THE STABILIZATION PROPERTIES OF EQUALIZATION: EVIDENCE FROM SASKATCHEWAN

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1. Introduction

Although it has been only two years since the last renewal of equalization, the program that is at the center of Canadian fiscal federalism has been much in the news of late. In part, this may be a reflection of the fact that the last renewal was a low-key exercise that focused mainly on technical issues or perhaps because Canada is currently on the downside of the business cycle. In any event, recently both provincial and federal politicians have decided to engage in a public and sometimes acrimonious discussion of equalization.[1]

A number of issues have been raised as part of the public debate. The first has to do with the growth and coverage of the equalization program itself. Provincial and Territorial Finance Ministers have been urging the removal of the equalization ceiling and for a return to a ten-province rather than the current five-province standard.[2] The fiscal capacity of the receiving provinces and how they will cope if Alberta and Ontario continue to reduce taxes is another issue being discussed. Finally, Nova Scotia, and more recently Newfoundland, have argued for an ad hoc change to the program to allow them to benefit more fully from offshore energy development.[3]

Parallel to the political debate has been a debate among academics and other policy analysts concerning the incentives inherent in the equalization program and the transparency and accountability properties of the program. Research on the so-called macro approach to replace the current representative tax system (RTS) approach has be aimed at addressing some of these perceived shortcomings.

However, in all these discussions relatively little attention has been paid to the stabilization properties of equalization. Generally, it is taken for granted that, in addition to addressing on-going deficiencies in fiscal capacity, the program will also be responsive to shorter-run fluctuations in revenues and, other things being equal, contribute to enhanced stability of provincial government revenues. Indeed, its responsiveness to revenue fluctuations is sometimes identified as one of the key features of the program.

Actual experience suggests that equalization may not be responsive to revenue fluctuations in all provinces. Therefore, the purpose of this paper is to examine whether equalization actually contributes to the stability and predictability of provincial government revenues. Practitioners know that each province has its own fiscal history and unique features of its revenue budget. These unique features must be properly taken into account if provincial fiscal data are to be analyzed. In order to keep the scope of this study manageable, the focus will be on a single province: Saskatchewan.

The remainder of the paper is organized as follows. In the next section, we develop a simple model of the interaction between equalization and provincial own-source revenue. Two propositions relating to revenue volatility and predictability are derived. In section 3 we describe the Saskatchewan data followed by an

1 Of course, equalization is *always* a subject for debate in Canada. For a classic work on equalization, see Courchene (1984). For a recent volume extolling the virtues of the current system, see Boadway and Hobson (1998). A recent call for reform is contained in Boothe (1998).

2 See Provincial and Territorial Finance Ministers (2001).

3 See Hamm (2001).

analysis of the data and a test of the two propositions. The paper concludes with a summary and a discussion of policy implications.

2. The Model

Although in practice Canadian equalization is quite complex, based on a representative tax system with 33 bases, a five-province standard and a number of ad hoc arrangements, the theoretical representation of equalization entitlements is relatively simple:

$$E_i/N_i = t\,[B_s/N_s - B_i/N_i] \qquad (1)$$

Where:

E_i is equalization to province i,
N_i is the population of province i,
t is the national average tax rate.
B_s is the standard provinces' tax base,
N_s is the population of the standard provinces, and
B_i is the tax base of province i.

For the sake of simplicity, we assume a single tax base, say income tax. If the per capita base for the standard provinces is greater than the per capita base for a particular province, that province qualifies for equalization payments equal to the national average tax rate applied to the deviation from the standard provinces' per capita base.[4] In other words, provinces with a per capita base below the base are 'levelled up' to the standard.

From equation (1) it is clear that, other things being equal, a rise in the size of a province's tax base will cause its entitlement to decline. If the negative covariance tax base and entitlements is sufficiently large, other things being equal, the variance of own-source revenue plus equalization will be smaller than the variance of own-source revenue alone.[5] A further implication is that, for similar reasons, the variance of budget forecast errors should be smaller for own-source revenue plus equalization than the variance for forecast errors related to own-source revenue alone.

