consumption decreases. Based on the three models used to test this hypothesis, the analysis concludes that this is the case for both ODA and CGT.
An increase in ODA per capita is associated with a reduction in the proportion of expenditures used for consumption. Most of this association is due to an increase in investment expenditures, since the consumption expenditure models showed no statistically significant effect of ODA per capita on the level of municipal government consumption per capita. However, while increases in ODA per capita are correlated with a positive increase in investment expenditures per capita, they are not correlated with an increase in investment equal to the full amount of those funds (i.e. the standardized coefficient on ODA is not close to 1, which would signify that nearly all ODA funds are spent on investment). Rather, the estimates range around a 0.3 standard deviation increase in investment expenditures per capita for each one standard deviation increase in ODA per capita. Given that the standard deviation of ODA per capita in the sample is 115.15 Córdobas, and the standard deviation for investment expenditures per capita is 166.75 Córdobas, this is equivalent to a 115 Córdoba increase in ODA per capita being associated with an increase in investment expenditures per capita of approximately 50 Córdobas, or 43% of the initial funding. This numerical example is strictly an illustration, though. Because of the reverse causation bias in the investment expenditure models, it is difficult to determine the extent to which ODA is fungible in Nicaraguan municipal governments from this model.

Central government transfers tend to also be associated with a shift from consumption to investment expenditures. However, the fungibility of the investment spending is significantly decreased. In the first model estimated, CGT per capita is
associated with a significant decrease in the proportion of expenditures used for consumption purposes. This is particularly notable since CGT per capita is also associated with an increase in consumption expenditures per capita, a finding that is consistent across nearly all models. Thus, CGT per capita must necessarily be correlated with a very large increase in investment expenditures per capita in order to offset the increased consumption expenditures. This fact is confirmed by the results. The high-end estimate states that a one standard deviation increase in central government transfers per capita is associated with a 0.793 standard deviation increase in investment expenditures per capita. Since the standard deviation of CGT per capita and investment expenditures per capita are nearly equal (165.5 and 166.8, respectively), this suggests that nearly 80% of CGT gets converted into investment expenditures by the municipal government.

Generally speaking, all of these results are consistent with the existing literature. In particular, most literature found that aid was fungible to an extent, but the degree to which this is true varies between studies. This analysis finds that ODA is much more fungible than CGT. The accountability hypothesis posits that this is because the amount of revenue municipal governments receive from the central government is much greater than the amount received from foreign donors.

**Conclusions and Recommendations:**

**Implications for Donors**

Given these findings, policy recommendations to improve the delivery of aid vary depending on the goal of donor governments. If the desired outcome of improving aid
delivery is to ensure that all of the funds provided are spent in the targeted expenditure categories, donors have three options. First, they can increase the amount of funding they provide to solidify their position as the revenue source to which the municipality is most accountable. However, it seems unlikely that donor governments would consider limiting aid fungibility an important determinant of the size of aid flows. This goal could also be accomplished, though, by pooling donor resources to ensure that donors are not competing with each other for the accountable relationship. The current trend of funding development in recipient countries through a sector wide approach, or SWAp, is an example of this approach. Donors aggregate their funds for a specific sector after agreeing to a common set of expenditure targets for that sector. This helps ensure that recipient governments are accountable to the agreed-upon joint expenditures goals, rather than to the individual donor willing to offer the most support.6

Alternatively, donors could reduce aid fungibility by moving to a system of performance-based disbursements that would limit the size of future transfers in response to a government’s fungible use of donor funds. The most prominent, current example of this system is the Millennium Challenge Corporation, which ties all disbursements to meeting previously agreed upon standards for performance.

On the other hand, if the goal of improving aid delivery is to ensure that revenues are spent in expenditure categories desired by local populations, donors should ensure that funds are provided in expenditure categories that coincide more closely with the

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6 For a more thorough discussion of the use of SWAps, see Brown, Foster, Norton, and Naschold (2001).
goals of recipient governments. This could be achieved in two ways. First, donors could increase recipient government coordination and citizen consultation in the design and planning of aid projects. The change in strategy of the World Bank since 2002 to base their Country Assistance Strategies on Poverty Reduction Strategy Papers (PRSP), which are required to be “country-driven, involving broad-based participation by civil society and the private sector as they are produced” is one example (World Bank, 2007).

Donors could also ensure that funds are provided in expenditure categories coinciding more closely with recipient government goals by providing more funding through direct budget support (DBS). In this method, the recipient government allocates foreign revenue through its budget to maintain a primary accountability relationship with its citizens. In one of the most prominent examples of budget support, the Department for International Development (DFID), the British government’s aid delivery agency, provides more than 80% of its funding for Tanzania through DBS. After assessing a “partner government’s planned budget priorities in support of poverty reduction; administrative, technical and financial capacity;” and other determinants of aid effectiveness, DFID often opts to provide its funding through DBS specifically because it promotes “stronger domestic accountability between partner countries and their citizens” (DFID, 2007).

