# II. AKTUALNE TEME

## 1. MODELING CROATIAN TAX COLLECTIONS

### 1. INTRODUCTION

Much changed as Croatia moved from its past to its present. Its past must be understood in a context broader than purely chronological. For while the past surely can be gauged in terms of time as a collection of years, it also can be measured in terms of attitude, demeanor, and prospects. And in that broader context, the present is truly different from the past. The changes from the past to the present have been dramatic, and like all dramatic changes, they have brought with them great challenges.

In regard to economic matters, one of the principal challenges for the country's government concerns its budget. Put as a question, How can the central government finance the many activities and projects that are critical for the passage of Croatia from the past to the present en route to the future? This issue clearly revolves around tax collections. Factors that affect those collections must be identified, and the strengths of the linkages must be established. Since the determinants themselves are elements in an overall economic system, they ought to be treated not as separate, isolated concepts but rather as parts of a whole. Furthermore, to improve decision making, that treatment should reveal how the determinants respond to fiscal policy; in particular, to government spending. Efforts along those lines have been continual within the Ministry of Finance. Most recently, however, those efforts have intensified by virtue of support through the World Bank. This paper deals mainly with the contribution of the current writer to the new work.

Section 2 concentrates on three tax series: the sales tax, the income tax, and the profit tax. By means of estimated equations, the determinants of those taxes are brought to light, and the linkages are quantified. In addition, the elasticities underlying the relationships are derived. Section 3 positions the tax determinants within the Croatian economic network. Along the way it notes how government spending influences the determinants. Section 4 completes the fiscal model by summarizing the results derived by other members of the research team. Those results combine with the findings on the sales, income, and profit taxes to account for 98.1 percent of all tax revenues collected by Croatia during the first three months of 1996. Section 5 discloses by word and picture how the model solves and how government spending can impact tax collections. In theory and in practice, there is a flow between spending and collections, and Section 5 maps it out. Section 6 closes the discussion with reflections on the work now done and on possible extensions.

It may be observed here that all data used in the inquiry are supplied by the Ministry of Finance. They have a monthly frequency and, for the present writer, typically cover the 63 months from 1991:1 to 1996:3. Many series, however, are available only over shorter periods of time. Notable in that regard are the tax series, which are recorded from 1993:1 thereby reducing observations to 39 given the 1996:3 endpoint. It also may be observed that, for purposes of study, the tax variables are defined in real terms; namely, actual (nominal) tax collections deflated by the retail price index RPI, which is based at 1.00. There are two reasons for following a strategy of deflation. First, during the months of hyperinflation, Croatia's nominal tax collections—like most nominal variables—simply explode in magnitude thereby robbing the data of informational content. That is, the ballooning of the nominal figures swamps and masks fundamental forces that govern collections. Deflation, by combating the confounding effects of hyperinflation, helps to uncover those fundamental forces. Second, real tax collections lend themselves to ready incorporation into a larger econometric model that might be designed to explain and forecast Croatian economic performance generally. Thus modeling taxes in real terms now gives the Ministry a head start on possible modeling efforts later.

As final prefatory points it might be mentioned that, unless otherwise indicated, real series deflate by the RPI and appear in thousands of kunas. Analogously, unless otherwise indicated, estimation proceeds by ordinary least squares. It might be mentioned too that the equations given below represent the best formulations from the hundreds actually tested. They rate highest in terms of economic theory, econometric performance, and policy practice, and they carry the approval of the full research team. Assistant Finance Minister Zoran Anušić headed the team, which also included Martina Dalić, Sanja Madžarević, Andrea Mervar, Kaniz Siddique, and the author.

## 2. SELECTED TAX EQUATIONS

### Sales Tax

The sales tax is by far the largest single revenue raiser in Croatia generating 50.3 percent of all tax revenues collected in the first three months of 1996. Inasmuch as the tax is levied on sales, the real sales tax RSALTAX is necessarily tied to real sales volume RSALES. Nevertheless, other factors may enter the picture.

For instance, inflation may influence *real* collections in a negative way because inflation-and especially hyperinflation-undermines economic performance. As Smyth (1994, p. 261) asserts:

> ***Inflation distorts price signals in the market and introduces noise into the system. The result is that economic agents use time and resources to cope with inflation. Thus the ability of an economy to produce output and to grow is reduced below what it would be in an inflation free economy.***

Inflation compromises output and sales. It also encourages tax evasion. Accordingly, inflation INF, stated as the decimal

$$INF = RPI / RPI_{-1} - 1 , \qquad (1)$$

is likely to have a negative effect on real sales tax collections. By contrast, tourism should have a positive effect. To tour means to spend; the two go together. Even Croatian residents who tour the country spend in proportions greater than normal. They eat at restaurants rather than at their own tables, they sleep in hotels rather than in their own beds, and they shop for souvenirs rather than window shop. Consequently, tourism TOUR, understood as the number of nights spent in Croatia by all tourists and measured in thousands, should influence collections positively.