In summary, we derive two testable predictions from the model. The first is that if equalization is indeed stabilizing, the volatility of own-source revenue plus equalization will be smaller than the variance of own-source revenue alone. The second is that the predictability of own-source revenue plus equalization should be greater than the predictability of own-source revenue alone.

3. The Data

All revenue data analyzed in this paper are drawn from relevant volumes of the Saskatchewan Public Accounts.[6] Two adjustments are made to total revenue:

$$AR = TR - TGE - EQ. \qquad (2)$$

Where:

AR is adjusted revenue,
TR is total revenue,
TGE is transfers from government entities, and
EQ is equalization.

Transfers from government entities are subtracted from total revenue because it has been the practice in Saskatchewan to use transfers from entities such as the Saskatchewan Liquor and Gaming Authority and Crown Investments Corporation to smooth revenues and protect against negative revenue shocks. In fact, this practice was formalized in 1999-2000 with the establishment of Saskatchewan's Fiscal Stabilization Fund. The second adjustment to

4 For the sake of simplicity, in this discussion we ignore the impact of floor payments, ceilings and other ad hoc features of the program.

5 This follows because the variance of a sum of random variables is simply equal to the sum of the variances plus two times the covariance.

6 I am grateful to the Economic and Fiscal Policy Branch of Saskatchewan Finance for assembling the data from the Public Accounts.

total revenue is the subtraction of equalization, to permit study of the impact of that transfer on revenue volatility and predictability.

AR and EQ for the period 1986-87 to 2000-01 are presented in Figure 1. The sample period is chosen to correspond to the most recent uninterrupted period in which Saskatchewan received positive equalization transfers. Adjusted revenue grows at an average rate of about $200 million per year over the period from about $2.5 billion in 1986-87 to about $5.5 billion in 2000-01. Equalization shows no discernable trend but ranges from a high of $663 million to a low of $8 million.

One representation of volatility is presented in Figure 2 which shows changes in AR and AR+EQ. This chart allows an examination of the impact of equalization on the volatility of revenue. For the most part (11 of 14 years), changes in AR are positive in keeping with the average positive growth rates over the sample. Noteworthy is that fact that changes in AR+EQ are actually larger than changes in AR in 10 of the 14 years in the sample.

An alternate view of volatility is presented in Figure 3. Here the volatility of AR and AR+EQ are calculated as deviations from trend. Trend series were calculated using a simple regression against time, with regression results shown in Table 1.[7] This chart illustrates clearly the extreme volatility of revenues with 5 of 15 observations being greater than $250 million. Once again, it is noteworthy that absolute deviations in AR+EQ are greater than deviations in AR in 8 of 15 years.

Finally, some information on the impact of equalization on the predictability of revenues is presented in Figure 4. Forecast errors are defined as actual minus budget, so positive values indicate that revenues were underestimated. Here we see that forecast errors for AR+EQ were smaller than AR forecast errors 9 out of 15 times.

4. Analysis

Tests of the two hypotheses are straightforward. The first hypothesis is that equalization reduces the volatility of government revenues. Table 2 presents descriptive statistics and tests of equality of variance for changes in AR and AR+EQ. From the descriptive statistics we see that changes in AR+EQ have maximum and minimum values that exceed their counterparts for AR alone. Further, the standard deviation of changes in AR+EQ is more than $50 million larger than that of changes in AR alone. Formal testing shows that the null hypothesis of equality of the variances of AR+EQ and AR cannot be rejected in favor of the alternative that the variance of AR+EQ is less than the variance of AR alone.

Table 3 presents a similar picture for deviations from trend AR and AR+EQ. Once again, maximums, minimums and standard deviations for deviations from trend AR+EQ are larger than those for deviations from trend AR alone. Formal testing also fails to reject the null hypothesis of equality of variances.

