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Evaluation and comparative study of theoretical ultrasonic velocities in binary liquid mixtures of o-chloro phenol with alkoxyethanols at different temperatures and atmospheric pressure

G.R.Satyanarayana¹, K.Sujatha², Zareena Begum¹, C.Rambabu^{1*} ¹Department of chemistry, Acharya Nagarjuna University, A.P., (INDIA) ²Department of Chemistry, St.V.Depaul College, Eluru, A.P., (INDIA) E-mail: rbchintala@gmail.com

ABSTRACT

Theoretical velocities of binary liquid mixtures of orthochlorophenol (OCP) with 2-methoxyethanol(MOE), 2-ethoxyethanol(EOE) and 2butoxyethanol(BOE), at T = (303.15, 308.15, 313.15, 318.15) K and atmospheric pressure, have been evaluated by using Nomoto (NOM), impedance (IMP), Van Dael and Vangeel (VDV), Junjie (JUN) and Rao's specific velocity (RAO) modwls. Ultrasonic velocities and densities of these mixtures have also been measured experimentally as a function of composition of OCP and temperature. A good agreement is found between experimental and theoretical values. U_{exp}^2 / U_{imx}^2 has also been evaluated for non-ideality in the mixtures. Chi-square test for the goodness of the fit is applied to investigate the relative applicability of these theories to the present systems. The results are discussed in terms of intermolecular interactions between the component molecules in these binary liquid mixtures. © 2014 Trade Science Inc. - INDIA

INTRODUCTION

In the recent past, there is a rapid growth on ultrasonic studies in various organic liquid mixtures^[1-10] due to the fact that the optical methods cannot detect and assess all types of interactions, especially weak interactions in liquid mixtures. The important physicochemical properties like adiabatic compressibility, heat capacity, coefficient of expansion and critical temperature may be obtained from ultrasonic velocity, density and viscosity data. The molecular interactions in pure and binary liquid mixtures can be analyzed using ultrasonic velocity measurements which are of considerable inter-

KEYWORDS

Theoretical velocities; Ultrasonics; Hydrogen bonding; Chi-square test; Molecular interaction parameter.

est for the physicists in the last few decades^[11-21]. Using various theories^[22-30], ultrasonic sound velocities in liquid mixtures have been calculated and compared with experimental values.

The present work is a continuation of our research programme on a comparison of experimental ultrasonic velocity with the theoretical models of Nomoto, Van Dael ideal mixing relation, Rao's specific velocity, impedance relation and Junjie relation for the binary mixtures of several systemsat varios temperatures by Rama Rao et al^[31-34]. Of these models, Nomoto relation was reported to be in good agreement with experimental results for the binary mixture at all temperatures under

Full Paper

study and the results are interpreted in terms of intermolecular interactions between the binary component liquid mixtures.

In this paper, we report the experimental and theoretical ultrasonic velocities of the binary liquid mixtures of OCP with 2-methoxyethanol, 2-ethoxyethanol and 2-butoxyethanol at 303.15, 308.15, 313.15, 318.15K over the entire composition range, evaluated by using various theories such as Nomoto (NOM), impedance (IMP), Van Dael and Vangeel (VDV), Junjie (JUN) and Rao's specific velocity (RAO) relations. Further a comparative study of theoretical results with experimental values using Chi-square test and the study of molecular interactions from the deviation (α) in the value of U²_{exp}/U²_{imx} (from unity) have also been reported.

EXPERIMENTAL

The commercially available pure solvents were used in the present investigation. OCP (Merk > 99%) and MOE,EOE,BOE of AR grade procured from S.D fine chemicals (India) were purified by the standard methods described by A. Weissberger^[35] and the purity of the chemicals was assessed by comparing their measured densities (ρ) and ultrasonic velocities (U) which were in good agreement with literature values. The mixtures were prepared gravimetrically using an electronic balance (Shimadzu AY120) with an uncertainty of \pm 1×10^{-7} Kg and were stored in air-tight glass bottles. The uncertainty in the mole fraction was estimated to be less than $\pm 1 \times 10^{-4}$. It was ensured that the components were adequately mixed before being transferred in to the apparatus. The required properties were measured within one day of the mixture preparation.

The densities, ρ , of pure liquids and their mixtures determined using a 10⁻⁵m³ Double - arm pycnometer, and the values from triplicate replication at each temperature are reproducible within 2 x 10⁻¹kg m³ and the uncertainty in the measurement of density is found to be 2 parts in 10⁴ parts. The reproducibility in mole fractions was within ±0.0002 Temperature control for the measurement of viscosity and density is achieved by using a microprocessor assisted circulating water bath, (supplied by Mac, New Delhi) regulated to ±0.01 K, using a proportional temperature controller. Adequate precautions were taken to minimize evaporation losses

Physical CHEMISTRY An Indian Journal during the actual measurements. The ultrasonic velocity of sound (U) is measured using an ultrasonic interferometer (Mittal Enterprises, New Delhi model F05) operating at 2 MHz. The measured speeds of sound have a precision of 0.8 m. sec⁻¹ and an uncertainty less than ± 0.1 m. sec⁻¹. The temperature stability was maintained within ± 0.01 K. by circulating water bath around the measuring cell through a pump.

THEORETICAL CONSIDERATIONS

Nomoto theory

Nomoto's empirical formula for the sound velocity (U) in binary liquid mixtures, based on the assumption of the linear dependence of the molecular sound velocity on concentration and the additivity of the molar volume in the liquid mixture is given by

$$U = \left[\frac{\sum_{i=1}^{n} x_i R_i}{\sum_{i=1}^{n} x_i V_i}\right]^3$$

where the molar sound velocity $\mathbf{R} = \mathbf{x}_1 \mathbf{R}_1 + \mathbf{x}_2 \mathbf{R}_2$. Hence, ultrasonic velocity (U) is given by

$$U = \left[\frac{x_1 R_1 + x_2 R_2}{x_1 V_1 + x_2 V_2}\right]^3$$
(1)

In the above equation $\mathbf{R}_i = (\mathbf{M}_i / \rho_i) \mathbf{U}_i^{1/3} = \mathbf{V}_i (\mathbf{U}i)^{1/3}$

Impedance relation

Using the specific acoustic impedance of the pure liquids, the ultrasonic velocity in the liquid mixtures is determined using the following relation:

$$U = \sum x_i Z_i / \sum x_i \rho_i$$
where Z_i is acoustic impedance and ρ_i is the density of the mixture.
(2)

Van Dael and Vangeel relation

Van Dael and Vangeel derived the formula for ultrasonic velocity in the liquid mixtures using the adiabatic compressibilities of the pure liquids based on ideal mixing of the liquids. Van Dael and Vangeel assumed that the adiabatic compressibility (β_{ad}) of the mixture is given by

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 $\beta_{ad} = \phi_A (\beta_{ad})_A + \phi_B (\beta_{ad})_B$ and

suggested the following relation for sound velocity in homogeneous liquid mixtures.

$$\beta_{ad}^{im} = \phi_{\rm A} \; \frac{\gamma_{\rm A}}{\gamma^{im}} \; (\beta_{ad})_A + \phi_{\rm B} \; \frac{\gamma_{\rm B}}{\gamma^{im}} \; (\beta_{ad})_B$$

Where ϕ and γ refer the volume function and principal specific ratio.