Estimating the sales tax equation over the 38 months from 1993:2 to 1996:3 confirms these hypotheses. In particular, the equation that emerges reads

$$\begin{aligned} RSALTAX = {} & 751.4 + 106.3\ D9310 + 155.2\ D944A5 - 114.6\ D954A5 \\ & [9.739]\ \ [1.710]\ \ \ \ \ [3.726]\ \ \ \ \ [-2.786] \\ & + .3168\ RSALES - .1881\ RSALES_{-1} \\ & \ \ [5.465]\ \ \ \ \ [-3.276] \\ & - 399.4\ INF + .0101\ TOUR_{-1}\ , \\ & \ \ [-4.470]\ \ \ [1.749] \end{aligned} \qquad (2)$$

where the brackets contain the Student-t statistics. Moreover, $\overline{R}^2 = .731$, $F = 15.35$, and $DW = 1.96$. The variables prefixed by a "D" are dummy variables that assume unit values in the months indicated and zeros otherwise. Hence D9310 takes its unit value in October 1993; D944A5, in April and May of 1994; and D954A5, in April and May of 1995. These measures allow for "spikes" or extremes in the data.

Equation (2) shows that sales tax collections are subject to some inertia. Current collections stretch across the sales of two periods, the current month and the immediate past month, and they reflect the past month's tourism. Delays in filing and recording probably account for these lags. If the time frame of the equation were broadened to cover an entire quarter or a whole year, then the lagged effects likely would disappear. That is, sales tax collections are probably simultaneous with filing and recording practices in an extended temporal format. Of course, quarterly and annual frequencies are ruled out by the brevity of the data.

A coefficient in an equation quantifies the responsiveness of the dependent variable y to an independent variable x. However, the coefficient is scale dependent as its value varies with the units of measurement of the variables. A responsiveness indicator that is dimension free is the elasticity as it gives the percent change in y due to a unit percent change in x. If the elasticity exceeds one in absolute value, then the relationship between y and x is said to be elastic or sensitive. If it equals one, then the relationship is unitary elastic whereas if it falls below one, then the relationship is inelastic or insensitive.

Table 1 reports elasticities with respect to the base variables. Column 1 deals with the sales tax. Specifically, it presents the elasticity of RSALTAX with respect to RSALES, and it distinguishes between short and long runs on the one hand and between constant and variable magnitudes on the other. The short-run perspective addresses the "immediate" effect of a change in RSALES on RSALTAX. Since RSALES enters the equation in a slightly protracted manner, the short-run elasticity imposes the condition that RSALES = $RSALES_{-1}$ before the calculation is made. The long-run perspective considers the permanent effect of a change in the base variable. It would impose the condition that RSALTAX = $RSALTAX_{-1}$ before the computation is attempted. But because equation (2) involves no lagged dependent variable, the long-run elasticities are identical to their short-run counterparts.

What about constant versus variable? The constant elasticity presumes that the elasticity remains the same from month to month. Representing an average value, it emerges from the logarithmic variant of equation (2):

$$\begin{aligned} \ln(RSALTAX) = {} & 5.233 + .1091\ D9310 + .1413\ D944A5 - .1174\ D954A5 \\ & [9.668]\ \ [1.725]\ \ \ \ \ [3.380]\ \ \ \ \ [-2.827] \\ & + .5434 \ln(RSALES) - .3395 \ln(RSALES_{-1}) \\ & \ \ [5.138]\ \ \ \ \ \ \ \ [-3.239] \\ & - .4692\ INF + .0225 \ln(TOUR_{-1}), \\ & \ \ [-5.209]\ \ \ [2.425] \end{aligned} \qquad (3)$$

whose $\overline{R}^2$ = .740, F = 16.05, DW = 2.20, Period = 1993:2–1996:3, and number of observations NOB = 38. Imposing the restriction that

RSALES = $RSALES_{-1}$ yields a coefficient of .2039, which is the elasticity shown in Table 1.

Table 1.
**TAX ELASTICITIES WITH RESPECT TO THE BASE VARIABLES**

| Type | Real Sales Tax with Respect to Real Sales | Real Income Tax with Respect to Real Wages Plus | Real Profit Tax with Respect to Real Gross Domestic Product |
|---|---|---|---|
| Short Run | | | |
| Constant | .2039 | .6273 | 1.4685 |
| Variable | .2668 | .7498 | 1.0446 |
| Long Run | | | |
| Constant | .2039 | 1.1511 | 1.7198 |
| Variable | .2668 | 1.0975 | 1.1080 |
| Overall | .9163 | | |

Notes: Constant elasticities are calculated from the logarithmic counterparts of the level equations. Variable elasticities are calculated from the level equations using averages for the three months 1996:1 to 1996:3.

As opposed to the constant elasticity, the variable elasticity changes from month to month in reflection of the changing values of RSALTAX and RSALES. It comes directly from the level equation (2) under the proviso that RSALES = $RSALES_{-1}$. For the period 1996:1 to 1996:3, it equals .2668.