The second proposition is that equalization improves the predictability of government revenues. Results pertaining to this proposition are presented in Table 4. Looking first at the descriptive statistics, we see that the mean forecast error for AR is $176 million or about 4.4 percent on average over the sample period. The mean forecast error for AR+EQ is $165 million or about 3.75 percent on average over the sample period. AR+EQ forecasts have the largest positive error while AR forecasts have the largest negative error. The standard deviation of forecast errors is about $43 million larger for AR than AR+EQ. Formal tests do not allow us to reject the null hypotheses that either the means or the variances of the forecast errors are equal.

Given that our estimates of the means and variances are smaller for AR+EQ than for AR, it is legitimate to ask whether failure to reject the null is simply a function of the power of the test

7 A simple, linear specification was used. A second-order polynomial was also tested, but did not improve fit significantly.

in the face of such a small sample. To answer this question, consider the test results if means and variances had been estimated using 30 or even 60 observations. In both cases we are still unable to reject the null of equality at the 95 percent confidence level, although it would be possible to reject equality of the variances at the 90 percent confidence level if 60 observations was assumed.

5. Summary and Policy Implications

The results of the study are easily summarized. Using Saskatchewan data adjusted to remove equalization and transfers from Crown entities for the period 1987-2001, we tested the propositions that equalization reduced the volatility and improved the predictability of provincial government revenues. Based on an examination of both changes in revenue and deviations from trend revenue, we found that the volatility of revenues were actually larger for AR+EQ than for AR alone. Statistically, we could not reject that hypothesis that the variances of the two series were equal. We therefore conclude that equalization did not contribute to reducing revenue volatility for Saskatchewan over the 1987-2001 period.

Regarding the predictability of revenue, we examined budget forecast errors for AR+EQ and AR alone. Average forecast errors were about $11 million lower (0.25 percent) for AR+EQ than for AR over the period. The standard deviation of forecasts errors was also smaller for AR+EQ than AR alone. However, using formal statistical tests, we could not reject the hypotheses that the means or variances of both sets of forecast errors were equal. Therefore, we find little evidence that equalization improved the predictability of Saskatchewan government revenues over the period 1987-2001.

If they generalize to other equalization-receiving provinces, at least two policy implications flow from these results. The first is that equalization does not contribute to reducing the volatility of provincial revenues and provincial governments therefore may need other mechanisms to manage revenue volatility. Indeed, to this end a number of provinces have moved to create reserves or explicitly smoothed revenue forecasts to mitigate the impact of volatility and make revenues more predictable.

The second policy implication relates to the equalization program itself. Proponents of the current RTS system have argued that one of its benefits is its responsiveness to changes in provincial revenues. At least for Saskatchewan, this benefit appears to have been largely illusory. Thus, when considering future changes to the equalization program – whether they are fundamental (i.e. moving to a macro formula) or administrative (i.e. changing the timing of the release of data) – it will be useful to consider the stabilization properties of the proposed system.

Finally, with respect to future work, two research areas are suggested. The first is to see whether the findings for Saskatchewan generalize to other equalization-receiving provinces. The second is to investigate the reasons for equalization's failure to reduce the volatility and improve the predictability of revenues. At least three possibilities exist. The first is that movements in variables other than the individual province's tax bases dominate the formula. Other variables include tax rates and the standard tax base. The second is that prior-year adjustments, which make up the difference between entitlements, are cash actually received, and are largely related to the lagged release of data. Finally, it may be that ad hoc features of the program such as floor and ceiling payments and tax-back arrangements have diminished the stabilization properties of the program. Each of these possibilities warrant further investigation to determine what role, if any, they play in reducing the stabilization properties of equalization.