It holds true if the mixture is an ideal one and also $\gamma_A = \gamma_B = \gamma_{im}$. It can be transformed into a linear combination of the mole fractions if the additional assumption $v_A = v_B$ is made $\beta_{ad}^{im} = x_A (\beta_{ad})_A + x_B (\beta_{ad})_B$

The sound velocities appropriate to the above eqns are respectively

$$\frac{x_A v_A + x_B v_B}{x_A M_A + x_B M_B} \frac{1}{\left(U^{im}\right)^2} = \varphi_A \frac{v_A}{M_A U_A^2} + \varphi_B \frac{v_B}{M_B U_B^2}$$

and

$$\frac{1}{x_A M_A + x_B M_B} \frac{1}{\left(U^{im}\right)^2} = \frac{x_A}{M_A U_A^2} + \frac{x_B}{M_B U_B^2}$$
(3)

Junjie relation

Junjie^[26] relation for the ultrasonic velocity of the mixture in terms of the mole fraction, molecular weight and density of the mixture. Junjie's is given by

$$\mathbf{U} = \frac{\sum_{i=1}^{n} \mathbf{x}_{i} \mathbf{V}_{i}}{\left(\sum_{i=1}^{n} \mathbf{x}_{i} \mathbf{M}_{i}\right)^{1/2} \left(\sum_{i=1}^{n} \mathbf{x}_{i} \mathbf{V}_{i} / \boldsymbol{\rho}_{i} \mathbf{u}_{i}^{2}\right)^{1/2}}$$
(4)

where the symbols have their usual meanings.

Rao's relation

Using the ratio of the temperature coefficient of velocity and expansion coefficient, Rao^[13] derived a formula for ultrasonic velocity (U) given by

$$U = \left(\frac{R}{V}\right)^3$$
(5)

where V is the molar volume and R is called Rao's constant or molar sound velocity, which is constant for a liquid at a temperature.

CHI-SQUARE TEST FOR GOODNESS OF FIT

According to Karl Pearson Chi-square value is evaluated for the binary liquid mixtures under study using the formulan

$$\chi 2 = \sum U(\text{obs}) - U(\text{cal}) 2 / U(\text{cal})$$

$$i=1$$
(6)

where n is the number of data used, and 'U (obs) = experimental values of ultrasonic velocities, U(cal) = computed values of ultrasonic velocities

AVERAGE PRECENTAGE OF ERROR (SdU)

The Average percentage error is calculated using the relation

 $SdU = 1/n \sum (U \text{ (obs)} - U \text{ (cal)}) / U \text{ (obs)}) X100\%$ (7) where n is the number of data used, U (obs) = experimental values of ultrasonic velocities

MOLECULAR ASSOCIATIONS

The degree of intermolecular interaction or molecular association is given by

$$\alpha = [U_{exp}^2 / U_{imx}^2] - 1$$
 (8)

RESULTS AND DISCUSSION

The experimental values of ultrasonic velocity for the system along with theoretical values and percentage deviations for Nomoto's Relation (NOM), Impedance Relation (IMP), Vandeal Vangael Ideal Mixing Relation (VDV), Junjie's relation (JUN), Rao's specific velocity method (RAO) are compared for all the three binaries OCP+MOE, OCP+EOE, OCP+BOE by the equations from respective theories are presented in TABLES 1-3 at all the 4 temperatures 303.15, 308.15, 313.15, 318.15 K and atmospheric pressure. The validity of different theoretical formulae is checked by the chi-square test for all the mixtures at all the temperatures and the values are given in TABLE-4.

The values of ultrasonic velocity computed by various theories along with experimental values (U) are given in TABLES 1-3. There are variations between the evaluated and experimental values. Data reveals that the velocities computed from Nomoto's relation (NOM) and Impdance relation (IMP) exhibit more satisfactory agreement with the experimental values in the tempera-

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TABLE 1 : Experimental and	theoretical values of	velocities with their 9	% deviations for the s	system OCP+MOE
1				