Sales tax elasticities below one may seem to be low. Sales taxes are levied percentagewise against sales, and therefore intuition suggests that the elasticity should be on the order of one. Testing that hypothesis by the simple equation ln (RSALTAX) = ß ln (RSALES), ß being the elasticity, confirms that thinking by rendering ß = .9163, which Table 1 calls the overall elasticity. In short, the elasticity between RSALTAX and RSALES is about one when no allowance is made for the separate factors that influence the sales tax. Explicitly allowing for those separate influences—namely, holding constant the effect of other forces—reduces the elasticity from the overall mark and produces the values registered in Table 1.

## Income Tax

Responsible for 14.8 percent of the country's total tax revenue in early 1996, the income tax is unquestionably anchored in household income. That income variable includes earnings as captured by the total net wage bill; it also includes other income realized from labor contracts. It excludes social security benefits under the simplifying assumption that those benefits are not subject to the tax. The resulting base variable is called RWPLUS—real wages plus—to convey the idea that it involves more than just earnings.

Filing and recording delays may impart a lagged response to real income tax collections RINCTAX, and inflation, by disrupting economic activity, may have a negative impact on them. When added to the base relation, these hypotheses produce

$$\underset{[-.778]}{RINCTAX = -24.60} + \underset{[4.404]}{.0961\ RWPLUS} - \underset{[-2.511]}{131.1\ INF} + \underset{[2.819]}{.3169\ RINCTAX_{-1}}, \quad (4)$$

where $\bar{R}^2$ = .899, F = 110.97, DW = 1.80, Dh = .855, Period = 1993:2–1996:3, and NOB = 38. It is evident that income governs the income tax. It is also evident that the income tax exhibits some inertia and that inflation compromises collections.

Elasticities behind the income tax are posted in Table 1. The constant elasticities come from the logarithmic companion to equation (4); namely,

$$\underset{[-1.700]}{\ln(RINCTAX) = -1.766} + \underset{[3.401]}{.6273\ \ln(RWPLUS)} - \underset{[-3.639]}{.8157\ INF} + \underset{[4.709]}{.4550\ \ln(RINCTAX_{-1})}, \quad (5)$$

where $\bar{R}^2$ = .943, F = 203.59, DW = 2.02, Dh = -.074, Period = 1993:2–1996:3, and NOB = 38. Here the short-run constant elasticity is .6273. In the long run, when RINCTAX = $RINCTAX_{-1}$, the elasticity becomes 1.1511. The variable measure, calculated directly from schedule

(4) for the months 1996:1 to 1996:3, equals .7498 and 1.0975 respectively. Thus the income tax is inelastic in the short run but elastic or at least unitary elastic in the long run.

**Profit Tax**

Although the profit tax, representing 2.5 percent of all taxes collected in the first part of 1996, has not generated great sums of revenue, it may become a pronounced revenue raiser as the country moves further and further into the private enterprise system. Moreover, that tax exhibits an interesting pattern as spikes occur with regularity around April. For these two reasons, the profit tax is subjected to econometric analysis.

Profit tax obviously depends upon profit. The difficulty in quantifying that relationship is the absence of data that would permit a proper economy-wide statement of profit. Without series on capital stock and user cost, real profit might be approximated by the difference between real sales and the real wage bill. That approximation, however, proved to be unsatisfactory in preliminary testing, and consequently the base series is taken to be real gross domestic product RGDP, expressed as an index grounded at 100.0. The logic behind the substitution is straightforward: Real profit likely varies in a systematic manner with aggregate output making RGDP a natural proxy. Estimation over the 38 months from 1993:2 to 1996:3 leaves for real profit tax collections RPROTAX

$$\begin{aligned} RPROTAX = {} & -14.70 + 270.6\ MAR93 + 200.0\ APRIL \\ & [-.810] \quad [14.734] \quad\quad [18.458] \\ & + .9374\ RGDP + .0572\ RPROTAX_{-1} \\ & [2.683] \quad\quad [1.369] \end{aligned} \qquad (6)$$

For this schedule, $\bar{R}^2 = .936$, F = 137.09, DW = 1.63, and Dh = 1.059.

Variables MAR93 and APRIL are dummies. The former assumes a unit value in March 1993 while the latter takes units in April 1994, April

1995, and May 1995. These dichotomous measures allow for the perturbations in the profit tax series. In essence, the profit tax is paid by firms in monthly installments throughout the year with an "adjustment" being made around April to correct for the extent to which the installments underrepresent total tax liability. From the statistical results it should be manifest that the dummies aptly account for the balances paid. The results also confirm that RGDP serves as a decent proxy for profit levels. Finally, they reveal that there is slight inertia in collections.