6. References

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Table 1
Dependent Variable: AR
Method: Least Squares
Sample: 1987 2001
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-393865.2	22313.31	-17.65158	0.0000
TIME	199.5323	11.19020	17.83099	0.0000

R-squared	0.960718	Mean dependent var	4002.231
Adjusted R-squared	0.957697	S.D. dependent var	910.3957
S.E. of regression	187.2479	Akaike info criterion	13.42631
Sum squared resid	455802.9	Schwarz criterion	13.52072
Log likelihood	-98.69732	F-statistic	317.9442
Durbin-Watson stat	1.586805	Prob(F-statistic)	0.000000

Dependent Variable: AR+EQ
Method: Least Squares
Sample: 1987 2001
Included observations: 15

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-371478.5	27825.55	-13.35027	0.0000
TIME	188.5046	13.95461	13.50842	0.0000

R-squared	0.933496	Mean dependent var	4399.745
Adjusted R-squared	0.928380	S.D. dependent var	872.5309
S.E. of regression	233.5052	Akaike info criterion	13.86785
Sum squared resid	708821.0	Schwarz criterion	13.96226
Log likelihood	-102.0089	F-statistic	182.4773
Durbin-Watson stat	1.547771	Prob(F-statistic)	0.000000

Table 2

Descriptive Statistics
Sample: 1988 2001
Included observations: 14

	ΔAR	Δ(AR+EQ)
Mean	215.3451	217.4551
Median	299.3500	273.7870
Maximum	545.6950	645.3550
Minimum	-164.9530	-332.6130
Std. Dev.	235.3017	288.9449
Skewness	-0.424003	-0.386723
Kurtosis	1.875066	2.388729

Test for Equality of Variances Between ΔAR and Δ(AR+EQ)

Method	df	Value	Probability
F-test	(13, 13)	1.507926	0.4691
Siegel-Tukey		0.068922	0.9451
Bartlett	1	0.524308	0.4690
Levene	(1, 26)	0.173775	0.6802
Brown-Forsythe	(1, 26)	0.052532	0.8205

Table 3

Sample: 1987 2001
Included observations: 15

	Deviations from Trend AR	Deviations from Trend (AR+EQ)
Mean	-3.03E-11	-3.31E-11
Median	-27.68453	21.17637
Maximum	300.5345	342.2358
Minimum	-390.7772	-426.3840
Std. Dev.	180.4365	225.0113
Skewness	-0.413306	-0.619691
Kurtosis	2.855135	2.723723

Test for Equality of Variances Between Trend AR and AR+EQ Deviations

Method	df	Value	Probability
F-test	(14, 14)	1.555104	0.4190
Siegel-Tukey		0.580693	0.5614
Bartlett	1	0.653547	0.4188
Levene	(1, 28)	0.200639	0.6577
Brown-Forsythe	(1, 28)	0.138707	0.7124

Table 4

Sample: 1987 2001
Included observations: 15

	AR Forecast Errors	AR+EQ Forecast Errors
Mean	175.8439	164.9979
Median	171.3150	127.8690
Maximum	693.5100	755.4100
Minimum	-623.6320	-455.0720
Std. Dev.	344.5432	301.7946
Skewness	-0.457869	-0.082987
Kurtosis	3.153875	2.865417

Test for Equality of Means Between Series

Method	df	Value	Probability
t-test	28	0.091711	0.9276
Anova F-statistic	(1, 28)	0.008411	0.9276

Test for Equality of Variances Between Series

Method	df	Value	Probability
F-test	(14, 14)	1.303360	0.6268
Siegel-Tukey		0.000000	1.0000
Bartlett	1	0.236525	0.6267
Levene	(1, 28)	0.092082	0.7638
Brown-Forsythe	(1, 28)	0.107146	0.7459