AT 303.15K												
x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
0.0000	1356	1356.0	1356.0	1356.0	1356.0	1356.0	0.00	0.00	0.00	0.00	0.00	0.0000
0.0797	1361.2	1358.5	1358.6	1343.4	1353.3	1472.0	-0.20	-0.19	-1.31	-0.58	8.14	0.0266
0.1630	1364.4	1361.1	1361.2	1333.2	1351.8	1580.3	-0.25	-0.24	-2.29	-0.93	15.82	0.0473
0.2503	1367.5	1363.6	1363.8	1325.5	1351.4	1675.0	-0.29	-0.27	-3.07	-1.18	22.49	0.0643
0.3418	1370.4	1366.1	1366.3	1320.7	1352.1	1748.9	-0.31	-0.30	-3.63	-1.33	27.62	0.0767
0.4379	1373.2	1368.7	1368.9	1318.9	1354.0	1794.2	-0.33	-0.32	-3.95	-1.40	30.66	0.0840
0.5388	1375.9	1371.2	1371.4	1320.8	1357.0	1803.0	-0.34	-0.33	-4.00	-1.37	31.05	0.0852
0.6451	1378.2	1373.7	1373.9	1326.9	1361.3	1768.9	-0.32	-0.31	-3.72	-1.23	28.35	0.0788
0.7570	1380.3	1376.3	1376.4	1338.1	1366.7	1687.0	-0.29	-0.28	-3.06	-0.98	22.22	0.0641
0.8752	1382	1378.8	1378.9	1355.7	1373.4	1556.5	-0.23	-0.22	-1.91	-0.62	12.63	0.0392
1.0000	1381.4	1381.4	1381.4	1381.4	1381.4	1381.4	0.00	0.00	0.00	0.00	0.00	0.0000
	AT 308.15K											
x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
0.0000	1347.0	1347.0	1347.0	1347.0	1347.0	1347.0	0.00	0.00	0.00	0.00	0.00	0.0000
0.0797	1346.2	1348.3	1348.3	1333.9	1343.5	1466.7	0.16	0.16	-0.91	-0.20	8.95	0.0185
0.1630	1348.3	1349.6	1349.6	1323.2	1341.1	1578.6	0.10	0.10	-1.86	-0.54	17.08	0.0384
0.2503	1350.3	1350.9	1351.0	1314.8	1339.7	1676.4	0.04	0.05	-2.63	-0.78	24.15	0.0547
0.3418	1352.2	1352.2	1352.3	1309.2	1339.4	1752.3	0.00	0.01	-3.18	-0.94	29.59	0.0667
0.4379	1353.8	1353.5	1353.6	1306.6	1340.2	1798.1	-0.02	-0.02	-3.49	-1.01	32.82	0.0736
0.5388	1355.1	1354.8	1354.9	1307.3	1342.0	1805.6	-0.02	-0.02	-3.53	-0.97	33.24	0.0744
0.6451	1356.2	1356.1	1356.2	1312.1	1344.8	1767.9	-0.01	0.00	-3.25	-0.84	30.36	0.0684
0.7570	1356.9	1357.4	1357.4	1321.6	1348.8	1680.4	0.04	0.04	-2.60	-0.60	23.84	0.0541
0.8752	1357.2	1358.7	1358.7	1337.0	1353.8	1542.8	0.11	0.11	-1.49	-0.25	13.68	0.0304
1.0000	1360.0	1360.0	1360.0	1360.0	1360.0	1360.0	0.00	0.00	0.00	0.00	0.00	0.0000
						AT 313.	15K					
x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
		110111										
0.0000	1337.0	1337.0	1337.0	1337.0	1337.0	1337.0	0.00	0.00	0.00	0.00	0.00	0.0000
0.0000 0.0797	1337.0 1330.1	1337.0 1337.7	1337.0 1337.7	1337.0 1323.8	1337.0 1333.1	1337.0 1459.5	0.00 0.57	0.00 0.57	0.00 -0.48	0.00 0.23	0.00 9.72	0.0000 0.0096
0.0000 0.0797 0.1630	1337.0 1330.1 1331.1	1337.0 1337.7 1338.4	1337.0 1337.7 1338.4	1337.0 1323.8 1312.8	1337.0 1333.1 1330.2	1337.0 1459.5 1574.0	0.00 0.57 0.55	0.00 0.57 0.55	0.00 -0.48 -1.38	0.00 0.23 -0.06	0.00 9.72 18.25	0.0000 0.0096 0.0281
0.0000 0.0797 0.1630 0.2503	1337.0 1330.1 1331.1 1332.8	1337.0 1337.7 1338.4 1339.1	1337.0 1337.7 1338.4 1339.1	1337.0 1323.8 1312.8 1304.2	1337.0 1333.1 1330.2 1328.4	1337.0 1459.5 1574.0 1674.2	0.00 0.57 0.55 0.47	0.00 0.57 0.55 0.48	0.00 -0.48 -1.38 -2.15	0.00 0.23 -0.06 -0.33	0.00 9.72 18.25 25.62	0.0000 0.0096 0.0281 0.0444
0.0000 0.0797 0.1630 0.2503 0.3418	1337.0 1330.1 1331.1 1332.8 1334.3	1337.0 1337.7 1338.4 1339.1 1339.8	1337.0 1337.7 1338.4 1339.1 1339.8	1337.0 1323.8 1312.8 1304.2 1298.2	1337.0 1333.1 1330.2 1328.4 1327.6	1337.0 1459.5 1574.0 1674.2 1751.8	0.00 0.57 0.55 0.47 0.41	0.00 0.57 0.55 0.48 0.41	0.00 -0.48 -1.38 -2.15 -2.71	0.00 0.23 -0.06 -0.33 -0.50	0.00 9.72 18.25 25.62 31.29	0.0000 0.0096 0.0281 0.0444 0.0564
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379	1337.0 1330.1 1331.1 1332.8 1334.3 1335.4	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4	0.00 0.57 0.55 0.47 0.41 0.38	0.00 0.57 0.55 0.48 0.41 0.38	0.00 -0.48 -1.38 -2.15 -2.71 -3.02	0.00 0.23 -0.06 -0.33 -0.50 -0.57	0.00 9.72 18.25 25.62 31.29 34.67	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388	1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1	0.00 0.57 0.55 0.47 0.41 0.38 0.37	0.00 0.57 0.55 0.48 0.41 0.38 0.38	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54	0.00 9.72 18.25 25.62 31.29 34.67 35.10	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641
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0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752	1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.3 1335.5	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0	$\begin{array}{c} 0.00\\ 0.57\\ 0.55\\ 0.47\\ 0.41\\ 0.38\\ 0.37\\ 0.40\\ 0.47\\ 0.58\\ \end{array}$	0.00 0.57 0.55 0.48 0.41 0.38 0.41 0.38 0.41 0.47 0.59	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000	1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.3 1335.5 1344.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0	$\begin{array}{c} 0.00\\ 0.57\\ 0.55\\ 0.47\\ 0.41\\ 0.38\\ 0.37\\ 0.40\\ 0.47\\ 0.58\\ 0.00\\ \end{array}$	$\begin{array}{c} 0.00\\ 0.57\\ 0.55\\ 0.48\\ 0.41\\ 0.38\\ 0.38\\ 0.41\\ 0.47\\ 0.59\\ 0.00\\ \end{array}$	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000	1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.5 1336.3 1335.5 1344.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318.	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K	$\begin{array}{c} 0.00\\ 0.57\\ 0.55\\ 0.48\\ 0.41\\ 0.38\\ 0.38\\ 0.41\\ 0.47\\ 0.59\\ 0.00\\ \end{array}$	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1	1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.5 1336.5 1336.3 1335.5 1344.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1 0.0000	1337.0 1330.1 1331.1 1332.8 1335.4 1336.2 1336.5 1336.5 1335.5 1344.0 EXP 1314.0	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1344.0 NOM 1314.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 a 0.0000
