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Estimating Stochastic Frontier Tax Potential: Can Indonesian Local Governments Increase Tax Revenues Under Decentralization?

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ESTIMATING STOCHASTIC FRONTIER TAX POTENTIAL : CAN INDONESIAN LOCAL GOVERNMENTS INCREASE TAX REVENUES UNDER DECENTRALIZATION ?

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Abstract

One consequence of Indonesian fiscal decentralization is that local governments will have to seek additional revenues coming from their own resources. The first thing that they should do is to exploit their revenue potential from existing taxes before implementing any new taxes. This study attempts to estimate the tax potential of two sources of revenue for local governments: local taxes and property tax -- by using the special regression analysis of the stochastic frontier. Our empirical findings show that none of the local governments have maximized their tax potential. If all local governments were able to utilize all their tax potential, then they would get very substantial additional tax revenues (0.10 and 0.20 percent of GDP from local taxes and property tax, respectively, while current total local tax revenue is about 0.36 percent of GDP). What they have to do is to improve their tax collection performance in terms of efficiency by reducing tax evasion, mostly through decreasing corruption. In addition, support and cooperation from the central government are very important. For local taxes, the central government should modify its subsidy formula to local governments by giving a bigger portion of INPRES subsidies that are used for local development, which in turn will increase local governments' tax ratios. For property taxes, the central government should change its policy of setting targets for its property tax district offices.

Keywords: Tax potential; Inefficiency; Stochastic frontier; Decentralization; Corruption; Indonesia

JEL Classification: H0; H2; H7; O1

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I. Introduction

Indonesia has been going through a major change in its intergovernmental

easier for provinces with large unused tax potential to collect bigger revenues needed to fund their new responsibilities under the decentralized system, while provinces with small unused tax potential will struggle hard to surviv

stochastic frontier and the comparison of tax potential used up by various local governments. Section VI discusses policy implications and Section VII provides conclusions.

II. Fiscal Decentralization in Indonesia

One impact of the economic and political crisis that hit Indonesia in 1997-1998 was an increased pressure for regional autonomy, known as fiscal decentralization. As a result, the government passed two new decentralization laws: Law No. 22/1999 on Regional Government, and Law No. 25/1999 on the Fiscal Balance between the Central and Local Governments. Both were implemented as of 2001. These new laws substantially reform the practice of intergovernmental relations in Indonesia. If they are successfully implemented, Indonesia will be transformed from one of the most centralized among large economies to one of the most decentralized [IMF, 2002]. Alm, *et al.* (2001) consider Indonesia an exception compared to other economies with its characteristics, such as a large and diverse population residing in a very large area, as their empirical results implied that Indonesia would have been expected to adopt a more decentralized government much earlier.

One major criticism of this ambitious decentralization plan of Indonesian government structure is that not all details have been planned carefully. Decentralization has to be designed such that there should be a reasonable balance between expenditure and revenue arrangements with local governments. Indonesia's two decentralization laws seemingly focus more on the devolution of expenditure responsibilities. The scope of local governments' responsibilities is much greater now that it includes public works, health, education and culture, communications, industry

and trade, capital investment, environment, land, cooperative and manpower affairs. Note that most of those functions previously were under the central government's control, partly or entirely. For the revenue side, those laws introduce a new arrangement of the grant system based on expenditure needs and revenue capacities, plus a new scheme for revenue sharing for oil and gas. In addition, the government passed Law No. 34/2000 on Regional Government Taxes and Charges. This law states which taxes can be levied by local governments, and the tax rates allowed. To avoid double taxation, only certain goods and services can be taxed by provincial and district governments, and to prevent overcharging (as defined by the central government), the range of tax rates is also set by the central government. This law replaces the old law on the same matter, with the main difference being that it gives local governments more alternatives and flexibility for their own revenue sources. Nevertheless, many people believe that this new revenue assignment is still far from sufficient, or unlike the expenditure side, the scope of revenues devolved to local governments is much more limited. In summary, local governments will now have much bigger expenditures following the new and bigger assigned responsibilities, but they only have a little room to increase their revenues that truly come from their own resources. By analyzing the local governments' fiscal behavior before the decentralization, Silver *et al.* (2001) conclude that Indonesian local governments will still be very reliant on subsidies from the central government, so one of the most important factors to ensure the success of decentralization is the effective use of the discretionary in the new grant system.

It is generally predicted that without any major change or additional detailed guidance in this decentralization process, there will be a mismatch between expenditure and revenue responsibilities that are assigned to local governments. In terms of

the central government. In summing up, local governments might need even bigger additional revenues.