Corresponding to equation (6) is the constant-elasticity formulation

$$\ln(\text{RPROTAX}) = \underset{[-1.938]}{-2.808} + \underset{[6.254]}{2.516\ \text{MAR93}} + \underset{[7.893]}{1.883\ \text{APRIL}} + \underset{[3.839]}{1.4685\ \ln(\text{RGDP})} + \underset{[1.743]}{.1461\ \ln(\text{RPROTAX}_{-1})}, \quad (7)$$

whose $\bar{R}^2$ = .760, F = 30.34, DW = 1.79, Dh = .584, Period = 1993:2–1996:3, and NOB = 38. Equation (7) estimates the constant short-run elasticity to be 1.4685 and the constant long-run elasticity, which presumes that RPROTAX = $\text{RPROTAX}_{-1}$, to be 1.7198. The variable elasticities, derived from equation (6) for the months 1996:1 to 1996:3, are 1.0446 and 1.1080 respectively as Table 1 reports. The profit tax is (typically) elastic implying that improved economic fortune would greatly increase profit tax collections.

## 3. EXPLAINING DETERMINANTS

Equations (2), (4), and (6) isolate the determinants of real sales tax collections, real income tax collections, and real profit tax collections. Aside from the dummy variables and the lagged values of the tax collections, those determinants are RSALES, real sales; RWPLUS, real net wages extended to include other labor income; RGDP, real gross domestic product; INF, the inflation rate; and TOUR, all tourism. TOUR may be regarded as exogenous and influenced at least in part by policy

makers. It is self-explanatory. The other factors need to be explained. Rather than being treated as exogenous, they should be placed within the wider macro system to show how they themselves are determined and to clarify how they are affected by fiscal policy. RSALES, RWPLUS, and RGDP are considered first. INF, falling within the ambit of another researcher, is taken up later.

## Real Sales

*Explaining real sales calls to mind images of consumption functions* because sales and consumption can be regarded as roughly synonymous. Gapinski (1992, pp. 128–62) reviews the theory of consumption and notes that consumption is customarily posited as being dependent upon current income and lagged consumption. Applying that consensus to RSALES over the 62 months from 1991:2 to 1996:3 produces

$$\underset{}{\text{RSALES}} = \underset{[6.731]}{.2626\ \text{RPDY}} + \underset{[14.516]}{.6755\ \text{RSALES}_{-1}}\ , \qquad (8)$$

with $\overline{R}^2 = .929$, F = 791.97, DW = 1.79, and Dh = .274. Real personal disposable income RPDY satisfies the identity

$$\text{RPDY} = \text{RWPLUS} + \text{RSSB}\ , \qquad (9)$$

where RSSB represents real social security benefits. It is evident from equation (8) that conventional theoretics carry over nicely to the Croatian situation. This applicability of standard consumption logic to Croatia was anticipated from the work by Gapinski, Škegro, and Zuehlke (1989, pp. 51–55, 163) and by Gapinski (1993, pp. 51–56, 163–65).

## Household Income

Income RWPLUS can be envisioned to involve two components: real private-sector earnings RWPLUSP and real earnings paid out by the government RWAGES. In equation form

$$RWPLUS = RWPLUSP + RWAGES. \quad (10)$$

With RWAGES representing an exogenous policy variable, explaining RWPLUS amounts to explaining RWPLUSP. But RWPLUSP, being income, ought to move directly with general economic activity gauged by RGDP. It may move sluggishly though as wage settlements, whether contractual or otherwise, tend to hold for multiple periods. Earnings this month resemble earnings last month, and consequently $RWPLUSP_{-1}$ may help to explain RWPLUSP. Similarly, $RWAGES_{-1}$ may help with the explanation as wage settlements in the government sector may set the tone for future settlements in the private sector. Succinctly, there may be a demonstration effect in the general wage negotiation process. Such thinking gives rise to

$$RWPLUSP = \underset{[.713]}{162.0} + \underset{[2.517]}{12.43}\, RGDP + \underset{[1.443]}{.4396}\, RWAGES_{-1} + \underset{[2.231]}{.3036}\, RWPLUSP_{-1}, \quad (11)$$

with $\overline{R}^2 = .604$, $F = 13.71$, $DW = 1.90$, and $Dh = .256$. The period of coverage is 1994:2 to 1996:3 making the observation count 26.

## Real Gross Domestic Product

*Often real gross domestic product RGDP is solved by means of an* identity which conveys the idea that in equilibrium supply equals demand. However, this approach, as Gapinski (1992, pp. 24–27) describes, requires specification of each demand component and quickly expands the scope of the modeling effort. Besides, it maintains that the economy is in equilibrium, a situation which may not be appropriate for

today's Croatia. An alternative approach treats RGDP as a reduced form dependent on variables that can be considered to be exogenous. This latter approach does not broaden the modeling endeavor since the RGDP determinants require no additional explanatory equations. Furthermore, it does not impose the condition of equilibrium on the solution. For these two reasons, it is the preferred choice in the present context.