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1 0.0000 0.0797	1337.0 1330.1 1331.1 1332.8 1335.4 1335.4 1336.2 1336.5 1335.5 1344.0 EXP 1314.0 1299.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 1314.0 1314.0 1315.1	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24	0.00 0.57 0.55 0.48 0.41 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 α 0.0000 0.0034
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1 0.0000 0.0797 0.1630	1337.0 1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.3 1335.5 1344.0 EXP 1314.0 1299.0 1301.9	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1342.6 1343.3 1344.0 1314.0 1315.1 1316.2	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1 1316.3	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10	0.00 0.57 0.55 0.48 0.41 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 α 0.0000 0.0034 0.0176
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1 0.0000 0.0797 0.1630 0.2503	1337.0 1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.3 1335.5 1344.0 1299.0 1301.9 1304.4	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1342.6 1343.3 1344.0 1314.0 1315.1 1316.2 1317.4	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 1314.0 1315.1 1316.3 1317.4	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 1314.0 1310.6 1308.2 1306.9	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 a 0.0000 0.0034 0.0176 0.0346
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1 0.0000 0.0797 0.1630 0.2503 0.3418	1337.0 1337.0 1330.1 1331.1 1332.8 1335.4 1336.2 1336.5 1336.5 1335.5 1344.0 1299.0 1301.9 1304.4 1306.5	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1342.6 1343.3 1344.0 1315.1 1316.2 1317.4 1318.5	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 1315.1 1316.3 1317.4 1318.5	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4 1276.8	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2 1306.9 1306.5	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00 0.92	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19 0.00	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 0.0034 0.0000 0.0034 0.0176 0.0346 0.0471
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 0.8752 1.0000 0.0797 0.1630 0.2503 0.3418 0.4379	LAL 1337.0 1330.1 1331.1 1332.8 1335.4 1336.2 1336.5 1336.5 1335.5 1344.0 EXP 1314.0 1299.0 1301.9 1304.4 1306.5 1308.3	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1342.6 1343.3 1344.0 NOM 1315.1 1316.2 1317.4 1318.5 1319.6	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1 1316.3 1317.4 1318.5 1319.7	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4 1276.8 1274.1	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2 1306.9 1306.5 1307.1	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7 1780.1	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92 0.86	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00 0.92 0.87	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27 -2.61	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19 0.00 -0.09	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62 36.06	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 0.0034 0.0176 0.0346 0.0471 0.0544
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 0.8752 1.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388	LAL 1337.0 1330.1 1330.1 1331.1 1332.8 1335.4 1335.4 1336.2 1336.5 1336.3 1335.5 1344.0 1299.0 1301.9 1304.4 1306.5 1308.3 1309.5	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1342.6 1343.3 1344.0 1314.0 1315.1 1316.2 1317.4 1319.6 1320.7	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1 1316.3 1317.4 1318.5 1319.7 1320.8	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4 1276.8 1274.1 1274.7	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2 1306.9 1306.5 1307.1 1308.7	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7 1780.1 1787.5	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92 0.86 0.86	0.00 0.57 0.55 0.48 0.41 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00 0.92 0.87 0.86	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27 -2.61 -2.66	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19 0.00 -0.09 -0.06	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62 36.06 36.50	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 0.0034 0.0000 0.0034 0.0176 0.0346 0.0471 0.0544 0.0553