Figure 1
AR and EQ

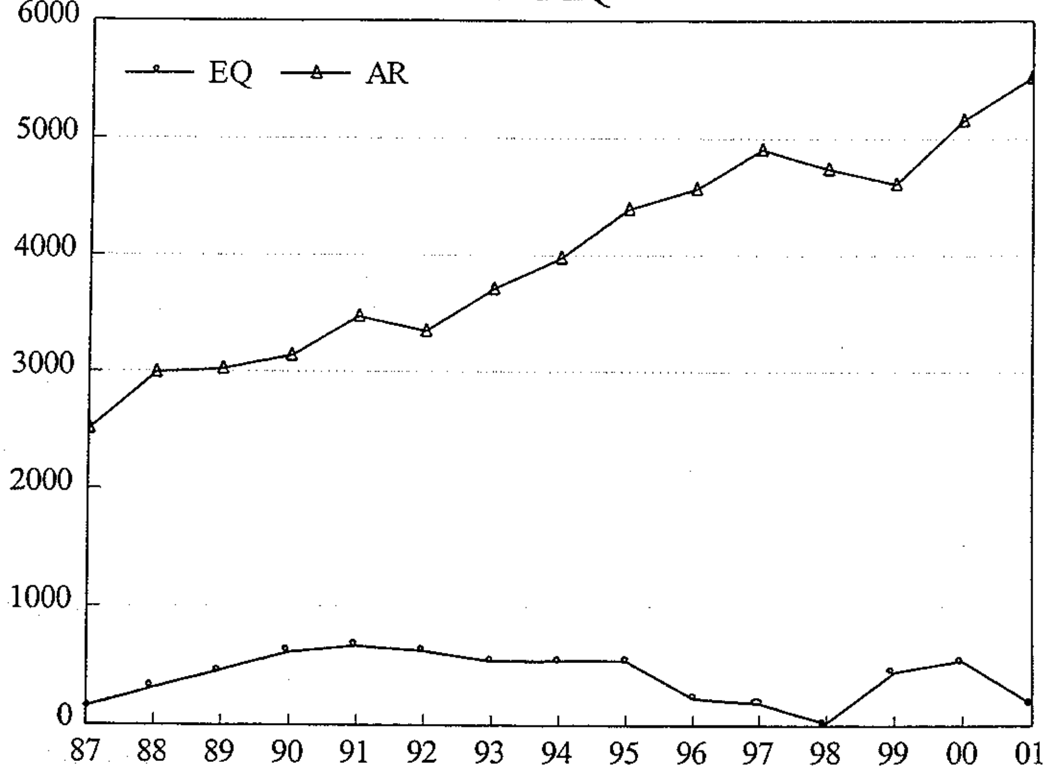

Figure 2
Changes in AR and AR+EQ

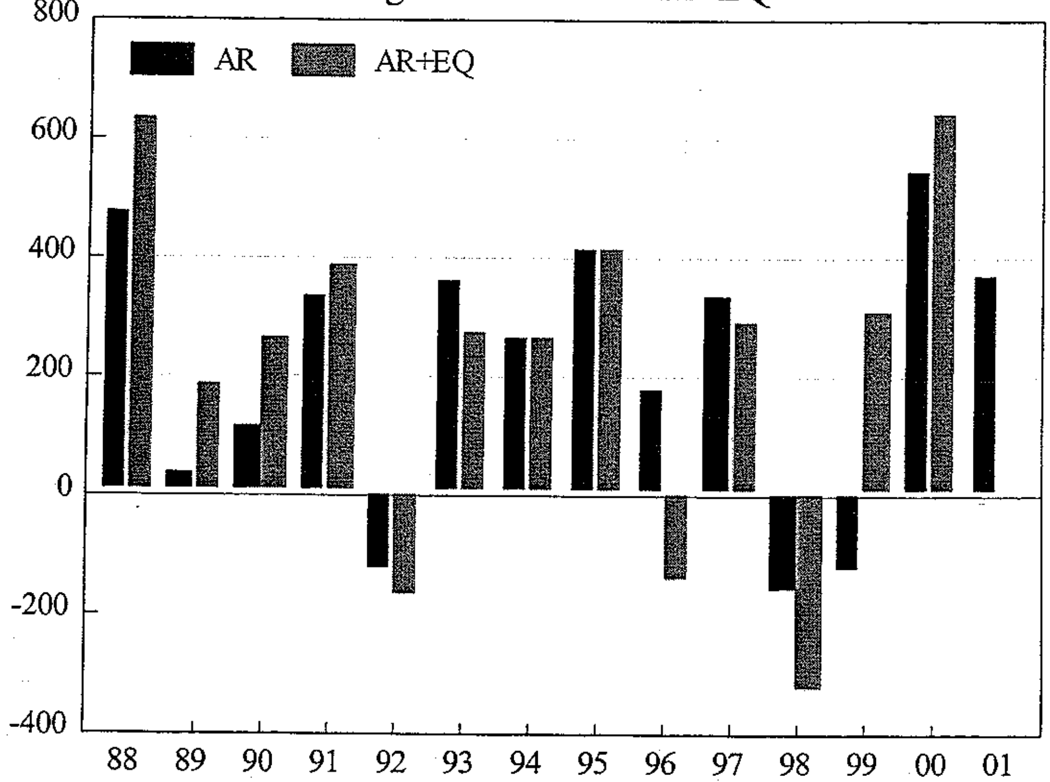