To fund their expenditures, Indonesian local governments in the pre-decentralization period had 2 main sources:

1. Local Government Original Reve

see the relative levels of taxation for different countries, but any inference on tax performance based on such a comparison fails to take into account that some countries simply choose to levy lower taxes, implying lower level provision of public goods and services, or to have a small government. Therefore, one country might have a lower tax effort intentionally, not because it lacks the energy to pursue a higher tax ratio. Tait *et al*. (1976) add that the use of term "tax effort" is potentially misleading, so they preferred to use the term "international tax comparisons" (ITC) index. Even with that limitation, opponents such as Bird (1976) note that individual countries are so unique in terms of economic, political, and institutional characteristics, that generalizing those differences will provide less meaningful information than they obscure.

This study is different from those above, in that it is not intended to compare tax performance of different economies, in this case Indonesian local governments. Instead, we try to develop a tax frontier so that this information can be used by local governments to utilize their tax potential in the effort to cope with the fiscal

does not have to take into account local governments' expenditure in determining each province's revenue collection target. Therefore, the property tax potential analysis may be used effectively to evaluate tax performance of provincial governments, since preferences of local public goods have no effect on the amount of tax collected. If one province has large unused property tax potential, then we could say that the tax effort of the district property tax office is relatively low compared to that of other district property tax offices, and this office should be able to increase its tax ratio.

The empirical study of the stochastic frontier was pioneered by Aigner, Lovell, and Schmidt (1977), and their approach has been very fundamental to the later development of econometric frontier estimation of any kind. They propose that a production frontier should be estimated with the usual regression model, but with two distinguishable error terms. The first error term (v_i) represents the usual statistical noise, something beyond the firm's control such as weather, and assumed to be independently and identically distributed with $v_i \sim N(0, \ ^2_v)$. The second error term (u_i) represents the level of inefficiency, that is the "failure" to produce the maximum amount given some input used, so it has to be nonpositive and is also assumed to be independently and identically distributed with $u_i \sim \ N(0, \ ^2_u)$, known as the half normal distribution [4]. Suppose a production function is given by $y_i \quad f(X_i; \ )$, where y_i is output produced, X_i is the vector of input used, and is the vector of parameters to be estimated. Then the stochastic frontier econometric model will be $y_i \quad f(X_i; \ ) \quad _i$, with $_i \quad v_i \quad u_i$. It is the non-positive error term u_i that will

4) Other one-sided error distributions that are commonly used are the exponential distribution proposed by Aigner, Lovell, and Schmidt (1977), the truncated normal distribution by Stevinson (1980), and the

determine the frontier that is now defined as $[f(X_i; \quad) \quad v_i]$. The difference between the level of production and the new derivation of the frontier represents the degree of inefficiency of one firm's production, since the resulting difference is now purely caused by something under the firm's control. With the presence of v_i, the frontier is stochastic, as opposed to the alternative deterministic frontier approach, in which the disturbances are assumed to consist of only the one-sided error term (u_i). But the presence of v_i creates an intriguing property, since in contrast to the deterministic approach, it is now possible for one observation to lie *above* the frontier if the usual statistical noise (v_i) is very big for that particular observation.

Jondrow *et al.* (1982) show that one can easily disentangle the "inefficiency" error term u_i from the total error term $_i$, so now researchers can analyze the degree of inefficiency of each individual firm. Moreover, since the error term $_i$ now consists of two different error terms v_i and u_i

> "One-sided disturbances …… present a particularly difficult estimation problem. The primary theoretical problem is that any measurement error in *y* must be embedded in the disturbance. The practical problem is that the entire estimated function becomes a slave to any single errantly measured data point." [Green, 2000]

There has been substantial research following the pioneering work of Aigner, Lovell, and Schmidt [6]. Their early model has been criticized for its caveats. In estimating the stochastic frontier, their model used the maximum likelihood estimation (MLE) with cross-sectional data. Waldman (1982) shows that for the production frontier estimation, the use of MLE in the original Aigner, Lovell, and Schmidt model requires, critically, that the third moment of the least squares residuals has to be negative (the OLS residuals are negatively skewed). Otherwise the maximum likelihood estimates are the same as the ordinary least squares estimates, implying no efficiency relative to frontier. As a consequence, in practice the stochastic frontier estimation is very sensitive to specification.