Explanatory variables for RGDP include dummies SEP94 and DEC94 to capture spikes for September 1994 and December 1994, tourism TOUR to capture the boost to general economic activity triggered by those citizens and foreigners who visit the countryside, and lagged RGDP to capture inertia in the temporal movement of output. Accompanying these determinants are two policy variables. The first instrument is real current spending RCURTOT defined as real government expenditures on earnings RWAGES, on employer contributions REMPCONT, on goods and services RGOODS, on current transfers RCURTRAN, and on subsidies RSUBS. The second instrument is real capital spending RCAPTOT defined as real government expenditures on capital goods RCAP and on net lending RLEND. Aggregating components into the current category presumes—perhaps arguably—that current spending is current spending: A million kuna expenditure on earnings is equivalent to a million kuna expenditure on goods and services. Likewise, aggregating components into the capital category presumes that capital spending is capital spending. Besides recognizing fungibility, aggregation recognizes the limited number of observations behind the expenditure data. Disaggregation simply would consume a substantial number of an already small number of degrees of freedom.

The consensus view of the research team was that current expenditures RCURTOT affect RGDP more quickly but more weakly than do capital expenditures RCAPTOT. Guided by this interpretation, the inquiry tested numerous lag structures for both variables and eventually found that RCURTOT behaved well within a two-period lag while RCAPTOT behaved well beyond a two-period lag. One preliminary regression is quite telling in this regard:

$$\begin{aligned} RGDP = {} & 19.49 + 11.86\ SEP94 + 11.70\ DEC94 + .0011\ TOUR \\ & [2.169] \quad [3.972] \quad\quad [4.158] \quad\quad [3.408] \\ & + .0057\ RCURTOT + .0032\ RCURTOT_{-1} + .0024\ RCAPTOT_{-3} \\ & \quad [1.736] \quad\quad\quad [.999] \quad\quad\quad [.582] \\ & + .0071\ RCAPTOT_{-4} + .2918\ RGDP_{-1}\ , \\ & \quad [1.183] \quad\quad\quad [2.417] \end{aligned} \tag{12}$$

with $\overline{R}^2$ = .670, F = 6.58, DW = 1.95, Dh = -.657, Period = 1994:5–1996:3, and NOB = 23. This equation reveals that the impact of current spending declines through time within two months (.0057 versus .0032) whereas the impact of capital spending increases through time beyond a two-month lag (.0024 versus .0071). Had data been more abundant, further lags might have disclosed a continuing decline in the influence of current expenditures and an inverted "V" in the effect of capital expenditures. Such tests, of course, must await the arrival of more observations.

Equation (12), though informative, contains numerous insignificant spending coefficients. Consequently, it is consolidated to yield

$$\begin{aligned} RGDP = {} & 27.31 + 10.32\ SEP94 + 12.49\ DEC94 + .0011\ TOUR \\ & [3.282] \quad [3.439] \quad\quad [4.290] \quad\quad [3.090] \\ & + .0054\ RCURTOT_{-1} + .0113\ RCAPTOT_{-4} + .2672\ RGDP_{-1}\ , \\ & \quad [1.745] \quad\quad\quad [2.107] \quad\quad\quad [2.132] \end{aligned} \tag{13}$$

where $\overline{R}^2$ = .639, F = 7.48, DW = 1.86, Dh = -.178, Period = 1994:5–1996:3, and NOB = 23. This equation, which performs well econometrically on all counts, has intuitive appeal. It says that current spending RCURTOT impacts RGDP after a one-month delay. But through the lagged term $RGDP_{-1}$ , a single surge in RCURTOT exerts repeated but diminishing effects on RGDP. Similarly, a burst of new capital spending RCAPTOT impacts output with a four-month lag as plans first must be satisfied and as machinery first must be put in place. Apart from its greater lag relative to current spending, capital spending has greater bearing on output. Again, through $RGDP_{-1}$, a single shot of capital expenditure leads to multiple but progressively smaller rounds of output

expansion. It follows that a spending package which involves both current and capital programs would shock economic activity with one- and four-period lags but would prompt continuing, albeit diminishing, influences on balance. The long-run consequences, which emerge under the condition that RGDP = $RGDP_{-1}$, can be deduced by multiplying the individual spending coefficients by 1.3646.

## 4. COMPLETING THE MODEL

Helping to complete the fiscal model are equations for real import tax RIMTAX, for real excise taxes on petroleum REXCPET and tobacco REXCTOB, and for their corresponding determinants. Andrea Mervar took charge of the import sector including both tax and companion equations; Kaniz Siddique handled the excise sector. The model ends with a mathematical statement of the real fiscal deficit RDEFICIT.