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 0.8752 1.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451	1337.0 1337.0 1330.1 1330.1 1331.1 1332.8 1335.4 1335.4 1336.2 1336.5 1336.3 1335.5 1344.0 1299.0 1301.9 1304.4 1306.5 1308.3 1309.5 1310.1	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1341.2 1341.3 1342.6 1343.3 1344.0 1315.1 1316.2 1317.4 1319.6 1320.7 1321.8	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1 1316.3 1317.4 1318.5 1319.7 1320.8 1321.9	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4 1276.8 1274.1 1274.7 1279.2	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2 1306.9 1306.5 1307.1 1308.7 1311.3	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7 1780.1 1787.5 1747.8	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92 0.86 0.86 0.90	0.00 0.57 0.55 0.48 0.41 0.38 0.41 0.47 0.59 0.00 1.24 1.10 1.00 0.92 0.87 0.86 0.90	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27 -2.61 -2.66 -2.36	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19 0.00 -0.09 -0.06 0.09	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62 36.06 36.50 33.41	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 0.0034 0.0000 0.0034 0.0176 0.0346 0.0471 0.0544 0.0553 0.0489
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 x1 0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570	LAL 1337.0 1330.1 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.5 1335.5 1344.0 1299.0 1301.9 1304.4 1306.5 1308.3 1309.5 1310.1 1310.0	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1341.2 1342.6 1343.3 1344.0 1314.0 1315.1 1316.2 1317.4 1319.6 1320.7 1321.8 1323.0	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1 1316.3 1317.4 1318.5 1319.7 1320.8 1321.9 1323.0	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4 1276.8 1274.1 1274.7 1279.2 1288.3	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2 1306.5 1307.1 1308.7 1311.3 1314.9	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7 1780.1 1787.5 1747.8 1656.5	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92 0.86 0.86 0.90 0.99	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00 0.92 0.87 0.86 0.90 0.99	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27 -2.61 -2.66 -2.36 -1.66	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19 0.00 -0.09 -0.06 0.09 0.37	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62 36.06 36.50 33.41 26.45	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 a 0.0000 0.0034 0.0176 0.0346 0.0471 0.0544 0.0553 0.0489 0.0340
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752	EAA 1337.0 1330.1 1331.1 1332.8 1334.3 1335.4 1336.2 1336.5 1336.5 1335.5 1344.0 EXP 1314.0 1299.0 1301.9 1304.4 1306.5 1308.3 1309.5 1310.0 1309.0	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1342.6 1343.3 1344.0 1315.1 1316.2 1317.4 1319.6 1320.7 1321.8 1323.0 1324.1	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 1315.1 1316.3 1317.4 1318.5 1319.7 1320.8 1321.9 1323.0 1324.1	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 1301.2 1290.6 1282.4 1276.8 1274.1 1274.7 1279.2 1288.3 1303.1	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 1314.0 1310.6 1308.2 1306.9 1306.5 1307.1 1308.7 1311.3 1314.9 1319.5	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7 1780.1 1787.5 1747.8 1656.5 1513.7	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92 0.86 0.86 0.90 0.99 1.15	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00 0.92 0.87 0.86 0.90 0.99 1.15	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27 -2.61 -2.66 -2.36 -1.66 -0.45	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 %JUN 0.00 0.89 0.49 0.19 0.00 -0.09 -0.06 0.09 0.37 0.80	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62 36.06 36.50 33.41 26.45 15.64	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 0.0034 0.0000 0.0034 0.0176 0.0346 0.0471 0.0544 0.0553 0.0489 0.0340 0.0090
0.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000 0.0797 0.1630 0.2503 0.3418 0.4379 0.5388 0.6451 0.7570 0.8752 1.0000	EXP 1337.0 1330.1 1330.1 1331.1 1332.8 1335.4 1335.4 1336.2 1336.5 1336.3 1335.5 1344.0 EXP 1314.0 1299.0 1301.9 1304.4 1306.5 1308.3 1309.5 1310.1 1309.0 1325.2	NOM 1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.2 1341.2 1342.6 1343.3 1344.0 1315.1 1316.2 1317.4 1318.5 1320.7 1321.8 1323.0 1324.1 1325.2	1337.0 1337.7 1338.4 1339.1 1339.8 1340.5 1341.2 1341.9 1342.6 1343.3 1344.0 IMP 1314.0 1315.1 1316.3 1317.4 1318.5 1319.7 1320.8 1321.9 1323.0 1324.1 1325.2	1337.0 1323.8 1312.8 1304.2 1298.2 1295.1 1295.3 1299.4 1308.1 1322.5 1344.0 VDV 1314.0 1301.2 1290.6 1282.4 1276.8 1274.1 1274.7 1279.2 1288.3 1303.1 1325.2	1337.0 1333.1 1330.2 1328.4 1327.6 1327.8 1329.0 1331.2 1334.4 1338.7 1344.0 JUN 1314.0 1310.6 1308.2 1306.9 1306.5 1307.1 1308.7 1311.3 1314.9 1319.5 1325.2	1337.0 1459.5 1574.0 1674.2 1751.8 1798.4 1805.1 1765.3 1674.2 1532.0 1344.0 AT318. RAO 1314.0 1437.2 1552.7 1654.0 1732.7 1780.1 1787.5 1747.8 1656.5 1513.7 1325.2	0.00 0.57 0.55 0.47 0.41 0.38 0.37 0.40 0.47 0.58 0.00 15K %NOM 0.00 1.24 1.10 0.99 0.92 0.86 0.86 0.90 0.99 1.15 0.00	0.00 0.57 0.55 0.48 0.41 0.38 0.38 0.41 0.47 0.59 0.00 %IMP 0.00 1.24 1.10 1.00 0.92 0.87 0.86 0.90 0.99 1.15 0.00	0.00 -0.48 -1.38 -2.15 -2.71 -3.02 -3.06 -2.78 -2.11 -0.98 0.00 %VDV 0.00 0.17 -0.87 -1.69 -2.27 -2.61 -2.66 -2.36 -1.66 -0.45 0.00	0.00 0.23 -0.06 -0.33 -0.50 -0.57 -0.54 -0.40 -0.14 0.24 0.00 -0.14 0.00 -0.00 0.89 0.49 0.19 0.00 -0.09 -0.06 0.09 0.37 0.80 0.00	0.00 9.72 18.25 25.62 31.29 34.67 35.10 32.09 25.29 14.71 0.00 %RAO 0.00 10.64 19.27 26.80 32.62 36.06 32.62 36.06 36.50 33.41 26.45 15.64 0.00	0.0000 0.0096 0.0281 0.0444 0.0564 0.0632 0.0641 0.0579 0.0436 0.0198 0.0000 0.0034 0.0176 0.0346 0.0471 0.0544 0.0553 0.0489 0.0340 0.0090 0.0000