Another criticism of Aigner, Lovell, and Schmidt's model is that it may fit well only in the case of cross-sectional data, but not in the case of panel data. Schmidt and th998 196.74 data Tc0.

level of education or the use of electricity. Thus, the determining factors for tax ratio are less obvious than those in a firm's production problem. As a result, one has to be able to find the 'right' combination of tax ratio determinants to find the tax frontier, otherwise the stochastic frontier approach will not work.

Another main difference is in the interpretation. In the study of the production frontier, the difference between current production and frontier purely represents the

The (international) tax ratio model was first introduced by Lotz and Morss, now known as the Lotz-Morss equation [Lotz and Morss, 1967]. Their model simply estimates tax ratio as a function of GNP per capita, to represent the stage of development, and the ratio of total export plus import to total GNP, to represent level of openness. They argue that a higher level of economic development is usually accompanied by a higher rate of literacy, increased monetization, and stricter law enforcement, which can be expected to increase tax capacity. From the administration standpoint, it is relatively easier to impose (and enforce) tax on foreign trade than domestic transactions. Some studies added some measure of the sectoral composition, while some others tried to include the ease of tax collection and the degree of compliance as explanatory variables. Others simply used some dummy variables to represent different social, political, and political factors.

For Indonesian provincial government levels, their tax potential might depend on several factors. Due to unavailability of data, the choice of variables to represent each factor is quite restricted. Tax potential is theoretically influenced by the stage of development of that particular province, and the explanatory variable we choose is level of education. Elementary school is basically free in Indonesia, so the model uses the number of high school students per capita to distinguish between people who have a basic level of education and those who do not. Stage of development may also function as a measure of tax base. A more developed economy means a bigger tax base that in turn would be expected to give a positive impact on tax potential. Another view as suggested by Tanzi and Zee (2000) is that a more developed economy is very likely to need a higher amount of public expenditures, at least up to some point, and to meet this

increased demand, it would have to increase taxing capacity. So the expected sign for this variable is positive.

The direction of causality between the measure of tax level and stage of development might become an issue. Theoretically, some people suggest that it is the stage of development that influences the level of taxation while others argue that higher tax levels might create a bigger distortion, so economic growth would be negatively affected. Tanzi and Zee (2000) argue that despite that theoretical conflict, it is commonly assumed that the direction of causation tends to run from stage of development (usually represented by income) to taxes, not the reverse, and this argument is supported by

The variable of level of education may also serve as a measure of tax awareness. More educated people are perhaps expected to be more tax obedient, so level of education can also represent level of ease of tax collection. In addition, Labor Force Participation Rate (LFPR) is also included to represent both tax base and level of ease with a sign expected to be positive. Another potential relevant factor is level of openness, represented by the ratio of total value of export and import to total output (Gross Regional Domestic Product). The higher the level of openness, the higher the tax potential should be, since it will be administratively easier for local governments to impose and collect taxes on foreign than on domestic transactions.

Two region dummy variables (DJAVA and DRICH) are used to control for otherwise unmeasured region-specific fixed effects. It can be easily recognized that in the pre-decentralization era, there was a significant gap of development between Java provinces, including Bali, and non-Java provinces, resulting from the very centralized regime of the old government system. On the other extreme, there are some very rich provinces with oil and mineral reserves, but their standard of living does not reflect those valuable resources they own [7)]. This weak linkage reflects national control of extractive industries, since revenues from oil and minerals were collected by the central government. Those revenues were primarily used to fund the central government, and some part of it was redistributed to all provinces by using the equality principle [8)]. Lastly, to capture both firm and time effects that have to be incorporated in a panel data analysis, the procedure by Cornwell *et al.* (1990) is adopted.

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7) From 1996/1997 to 1999/2000, those four rich provinces (Aceh, Riau, East Kalimantan, and Papua) are in the top five in terms income per capita, with East Kalimantan as the highest, followed in order by Jakarta, Riau, Papua, and Aceh.

8) Note that today revenues are being returned in larger proportion to local governments.