Implications for Recipient Governments

From the recipient’s perspective, improving aid effectiveness typically means ensuring that positive development outcomes are attained with the funds received.
Recipients have a choice, though, in deciding how to allocate this revenue. To ensure the continued delivery of transfer funds, it is logical to expect that governments will choose to become at least partially accountable to the sources of those funds, shifting government expenditures into the priority areas identified by donors. However, these allocations may not always be in categories that citizens consider the most productive. To mediate these often contrary views, recipient governments could strive to place themselves in the role of interlocutor between donors and citizens. By working with donors through processes like the PRSP described above, recipient governments can ensure meaningful donor consultation with local populations in the design of projects. Additionally, by improving reporting mechanisms, as required by DFID to receive DBS (described above), recipient governments could take steps to ensure that donors not view the shifting of funds to consumption expenditures as fungibility and reduce future transfers as a result.
## APPENDIX 1
### Descriptive Statistics

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Number of Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent Expenditures as Percentage of Total Expenditures</td>
<td>693</td>
<td>46.80%</td>
<td>18.95%</td>
<td>9.37%</td>
<td>100.00%</td>
</tr>
<tr>
<td>Recurrent Expenditures Per Capita*</td>
<td>693</td>
<td>107.03</td>
<td>117.51</td>
<td>4.49</td>
<td>1864.33</td>
</tr>
<tr>
<td>Investment Expenditures Per Capita*</td>
<td>693</td>
<td>151.40</td>
<td>166.75</td>
<td>0.00</td>
<td>1411.51</td>
</tr>
<tr>
<td>Tax Revenue Per Capita*</td>
<td>713</td>
<td>30.19</td>
<td>40.86</td>
<td>0.00</td>
<td>493.38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Number of Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Expenditures Per Capita*</td>
<td>693</td>
<td>258.43</td>
<td>249.90</td>
<td>4.49</td>
<td>3222.43</td>
</tr>
<tr>
<td>ODA Per Capita*</td>
<td>717</td>
<td>41.04</td>
<td>115.15</td>
<td>0.00</td>
<td>1512.24</td>
</tr>
<tr>
<td>Central Government Transfers Per Capita*</td>
<td>717</td>
<td>118.59</td>
<td>165.50</td>
<td>0.00</td>
<td>2359.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Variables:</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density (per square Km)</td>
<td>755</td>
<td>160.79</td>
<td>406.31</td>
<td>0.18</td>
<td>3960.69</td>
</tr>
<tr>
<td>Percentage of the Population Working Age</td>
<td>760</td>
<td>59.37%</td>
<td>4.09%</td>
<td>47.90%</td>
<td>67.16%</td>
</tr>
<tr>
<td>Percentage of Households Partaking in Agricultural Activities</td>
<td>760</td>
<td>38.41%</td>
<td>20.65%</td>
<td>1.00%</td>
<td>89.00%</td>
</tr>
<tr>
<td>Percentage Employed in Formal Sector</td>
<td>760</td>
<td>39.56%</td>
<td>5.61%</td>
<td>19.00%</td>
<td>54.00%</td>
</tr>
<tr>
<td>Percentage of Population Male</td>
<td>760</td>
<td>50.20%</td>
<td>1.32%</td>
<td>47.00%</td>
<td>54.00%</td>
</tr>
<tr>
<td>Percentage of Population Completed at least Secondary School</td>
<td>760</td>
<td>22.31%</td>
<td>11.87%</td>
<td>2.00%</td>
<td>53.00%</td>
</tr>
<tr>
<td>Percentage of Households with Access to Improved Water Source</td>
<td>760</td>
<td>50.34%</td>
<td>23.86%</td>
<td>0.57%</td>
<td>97.09%</td>
</tr>
<tr>
<td>Percentage of the Population Literate</td>
<td>760</td>
<td>69.13%</td>
<td>11.57%</td>
<td>32.00%</td>
<td>89.00%</td>
</tr>
<tr>
<td>Percentage of Population Living within 5 Km of Health Center</td>
<td>760</td>
<td>68.93%</td>
<td>20.54%</td>
<td>8.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

*Monetary values in constant 2000 Córdobas
APPENDIX 2
Discussion of Estimates of Control Variables

Even though the addition of the six control variables for municipality characteristics (proportion of households performing agricultural activities; proportion of population working age; population density; proportion of population formally employed; proportion of population male; and an index for income per capita) did little to change the statistical significance of any of the estimated effects of ODA and CGT in the multiple regressions performed, it is interesting to note which variables were statistically significant in the majority of the models. The three variables that regularly have statistically significant coefficients are the index for income per capita, the proportion of households participating in agricultural activities, and the proportion of the population that is male. Additionally, as one would expect, the variable for the proportion of the population that is working age is statistically significant in the tax revenue regressions.

The income per capita variable is statistically significant in five of the eight regressions it was included in. Interestingly, in the capital expenditures models and in the tax revenue models, the correlation between the income index and the dependent variables is negative, while in the consumption expenditures models, the correlation is positive. This suggests that increasing per capita income in municipalities is correlated with an increase in consumption and a decrease in investment. This is probably in line with donors’ expectations that more capital investment occur in poorer municipalities.

The proportion of the population participating in agricultural activities is statistically significant in six of the eight regressions. This variable is positively
correlated with capital expenditures, and negatively correlated with consumption, the proportion of expenditures used for consumption, and tax revenue. Assuming municipalities with a higher proportion of households performing agricultural work are more rurally based, these findings are consistent with the literature regarding aid and transfers for capital investment being directed to poorer, rural areas.

Finally, and perhaps most interestingly, the proportion of the population that is male is statistically significant in half the regressions it is included in. It is negatively correlated with investment and positively correlated with consumption and the proportion of expenditures used for consumption. One possible explanation for this is the migration of men from rural to urban areas where they can earn a higher wage. This would increase the proportion of women in rural areas, where more aid and transfers for capital investment are targeted.
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OECD/DAC. 2006. International Development Statistics Online Database. Available at: http://www.oecd.org/document/33/0,2340,en_2649_34447_36661793_1_1_1_1,00.html