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Full Paper

AT 303.15K													
x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α	
0.0000	1316.0	1316.0	1316.0	1316.0	1316.0	1316.0	0.00	0.00	0.00	0.00	0.00	0.0000	
0.0961	1327.4	1322.4	1324.3	1313.0	1314.9	1424.6	-0.37	-0.23	-1.09	-0.94	7.32	0.0221	
0.1930	1337.8	1328.9	1332.1	1311.9	1315.3	1519.1	-0.67	-0.43	-1.94	-1.68	13.55	0.0400	
0.2907	1347.3	1335.4	1339.5	1312.6	1317.4	1594.8	-0.88	-0.58	-2.57	-2.22	18.37	0.0535	
0.3894	1355.7	1341.9	1346.4	1315.4	1321.1	1647.7	-1.02	-0.68	-2.97	-2.55	21.54	0.0622	
0.4889	1363.0	1348.4	1353.0	1320.2	1326.5	1674.1	-1.07	-0.73	-3.14	-2.68	22.83	0.0658	
0.5893	1369.2	1355.0	1359.3	1327.3	1333.6	1671.9	-1.04	-0.72	-3.06	-2.60	22.11	0.0641	
0.6906	1374.2	1361.6	1365.2	1336.7	1342.5	1640.1	-0.92	-0.65	-2.73	-2.30	19.36	0.0569	
0.7928	1377.9	1368.2	1370.9	1348.6	1353.3	1579.4	-0.71	-0.51	-2.12	-1.78	14.63	0.0438	
0.8959	1380.3	1374.8	1376.3	1363.4	1366.3	1491.9	-0.40	-0.29	-1.22	-1.02	8.09	0.0249	
1.0000	1381.4	1381.4	1381.4	1381.4	1381.4	1381.4	0.00	0.00	0.00	0.00	0.00	0.0000	
						AT 308.	15K						
x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α	
0.0000	1299.8	1299.8	1299.8	1299.8	1299.8	1299.8	0.00	0.00	0.00	0.00	0.00	0.0000	
0.0961	1310.4	1305.7	1307.4	1296.6	1298.4	1411.1	-0.35	-0.23	-1.05	-0.91	7.69	0.0214	
0.1930	1320.1	1311.7	1314.6	1295.2	1298.6	1508.0	-0.63	-0.41	-1.89	-1.63	14.24	0.0388	
0.2907	1328.8	1317.7	1321.4	1295.6	1300.3	1585.5	-0.84	-0.56	-2.50	-2.14	19.32	0.0519	
0.3894	1336.6	1323.7	1327.8	1298.0	1303.6	1639.5	-0.97	-0.66	-2.89	-2.46	22.67	0.0603	
0.4889	1343.3	1329.7	1333.9	1302.4	1308.6	1666.0	-1.02	-0.70	-3.05	-2.59	24.02	0.0638	
0.5893	1349.0	1335.7	1339.6	1308.9	1315.2	1662.8	-0.98	-0.69	-2.97	-2.51	23.27	0.0622	
0.6906	1353.5	1341.8	1345.1	1317.7	1323.5	1629.0	-0.87	-0.62	-2.65	-2.22	20.35	0.0551	
0.7928	1356.9	1347.8	1350.3	1329.0	1333.6	1565.3	-0.67	-0.49	-2.06	-1.71	15.36	0.0425	
0.8959	1359.1	1353.9	1355.3	1343.0	1345.8	1474.3	-0.38	-0.28	-1.19	-0.98	8.48	0.0241	
1.0000	1360.0	1360.0	1360.0	1360.0	1360.0	1360.0	0.00	0.00	0.00	0.00	0.00	0.0000	
		AT 313.15K											
				T 7 T 7 T 7	****	\mathbf{D}	A/3103 F			0 / TTTNT			
XI 0.0000	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α	
0.0000 0.0000	EXP 1274.0	NOM 1274.0	IMP 1274.0	VDV 1274.0	JUN 1274.0	RAO 1274.0	%NOM 0.00	%IMP 0.00	%VDV 0.00	%JUN 0.00	%RAO 0.00	α 0.0000	
0.0000 0.0961	EXP 1274.0 1284.7	NOM 1274.0 1280.9	IMP 1274.0 1282.9	VDV 1274.0 1271.5	JUN 1274.0 1273.4	RAO 1274.0 1392.4	%NOM 0.00 -0.30	%IMP 0.00 -0.15	%VDV 0.00 -1.03	%JUN 0.00 -0.88	%RAO 0.00 8.38	α 0.0000 0.0209	
0.0000 0.0961 0.1930	EXP 1274.0 1284.7 1294.7	NOM 1274.0 1280.9 1287.8	IMP 1274.0 1282.9 1291.2 1200.1	VDV 1274.0 1271.5 1270.8	JUN 1274.0 1273.4 1274.4	RAO 1274.0 1392.4 1496.1	%NOM 0.00 -0.30 -0.53 0.70	%IMP 0.00 -0.15 -0.27	%VDV 0.00 -1.03 -1.85 2.45	%JUN 0.00 -0.88 -1.57 2.07	%RAO 0.00 8.38 15.56	α 0.0000 0.0209 0.0379	
x1 0.0000 0.0961 0.1930 0.2907	EXP 1274.0 1284.7 1294.7 1304.0 1212.4	NOM 1274.0 1280.9 1287.8 1294.8 1201.7	IMP 1274.0 1282.9 1291.2 1299.1 1206.5	VDV 1274.0 1271.5 1270.8 1272.1 1275.2	JUN 1274.0 1273.4 1274.4 1276.9	RAO 1274.0 1392.4 1496.1 1579.6 1628.2	%NOM 0.00 -0.30 -0.53 -0.70 0.81	%IMP 0.00 -0.15 -0.27 -0.37 0.45	%VDV 0.00 -1.03 -1.85 -2.45 2.82	%JUN 0.00 -0.88 -1.57 -2.07 2.20	%RAO 0.00 8.38 15.56 21.14 24.82	α 0.0000 0.0209 0.0379 0.0508	
x1 0.0000 0.0961 0.1930 0.2907 0.3894 0.4880	EXP 1274.0 1284.7 1294.7 1304.0 1312.4	NOM 1274.0 1280.9 1287.8 1294.8 1301.7 1208.7	IMP 1274.0 1282.9 1291.2 1299.1 1306.5 1212.6	VDV 1274.0 1271.5 1270.8 1272.1 1275.3 1280.5	JUN 1274.0 1273.4 1274.4 1276.9 1281.1 1286.0	RAO 1274.0 1392.4 1496.1 1579.6 1638.2	%NOM 0.00 -0.30 -0.53 -0.70 -0.81 0.85	%IMP 0.00 -0.15 -0.27 -0.37 -0.45 0.48	%VDV 0.00 -1.03 -1.85 -2.45 -2.83 2.00	%JUN 0.00 -0.88 -1.57 -2.07 -2.39 2.51	%RAO 0.00 8.38 15.56 21.14 24.83 26.22	α 0.0000 0.0209 0.0379 0.0508 0.0591	
x1 0.0000 0.0961 0.1930 0.2907 0.3894 0.4889 0.5892	EXP 1274.0 1284.7 1294.7 1304.0 1312.4 1320.0	NOM 1274.0 1280.9 1287.8 1294.8 1301.7 1308.7 1215.7	IMP 1274.0 1282.9 1291.2 1299.1 1306.5 1313.6 1220.2	VDV 1274.0 1271.5 1270.8 1272.1 1275.3 1280.5 1289.0	JUN 1274.0 1273.4 1274.4 1276.9 1281.1 1286.9	RAO 1274.0 1392.4 1496.1 1579.6 1638.2 1667.4	%NOM 0.00 -0.30 -0.53 -0.70 -0.81 -0.85 0.82	%IMP 0.00 -0.15 -0.27 -0.37 -0.45 -0.48 0.48	%VDV 0.00 -1.03 -1.85 -2.45 -2.83 -2.99 2.02	%JUN 0.00 -0.88 -1.57 -2.07 -2.39 -2.51 -2.42 -2.51	%RAO 0.00 8.38 15.56 21.14 24.83 26.32 25.47	α 0.0000 0.0209 0.0379 0.0508 0.0591 0.0626 0.0611	