In summary, the regression equations of tax potential are as follows :

$$\ln \frac{T}{Y}_{itj} = {}_{0j} + {}_{1j}[HS]_{itj} + {}_{2j}[AGRI]_{itj} + {}_{3j}[LFPR]_{itj} + {}_{4j}[OPDOL]_{itj} + {}_{5j}[DJAVA]_{itj} + {}_{6j}[DRICH]_{itj} + {}_{7j}[T1]_{itj} + {}_{8j}[T2]_{itj} + {}_{itj}$$

with : ${}_{itj} = v_{itj} - u_{itj}$

where :

i : province
t : time (year)
j : type of taxes
$\ln \frac{T}{Y}_{itj}$: natural log of tax ratio of province *i*, year *t*, type of tax *j*.
$[HS]_{itj}$: number of high school student per capita of province *i*, year *t*, type of tax *j*.
$[AGRI]_{itj}$: shares of agricultural sector of province *i*, year *t*, type of tax *j*.
$[LFPR]_{itj}$: Labor Force Participation Rate of province *i*, year *t*, type of tax *j*.
$[OPDOL]_{itj}$

analysis uses 104 observations. The complete estimation result of the stochastic frontier along with OLS estimates for comparison can be seen in Table 5.1.

Table 5.1. Results of Regression Analysis of the Stochastic Frontier and OLS.

EXPLANATORY				

the total variance is accounted for by the variance of inefficiency u [9]. In the OLS, all

Table 5.2. Actual Tax Ratio, Tax Potential, and Tax Potential Used.

economies should have higher tax potential. Rich provinces, such as Aceh, East Kalimantan, Papua, and Riau, which have abundant natural resources, on the other hand are at the bottom of the list. As mentioned before, those natural resource revenues are extracted to Jakarta and the generating provinces received only a very limited part of revenues as grants from the central government, where the amount is almost the same as the level other provinces receive.

For local taxes, Bali has the highest tax potential used with 88%. Bali has some special tax bases that other provinces may not have, or bigger tax bases than other provinces. Only some limited goods and services can be taxed by local governments, and the biggest local tax revenu

economy as a whole would be more significant than that of a similar increase of tax ratio in provinces with low tax potential, such as Central Kalimantan and Maluku.

For property tax, the average actual tax ratio is 0.62 percent of GDP, and the average tax potential is 0.82 percent. If all provinces could collect all their tax potential, then the additional tax ratio can be collected is about 0.20 percent of GDP. Unlike local taxes, the property tax frontier provides a less systematic pattern. Central Kalimantan apparently has the highest tax potential. Agriculture is the most important sector in this province. Its average of 43 percent is the highest in the nation, far above the national average of 26 percent. Central Kalimantan is also known as one of the centers for the forestry industry, including export. The combination of a very important agriculture sector and a high level of export explains why Central Kalimantan has a very high

VI. Policy Implications

The empirical results in the previous section show that in the pre-decentralization period, Indonesian local governments had not fully utilized their tax potential. Therefore, in anticipation of revenue shortfalls resulting from decentralization, they would be wise to exploit the potential of their existing taxes before introducing new ones. The question is how those local governments could accomplish that.

As mentioned before, the decision of a local government *not* to use all of its tax potential in the period before decentralization may be a result of by two factors: *(i)* preferences for having small government, so the low tax ratio is chosen intentionally, and / or *(ii)* inefficiency of local governments. Under the new regime of decentralization, local governments do not have any choice but to pursue higher tax ratio to deal with their new (much bigger) expenditure responsibilities. Therefore, if there were some local governments that in the past had some unused tax potential because of their preferences, it would be easier for them to increase the tax ratio than it would be for provinces with a low tax ratio caused by inefficiency. However, it seems unlikely that there are provinces that fall into the former category. Most, if not all, appear to have failed to collect their tax potential due to their inefficiency, and not because of their preferences. Therefore, to close the potential deficit, local governments should concentrate on the second factor of inefficiency.

For less developed countries, especially Indonesia, the major root of inefficiency of government is very likely to be tax evasion and / or corruption [13]. Remarkably weak

13) According to the Transparency International, in 2002, Indonesia has a Corruption Perceptions Index of 1.9, and ranks 96 of 102 countries, only above Kenya, Angola, Madagascar, Paraguay, Nigeria, and Bangladesh.

law enforcement is often pointed out as the main cause of large and extensive tax evasion in Indonesia, and this weakness is obviously related to the level of corruption of local tax officials [14]. In other words, a low tax ratio (that is much smaller than the tax potential) is likely mainly to be caused by a high level of corruption, while other factors, such as incompetence of local tax officials, out-of-date technology and equipment, lack of human resources, and so forth, might contribute insignificantly [15]. From the taxpayers' standpoint, it seems more advantageous to pay some bribes to local tax officials than to pay the full amount of tax owed. From the tax officials' standpoint, they are still better off to accept those bribes even though they might also have to bribe other law enforcers so that their actions will not be prosecuted. The solution is then very straightforward, if difficult: eliminate or at least reduce levels of corruption.