### Import Sector

Producing 13.7 percent of total tax collections in early 1996, the import tax, when written in real terms, depends upon the real kuna volume of imports RIMKUNA along with dummy variables to account for spikes and structural shifts. Run over the 40 months from 1993:1 to 1996:4, its equation becomes

$$\begin{aligned} RIMTAX = {} & 117.6 - 99.42\ JAN + 248.5\ D294END \\ & [2.308]\ [-2.559] \qquad [6.259] \\ & + 28.47\ RIMKUNA + 25.57\ RIMKUNA_{-1}. \\ & [3.578] \qquad\qquad [3.719] \end{aligned} \tag{14}$$

The $\overline{R}^2$ = .846, F = 54.74, DW = 1.91, and autocorrelation coefficient RHO = .218. Equation (14), the only expression in the model proper to call for first-order autocorrelation correction, discloses a protracted response of import tax collections to changed import levels: Tax collections today depend upon import levels today and yesterday. The

corresponding coefficients are positive and roughly equal making the full effect, applicable when RIMKUNA = $RIMKUNA_{-1}$, about twice the separate effects. JAN denotes a dummy that assumes units in January while D294END names a dummy that takes units from February 1994 to April 1996, the end of the relevant series. The former accounts for spikes; the latter accounts for a structural shift that took hold soon after implementation of the stabilization program.

Equation (14) requires a description of import volume. RIMKUNA denotes volume in kunas. Estimating volume initially in United States dollars IMDOL over the 51 months 1992:2 to 1996:4 leaves

$$\begin{aligned} \ln(\text{IMDOL}) = {} & 6.979 - .4708\ \text{DUM292} - .7293\ \text{DUM193} + .6411\ \text{DUM293} \\ & [5.892]\ [-2.475]\ \ [-3.840]\ \ [3.293] \\ & + .4918\ \text{DUM993} - .7905\ \text{DUM194} + .4940 \ln(\text{RGDP}) \\ & [2.651]\ \ [-3.906]\ \ [2.221] \\ & - .4084 \ln(\text{IREER}_{-1}) - 2.514 \ln(\text{DMDOL}_{-1}) , \\ & [-2.805]\ \ [-5.381] \end{aligned} \qquad (15)$$

with $\bar{R}^2 = .788$, F = 24.25, and DW = 2.23. The month and year applicable to each dummy "DUM" are given sequentially in the suffix. IREER is an index of the real effective exchange rate whereas DMDOL is a relative exchange rate; more precisely, the kuna against the US dollar expressed relative to the kuna against the German mark. Both IREER and DMDOL are exogenous; RGDP is established by equation (13).

With imports RIMKUNA in formulation (14) calibrated in kunas and with imports IMDOL in schedule (15) stated in dollars, it is necessary to connect the two measures. The appropriate bridge equation is the identity

$$\text{RIMKUNA} = V \cdot \text{IMDOL} , \qquad (16)$$

V being an exogenous conversion factor.

Although inflation INF surely does not arise in the import sector alone, its equation is so classified because it contains an import element in a

critical fashion and because it was prepared in conjunction with the trade equations. Thus

$$\begin{aligned} INF = {} & .0049 + .2392\ ERCH + .3657\ ERCH_{-1} \\ & [.717] \quad [3.038] \qquad [4.076] \\ & +.0069\ IR + .00001\ RDEFICIT_{-1}\,, \\ & [5.896] \quad [.427] \end{aligned} \tag{17}$$

whose $\overline{R}^2$ = .917, F = 136.89, DW = 1.83, Period = 1992:3–1996:4, and NOB = 50. Symbol ERCH represents the decimal rate of change in the nominal effective exchange rate, IR denotes the nominal interest rate in decimal terms, and RDEFICIT designates the real fiscal deficit. With the interest rate being treated as an exogenous policy tool, all explanatory variables in equation (17) are known rendering that relationship, like the RGDP expression (13), a reduced form.

**Excise Sector**

Greatest excise tax collections come from petroleum and tobacco and respectively amount to 9.3 percent and 7.5 percent of total collections for early 1996. As regards petroleum, real excise tax REXCPET, expressed in thousands of kunas and created by using the exogenous price index for petroleum PPET as the deflator, reads

$$\begin{aligned} REXCPET = {} & -104{,}301 - 41{,}550\ DM2 + 59{,}008\ DM3 \\ & [-.191] \quad [-1.478] \qquad [2.072] \\ & + 16{,}024\ T - 471.4\ T^2 \\ & [3.148] \quad [-2.534] \\ & + 1{,}558\ RORPI + 331.9\ RGDP_{-1}\,, \\ & [.304] \qquad [.736] \end{aligned} \tag{18}$$

for which $\overline{R}^2$ = .640, F = 7.23, DW = 1.92, Period = 1994:8 to 1996:5, and NOB = 22. The "DM" variables stand for dummies. T denotes time and along with $T^2$ allows for a quadratic trend. RORPI

signifies the relative price of petroleum. It divides the petroleum price index PPET by the RPI:

$$RORPI = PPET / RPI. \quad (19)$$

Evidently, excise tax collections rise as petroleum prices rise, say, through an increase in the excise tax rate. They also rise as more people take to the roads during economic expansion. Both reactions make sense.