x1 0.0000 0.0961 0.1930 0.2907 0.3894 0.4889 0.5893 0.5893	EXP 1274.0 1284.7 1294.7 1304.0 1312.4 1320.0 1326.7 1326.7	NOM 1274.0 1280.9 1287.8 1294.8 1301.7 1308.7 1315.7 1322.8	IMP 1274.0 1282.9 1291.2 1299.1 1306.5 1313.6 1320.3 1326.7	VDV 1274.0 1271.5 1270.8 1272.1 1275.3 1280.5 1288.0 1207.8	JUN 1274.0 1273.4 1274.4 1276.9 1281.1 1286.9 1294.4 1202.8	RAO 1274.0 1392.4 1496.1 1579.6 1638.2 1667.4 1664.6 1620.0	%NOM 0.00 -0.30 -0.53 -0.70 -0.81 -0.85 -0.83 0.72	%IMP 0.00 -0.15 -0.27 -0.37 -0.45 -0.48 -0.48	%VDV 0.00 -1.03 -1.85 -2.45 -2.83 -2.99 -2.92 2.61	%JUN 0.00 -0.88 -1.57 -2.07 -2.39 -2.51 -2.43 2.16	%RAO 0.00 8.38 15.56 21.14 24.83 26.32 25.47 22.25	α 0.0000 0.0209 0.0379 0.0508 0.0591 0.0626 0.0611 0.0542	
x1 0.0000 0.0961 0.1930 0.2907 0.3894 0.4889 0.5893 0.6906 0.7028	EXP 1274.0 1284.7 1294.7 1304.0 1312.4 1320.0 1326.7 1332.5 1332.5	NOM 1274.0 1280.9 1287.8 1294.8 1301.7 1308.7 1315.7 1322.8 1320.8	IMP 1274.0 1282.9 1291.2 1299.1 1306.5 1313.6 1320.3 1326.7 1322.7	VDV 1274.0 1271.5 1270.8 1272.1 1275.3 1280.5 1288.0 1297.8 1210.2	JUN 1274.0 1273.4 1274.4 1276.9 1281.1 1286.9 1294.4 1303.8 1215.1	RAO 1274.0 1392.4 1496.1 1579.6 1638.2 1667.4 1664.6 1629.0	%NOM 0.00 -0.30 -0.53 -0.70 -0.81 -0.85 -0.73 0.56	%IMP 0.00 -0.15 -0.27 -0.37 -0.45 -0.48 -0.48 -0.48 -0.43	% VDV 0.00 -1.03 -1.85 -2.45 -2.83 -2.99 -2.92 -2.61 2.02	%JUN 0.00 -0.88 -1.57 -2.07 -2.39 -2.51 -2.43 -2.16 1.67 -2.16	%RAO 0.00 8.38 15.56 21.14 24.83 26.32 25.47 22.25 16 75	α 0.0000 0.0209 0.0379 0.0508 0.0591 0.0626 0.0611 0.0542 0.0410	
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x1 0.0000 0.0961 0.1930 0.2907 0.3894 0.4889 0.5893 0.6906 0.7928 0.8959 1.0000	EXP 1274.0 1284.7 1294.7 1304.0 1312.4 1320.0 1326.7 1332.5 1337.4 1341.2 1344.0	NOM 1274.0 1280.9 1287.8 1294.8 1301.7 1308.7 1315.7 1322.8 1329.8 1336.9 1344.0	IMP 1274.0 1282.9 1291.2 1299.1 1306.5 1313.6 1320.3 1326.7 1332.7 1338.5 1344.0	VDV 1274.0 1271.5 1270.8 1272.1 1275.3 1280.5 1288.0 1297.8 1310.2 1325.5 1344.0	JUN 1274.0 1273.4 1274.4 1276.9 1281.1 1286.9 1294.4 1303.8 1315.1 1328.4 1344.0	RAO 1274.0 1392.4 1496.1 1579.6 1638.2 1667.4 1664.6 1629.0 1561.4 1464.8 1344.0	%NOM 0.00 -0.30 -0.53 -0.70 -0.81 -0.85 -0.83 -0.73 -0.56 -0.32 0.00	%IMP 0.00 -0.15 -0.27 -0.37 -0.45 -0.48 -0.48 -0.48 -0.48 -0.48 -0.48 -0.49 -0.40	% VDV 0.00 -1.03 -1.85 -2.45 -2.83 -2.99 -2.92 -2.61 -2.03 -1.17 0.00	%JUN 0.00 -0.88 -1.57 -2.07 -2.39 -2.51 -2.43 -2.16 -1.67 -0.95 0.00	%RAO 0.00 8.38 15.56 21.14 24.83 26.32 25.47 22.25 16.75 9.22 0.00	α 0.0000 0.0209 0.0379 0.0508 0.0591 0.0626 0.0611 0.0542 0.0419 0.0238 0.0000	
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x1 0.0000 0.0961 0.1930 0.2907 0.3894 0.4889 0.5893 0.6906 0.7928 0.8959 1.0000 0.0961 0.1930 0.2907 0.3894 0.4889 0.5893 0.6906 0.7928 0.8959 1.0000	EXP 1274.0 1284.7 1294.7 1304.0 1312.4 1320.0 1326.7 1332.5 1337.4 1341.2 1344.0 EXP 1250.2 1261.0 1271.2 1280.7 1289.4 1297.5 1304.7 1311.2 1316.8 1321.4 1325.2	NOM 1274.0 1280.9 1287.8 1294.8 1301.7 1308.7 1315.7 1322.8 1329.8 1336.9 1344.0 NOM 1250.2 1257.6 1265.0 1272.5 1279.9 1287.4 1294.9 1302.5 1310.0 1317.6 1325.2	IMP 1274.0 1282.9 1291.2 1299.1 1306.5 1313.6 1320.3 1326.7 1332.7 1338.5 1344.0 IMP 1250.2 1259.7 1268.6 1277.0 1285.0 1299.8 1306.6 1313.1 1319.3 1325.2	VDV 1274.0 1271.5 1270.8 1272.1 1275.3 1280.5 1280.5 1288.0 1297.8 1310.2 1325.5 1344.0 VDV 1250.2 1248.1 1247.9 1249.5 1253.1 1258.8 1266.8 1277.1 1290.1 1306.0 1325.2	JUN 1274.0 1273.4 1274.4 1276.9 1281.1 1286.9 1294.4 1303.8 1315.1 1328.4 1344.0 JUN 1250.2 1250.1 1251.6 1254.7 1259.3 1265.6 1273.6 1283.5 1295.2 1309.1 1325.2	RAO 1274.0 1392.4 1496.1 1579.6 1638.2 1667.4 1664.6 1629.0 1561.4 1464.8 1344.0 AT 318. RAO 1250.2 1374.5 1484.0 1572.5 1634.9 1656.0 1660.5 1625.4 1553.9 1452.0 1325.2	%NOM 0.00 -0.30 -0.53 -0.70 -0.81 -0.85 -0.83 -0.73 -0.56 -0.32 0.00 15K %NOM 0.00 -0.27 -0.48 -0.64 -0.74 -0.75 -0.66 -0.51 -0.29 0.00	%IMP 0.00 -0.15 -0.27 -0.37 -0.45 -0.48 -0.48 -0.48 -0.49 0.00 0.00 -0.11 -0.20 -0.01 -0.35 -0.38 -0.38 -0.38 -0.38 -0.38 -0.38 -0.316	%VDV 0.00 -1.03 -1.85 -2.45 -2.83 -2.99 -2.92 -2.61 -2.03 -1.17 0.00%VDV 0.00 -1.02 -1.83 -2.43 -2.81 -2.98 -2.91 -2.60 -2.03 -1.17 0.00	%JUN 0.00 -0.88 -1.57 -2.07 -2.39 -2.51 -2.43 -2.16 -1.67 -0.95 0.00 %JUN 0.00 -2.34 -2.34 -2.34 -2.34 -2.34 -2.34 -2.34 -2.34 -2.38 -2.11 -1.63 -0.93 0.00	%RAO 0.00 8.38 15.56 21.14 24.83 26.32 25.47 22.25 16.75 9.22 0.00 %RAO 0.00 9.00 16.75 22.79 26.79 26.79 26.79 27.63 27.27 23.97 18.01 9.88 0.00	α 0.0000 0.0209 0.0379 0.0508 0.0591 0.0626 0.0611 0.0542 0.0419 0.0238 0.0000 0.0208 0.0377 0.0505 0.0588 0.0623 0.0608 0.0541 0.0418 0.0238 0.0238 0.0541 0.0541 0.0541 0.0541 0.0541 0.0541 0.0543 0.0608 0.0541 0.0541 0.0543 0.0541 0.0543 0.0543 0.0541 0.0543 0.05443 0.05443 0.05443 0.05443 0.05443 0.05443 0.05443 0.054444 0.054444 0.054444 0.054444 0.0544444 0.0544444 0.054444444444 0.0544444444444444444444444444444444444	