There are also some other relevant factors that may influence local governments' decision not to use all their tax potential. Before decentralization, the role of the central government in both local expenditures and revenues was very vital. As a part of the old system, the central government had to give substantial subsidies every year to local governments. As a result, local governments became very dependent e3ud57lueT20.273erepay som18 TD0

There are two types of grants given by the central government to each local government: *(i)* SDO subsidies for routine spending and *(ii)* INPRES subsidies for local development projects. The regression model will use both types (measured as a percentage of a local government's total revenues) as explanatory variables, and they are expected to have a positive relationship with the dependent variable of level of tax potential not used by local governments (that is, the error term *u*). Another explanatory variable is income per capita. Year and region dummy variables are also used to control for otherwise unmeasured year-specific and region-specific fixed effects. Finally, a lagged dependent variable is now included in the model. The regression result can be seen in Table 6.1.

For local taxes, both subsidy variables have a positive sign as expected, but are not significant. SDO subsidies have much stronger effect than INPRES subsidies [16]. This supports the hypothesis that local governments are very revenue-dependent on such central government assistance. Income per capita negatively affects the level of unused tax potential as expected, and more developed provinces tend to be able to exploit their tax potential more successfully. The most significant factor, however, turns out to be the lagged variable. It seems that the amount of revenues collected by local governments largely depends on what they were able to collect in the previous year, implying that they made little effort to exploit their current or find new tax bases.

Since a local government's tax ratio is negatively affected by subsidies from the central government, especially SDO subsidies, then the central government could design a new transfer policy that would influence local governments to increase their utilization

16) To test the potential simultaneity problem of the use of the variable of income per capita, the Hausman test is carried out. The results show that the model does not possess a simultaneity problem, so the use of OLS is plausible.

Theoretically, the difference between tax potential and actual tax ratio for property tax can be interpreted as the level of inefficiency. Property tax is managed and collected by the central government through its district tax offices. The central government sets the collection target for each provincial tax office every year, and the Directorate of PBB - *Land and Building Taxes* - (2002) reveals that of 104 observations in 26 provinces between 1996 to 1999, only 8 observations (about 7.7 percent) had tax revenue collected below their target [18]. Thus, the performance of district tax offices is determined effectively by the targets set by the central government. This conclusion is supported by the findings from the regression analysis of unused property tax potential. The target (as a percentage of GRDP) has a negative effect on unused tax potential, suggesting that if the central government increases the target,

method of setting targets for property taxes. Targets should be set equal to tax potential,

Table 6.2. Grouping of ATP Used and ATP for Local Taxes and Property Tax.

LOCAL TAXES		PROPERTY TAX	
HIGH ATP **HIGH ATP USED**	**LOW ATP** **HIGH ATP USED**	**HIGH ATP** **HIGH ATP USED**	**LOW ATP** **HIGH ATP USED**
Jambi Jakarta Yogyakarta Bali South Sulawesi	Aceh North Sumatera West Sumatera Riau Bengkulu Lampung South Kalimantan North Sulawesi Central Sulawesi West Nusa Tenggara	Jambi South Sumatera Central Kalimantan South Kalimantan East Kalimantan South Sulawesi East Nusa Tenggara Maluku Papua	West Sumatera West Java Yogyakarta Southeast Sulawesi
HIGH ATP **LOW ATP USED**	**LOW ATP** **LOW ATP USED**	**HIGH ATP** **LOW ATP USED**	**LOW ATP** **LOW ATP USED**
West Java Central Java East Java	South Sumatera West Kalimantan Central Kalimantan East Kalimantan Southeast Sulawesi East Nusa Tenggara Maluku Papua	Riau	Aceh North Sumatera Bengkulu Lampung Jakarta Central Java East Java Bali West Kalimantan North Sulawesi Central Sulawesi West Nusa Tenggara

Our empirical findings show that none local governments have optimally used their tax potential. If those local governments were able to utilize all their tax potential of local taxes, then they would get additional tax revenue of 0.10 percent of GDP. For property tax, if all property tax district offices could operate efficiently with targets set by the central government to be equal to the tax potential, then the total additional tax revenue would be 0.20 percent of GDP. In other words, by *only* pursuing the tax

potential, local governments would be able to collect additional tax revenues of 0.30 percent of GDP. Essentially, what they have to do is to improve their tax collection performance in terms of efficiency by reducing tax evasion, mostly through decreasing the level of corruption. Note that these gains can be made without making major change

create a problem in estimating tax frontier, which unlike production function construction, involves determining factors that are less obvious.

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