Real excise tax on tobacco REXCTOB is postulated as rate times quantity:

$$REXCTOB = TBRATE \cdot TBQNT. \quad (20)$$

TBRATE signifies the excise tax rate per package of cigarettes, and TBQNT designates (in thousands) the quantity of packages sold. With TBRATE understood to be exogenous, schedule (20) necessitates the estimation of TBQNT alone. That is,

$$\underset{\quad}{TBQNT} = \underset{[5.284]}{446{,}020} + \underset{[5.897]}{26.94\ FT} - \underset{[-3.001]}{1{,}840\ RTRPI} + \underset{[1.562]}{.0516\ RPDY}, \quad (21)$$

whose $\overline{R}^2 = .720$, F = 19.04, DW = 2.00, Period = 1994:8–1996:5, and NOB = 22. Foreign tourists FT, stated in thousands of nights, smoke and add to the quantity of cigarettes sold. Relative tobacco price RTRPI, which divides the price index for tobacco PTOB by the RPI, affects quantity negatively with a constant elasticity of -.2998, and real personal disposable income RPDY affects it positively with a constant elasticity of .0070. Thus cigarette demand is price and income inelastic, a standard feature of necessities. FT can be thought of as exogenous. By contrast, RTRPI is endogenous and comes from

$$RTRPI = PTOB / RPI. \quad (22)$$

RPDY is endogenous and comes from equation (9).

### Fiscal Deficit

The final equation of the model concerns the real fiscal deficit RDEFICIT, which may be written in general fashion as the identity

$$\begin{aligned} \text{RDEFICIT} = (&\text{RCURTOT} + \text{RCAPTOT}) \\ &- (\text{RSALTAX} + \text{RINCTAX} + \text{RPROTAX} \\ &+ \text{RIMTAX} + \text{REXCPET} + \text{REXCTOB}) \\ &+ \text{RNOTHER}. \end{aligned} \tag{23}$$

The real deficit equals real spending minus real collections from the six taxes studied plus real net other budget activity RNOTHER, an exogenous portmanteau variable.

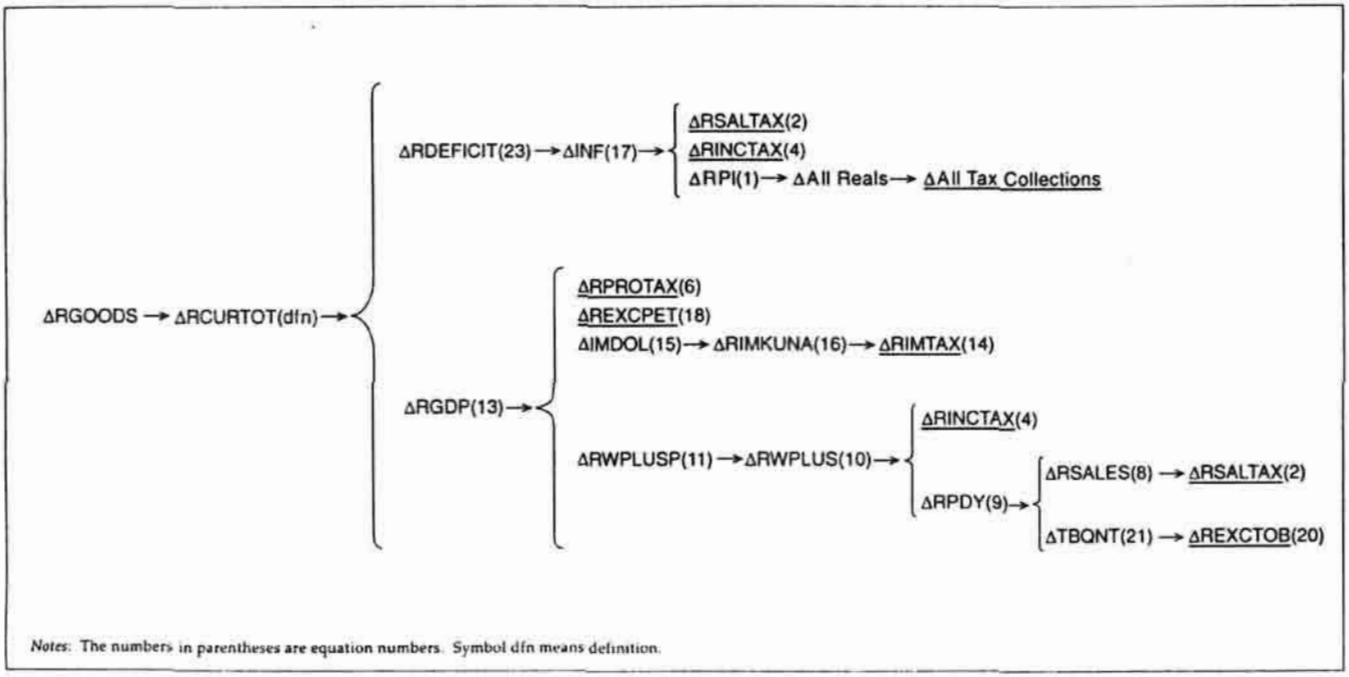
## 5. SOLUTION CHARACTERISTICS

As laid out, the fiscal model proper consists of 19 equations in 19 unknowns. Table 2 lists those elements. It also lists the exogenous variables, most of which have a policy dimension—at least indirectly. It must be remembered, however, that the policy instruments noted there are not all independent of each other. For instance, real earnings paid by the government RWAGES show up in real current spending RCURTOT. Still, the model does feature an ample amount of policy levers.