Figure 3
Deviations from Trend AR and AR+EQ

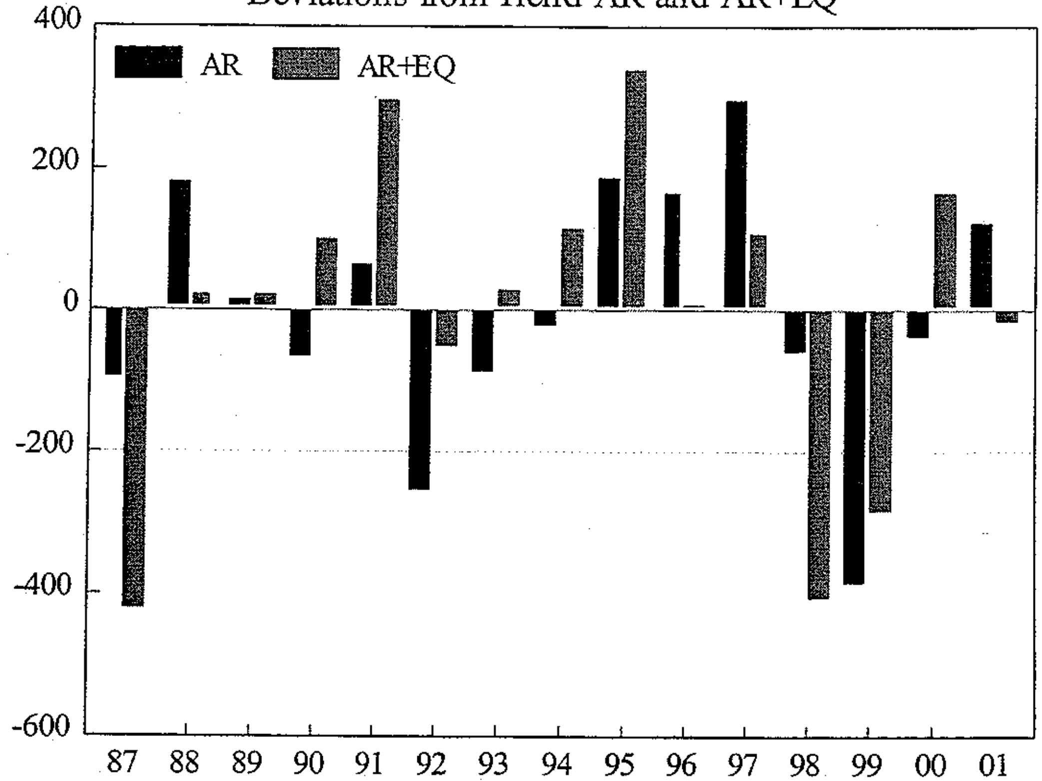

Figure 4
Forecast Errors for AR and AR+EQ