Pulling any of the policy levers initiates multiple rounds of responses involving the various tax series. Figure 1 depicts a sequence prompted by an adjustment in real government spending on goods and services RGOODS. Since RGOODS is embedded in RCURTOT, the latter changes by definition. From that point outward, the repercussions spread across the model ultimately impacting *all* tax collections in a complicated way. It is entirely possible that an initial increase in spending would create enough additional tax revenue to be roughly self-financing. In other words, an ex ante deficit action may have little effect on the deficit ex post. Hypotheses of that sort need to be tested by model simulations, but such testing fell beyond the scope of the project.

Figure 1.

## A SOLUTION SCHEMATIC FOR CHANGED GOVERNMENT SPENDING ON GOODS AND SERVICES




*Notes*: The numbers in parentheses are equation numbers. Symbol dfn means definition.

Table 2.
**CLASSIFICATION OF VARIABLES**

| Endogenous Variables | | | Exogenous Variables | |
|---|---|---|---|---|
| Simbolic Name | Complete Name | Determined by Equation | Simbolic Name | Complete Name |
| IMDOL | Imports in US Dollars | 15 | DMDOL | Exchange Rate Ratio |
| INF | Inflation Rate | 17 | ERCH | Exchange Rate Growth Rate |
| RDEFICIT | Real Fiscal Deficit | 23 | FT | Foreign Tourism |
| REXCPET | Real Excise Tax on Petroleum | 18 | IR | Interest Rate |
| REXCTOB | Real Excise Tax on Tobacco | 20 | IREER | Index of Real Effective Exchange Rate |
| RGDP | Real Gross Domestic Product | 13 | | |
| RPI | Retail Price Index | 1 | PPET | Price Index for Petroleum |
| RIMKUNA | Real Imports in Kunas | 16 | PTOB | Price Index for Tobacco |
| RIMTAX | Real Import Tax | 14 | RCAPTOT | Real Government Capital Spending |
| RINCTAX | Real Income Tax | 4 | RCURTOT | Real Government Current Spending |
| RORPI | Relative Price of Petroleum | 19 | | |
| RPDY | Real Personal Disposable Income | 9 | RNOTHER | Real Net Other Budget Activity |
| RPROTAX | Real Profit Tax | 6 | RSSB | Real Social Security Benefits |
| RSALES | Real Sales | 8 | RWAGES | Real Earnings Paid by Government |
| RSALTAX | Real Sales Tax | 2 | T | Time |
| RTRPI | Relative Price of Tobacco | 22 | | |
| RWPLUS | Real Wages Plus | 10 | TBRATE | Excise Tax Rate on Cigarettes |
| RVPLUSP | Real Private Sector Earnings | 11 | TOUR | All Tourism |
| TBQNT | Quantity of Cigarette Packs | 21 | V | Import Volume Converter |

## 6. REFLECTIONS AND EXTENSIONS

Building on already solid accomplishments, the Ministry of Finance now has an econometric model that brings fresh scholarship and sophistication to budget development and that adds formality to budget forecasting. Through the paradigm the budgetary consequences of spending decisions can be tracked for the present, for the near term, and for the long run. Similarly, the fiscal implications of a major new initiative such as a value added tax can be mapped and quantified. Indeed the model, by making explicit the relationships between budgetary causes and effects, must be seen as an important tool for use as the country creates its future.

Nevertheless, it must be understood that econometric models are only as good as the data from which they are fashioned. At the moment data on Croatia are in their infancy because the reborn Croatia is still in its

infancy. Thus series are short, degrees of freedom are few, and spikes are frequent. The encouraging thought in this regard is that time is a natural curative. As months advance, data points accumulate, degrees of freedom grow, and spikes lose influence as systematic tendencies become more pronounced. Given long series, the frequency of the data might be changed from monthly to quarterly thereby imparting a level of smoothness currently not seen in the numbers. Time, then, should help to cure data problems.

Along that same line, the Ministry might consider jettisoning the early observations as new observations become available. The months in 1991 and immediately thereafter probably are so dominated by chaos that they likely contain little or no information on normal relationships. If chaos is truly dominant initially, then eliminating observations may greatly alter coefficients. Prudence therefore suggests conducting robustness tests in the coming months. Prudence also suggests reestimating the entire model on a regular basis. Since reestimation is time consuming and costly, it should not be undertaken each time a monthly data point arrives. Instead, it might be done reasonably at six-month intervals.

Perhaps the greatest frustration in developing the fiscal model came from a need to sharply limit scope. Data and time constraints simply ruled out the possibility of constructing a broad model, within which the government's budget process would be one of several economic drivers. Croatia has much to gain from a broad model. By its fiscal model, it already has taken the first—and hardest—step toward the richer paradigm. It is strongly encouraged to take a few more.

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