TADIE2. E-mentionental and the exection local real and evel a sitis south the in 0/ deviations for the southern OC	DECE
IABLE 2 : Experimental and theoretical values of velocities with their % deviations for the system OC	P+EUE

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TABLE 3 : Experimental and theoretical values of velocities with their % deviations for the system OCP+BOE

xi EXP NOM IMP VIV JUN RAO *NOM %IMP %JUV %JUN %JUN<	AT 303.15K												
0.0000 1322.0 1322.0 1322.0 1322.0 1322.0 1322.0 1322.0 1320.0 1320.0 1320.0 1320.0 1320.0 1320.0 1320.0 1320.0 1320.0 1320.0 0320.0 0000 0.0	x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
0.1256 132.2 132.0 132.0 132.0 138.2 138.5 -0.32 -0.01 -0.33 -0.42 34.0 138.2 138.6 -0.54 -0.03 -0.52 1.7.0 7.2.8 0.0104 0.365 134.5 134.6 134.0.1 131.2 14.84 -0.05 -0.05 -0.24 -2.28 10.12 0.0141 0.568 136.7 135.74 136.5 138.1 133.1 149.3 -0.68 -0.03 -2.48 -0.010 0.0140 0.658 136.7 137.1 13	0.0000	1322.0	1322.0	1322.0	1322.0	1322.0	1322.0	0.00	0.00	0.00	0.00	0.00	0.0000
02.442 1341.0 1334.1 1318.2 1438.6 -0.64 -0.03 -0.52 -1.70 0.22 0.013 0.4628 1355.6 1345.6 1354.5 1345.1 1310.0 1473.1 -0.67 -0.08 -0.70 -2.49 10.12 0.0141 0.5638 1361.5 1351.5 1360.3 1332.1 1333.1 1493.3 -0.68 -0.09 -0.53 -2.46 9.26 0.0128 0.7510 1371.2 1363.4 1371.1 1374.2 1378.5 1375.6 1352.6 1472.2 -0.47 -0.08 -0.33 -2.16 0.000	0.1256	1332.1	1327.9	1332.0	1328.0	1319.2	1388.5	-0.32	-0.01	-0.31	-0.97	4.23	0.0062
0.3565 1348.7 1339.6 1348.0 1319.0 1319.0 1473.1 -0.67 -0.05 -0.64 -2.20 0.013 0.4628 1355.5 1356.5 1351.5 1361.5 1351.5 1363.3 1352.1 1321.8 1492.7 -0.74 -0.08 -0.68 -2.28 10.10 0.0140 0.6697 1357.4 1365.5 1338.1 1331.4 1493.3 -0.68 -0.08 -0.53 -2.15 7.73 0.0107 0.871 1371.2 1369.8 1352.7 1498.8 -0.23 -0.04 -0.21 -0.93 2.99 0.004 0.9000 1381.4 13	0.2442	1341.0	1333.7	1340.6	1334.1	1318.2	1438.6	-0.54	-0.03	-0.52	-1.70	7.28	0.0104
0.4628 1355.6 1345.6 1354.6 1354.1 1324.6 1490. -0.74 -0.08 -0.70 -2.49 10.12 0.0141 0.6538 1361.5 1355.5 1358.1 1333.1 1499.3 -0.68 -0.09 -0.69 -2.58 10.0 0.0140 0.8379 1375.1 1379.4 1374.2 1386.4 1381.7 1477.2 -0.57 -0.08 -0.53 -2.15 7.73 0.0107 0.9008 1378.5 1375.4 1378.4 1381.4	0.3565	1348.7	1339.6	1348.0	1340.1	1319.0	1473.1	-0.67	-0.05	-0.64	-2.20	9.22	0.0130
0.5638 1361.5 1352.1 1326.4 1499.0 -0.74 -0.09 -0.69 -2.88 10.10 0.0140 0.6597 1366.7 1357.4 1365.5 1358.1 1333.1 1433.3 -0.68 -0.09 -0.63 -2.46 9.26 0.0178 0.8797 1375.1 1369.4 1374.2 1368.8 1352.6 1452.2 -0.42 -0.07 -0.39 -1.64 5.60 0.0078 0.9208 1375.5 1375.4 1378.0 1375.6 1357.6 1376.0 0.00 0.	0.4628	1355.6	1345.6	1354.5	1346.1	1321.8	1492.7	-0.74	-0.08	-0.70	-2.49	10.12	0.0141
0.6697 1367.4 1365.5 1338.1 1493.3 -0.68 -0.08 -0.63 -2.16 9.26 0.0128 0.7510 1371.1 1364.4 1341.7 1477.2 -0.57 -0.08 -0.53 -2.15 7.73 0.0107 0.8379 1375.5 1375.4 1378.4 1378.6 1355.6 1356.7 1419.8 -0.23 -0.04 -0.21 -0.93 2.99 0.0042 0.0000 1276.0 1276.0 1276.0 0.00 0.001	0.5638	1361.5	1351.5	1360.3	1352.1	1326.4	1499.0	-0.74	-0.09	-0.69	-2.58	10.10	0.0140
0.7510 137.1.2 1363.4 1371.1 1364.0 1341.7 1477.2 -0.67 -0.63 -2.15 7.73 0.0107 0.8379 1375.5 1375.4 1371.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1382.5 1305.5 1305.5 1305.5 1305.5 1305.5 1305.5 1305.5 1315.5 1315.4 1315.5 1315.4 1301.5 1236.2 1310.5 1247.5 3065 0.16 -0.47 -1.79 8.32 0.0094 0.6597 1344.6 1324.2 13135.5 1315.5 13	0.6597	1366.7	1357.4	1365.5	1358.1	1333.1	1493.3	-0.68	-0.09	-0.63	-2.46	9.26	0.0128
08.879 1375.1 1369.4 1375.0 1375.6 1381.4	0.7510	1371.2	1363.4	1370.1	1364.0	1341.7	1477.2	-0.57	-0.08	-0.53	-2.15	7.73	0.0107
09208 1378.5 1375.4 1375.4 1375.4 1375.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 0.00 0.00 0.00 0.00 0.000	0.8379	1375.1	1369.4	1374.2	1369.8	1352.6	1452.2	-0.42	-0.07	-0.39	-1.64	5.60	0.0078
10000 1381.4 1381.4 1381.4 1381.4 1381.4 1381.4 0.00 0.00 0.00 0.00 0.000 x1 EXP NOM IMP VDV JUN RAO %ANOM %IIP %VDV %JUN %RAO α 0.0000 1276.0 1276.0 1276.0 1276.0 1276.0 1276.0 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.9208	1378.5	1375.4	1378.0	1375.6	1365.7	1419.8	-0.23	-0.04	-0.21	-0.93	2.99	0.0042
x1 EXP NOM IMP VDV IZA RAO %ADP %VDV %JUN %ABO a 0.0000 1276.0 127.0 1475.3 -0.55	1.0000	1381.4	1381.4	1381.4	1381.4	1381.4	1381.4	0.00	0.00	0.00	0.00	0.00	0.0000
th EXP NOM IMP VDV IION RAO %NOM %IMP %VDV %IUN %RAO a 0.0000 1276.0 1276.0 1276.0 1276.0 1276.0 1276.0 0.00 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th>AT 308.</th><th>15K</th><th></th><th></th><th></th><th></th><th></th></t<>							AT 308.	15K					
0.000 1276.0 1276.0 1276.0 1276.0 1276.0 0.000 0.000 0.000 0.000 0.000 0.000 0.1256 1284.1 1284.2 1290.1 1284.5 1274.9 1350.3 -0.30 0.16 -0.28 -1.02 4.83< 0.0005 0.2422 1299.1 1292.5 1302.2 1320.0 1278.6 1447.1 -0.64 0.28 -0.58 -2.36 11.55 0.0128 0.6563 1326.8 1317.6 1332.2 1310.5 1479.6 -0.65 0.21 -0.68 -2.66 11.51 0.0128 0.6579 1334.6 1332.0 1313.5 1459.5 -0.55 0.16 -0.49 -2.73 11.51 0.0128 0.8379 1343.4 1343.0 1343.6 1340.0 1360.0 -0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 <	x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
0.1256 1288.1 1284.2 1290.1 1284.5 1274.9 1350.3 -0.30 0.16 -0.28 -1.02 4.83 0.0055 0.2442 1299.1 1292.5 1302.2 1303.0 1275.8 1407.2 -0.50 0.24 -0.47 -1.79 8.32 0.0094 0.3565 1309.2 1320.0 1312.8 1301.5 1278.6 147.1 -0.64 0.28 -0.53 -2.66 11.55 0.0128 0.6589 1334.4 1340.2 1318.5 1220.2 1475.3 -0.65 0.016 -0.49 -2.33 8.77 0.0098 0.8379 1348.3 1342.9 1349.8 1343.6 1360.0 1360.0 1360.0 0.00 <th>0.0000</th> <th>1276.0</th> <th>1276.0</th> <th>1276.0</th> <th>1276.0</th> <th>1276.0</th> <th>1276.0</th> <th>0.00</th> <th>0.00</th> <th>0.00</th> <th>0.00</th> <th>0.00</th> <th>0.0000</th>	0.0000	1276.0	1276.0	1276.0	1276.0	1276.0	1276.0	0.00	0.00	0.00	0.00	0.00	0.0000
0.2442 1299.1 1292.5 1302.2 1293.0 1275.8 1407.2 -0.50 0.24 -0.47 -1.79 8.32 0.0094 0.3565 1309.2 1300.8 1312.8 1301.5 1278.6 1447.1 -0.64 0.28 -0.58 -2.34 10.53 0.0118 0.4628 1317.6 1320.0 1238.4 1470.7 -0.70 0.25 -0.63 -2.76 11.51 0.0128 0.6579 1344.6 1330.2 1310.5 1299.2 1475.3 -0.65 0.16 -0.49 -2.33 8.77 0.0098 0.8379 1348.3 1342.9 1349.8 1343.4 1345.4 1355.2 151.8 1340.0 1400.1 -0.22 0.06 -0.19 -1.02 3.38 0.0038 0.0000 1360.0 1360.0 1360.0 1360.0 1360.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	0.1256	1288.1	1284.2	1290.1	1284.5	1274.9	1350.3	-0.30	0.16	-0.28	-1.02	4.83	0.0055
0.3565 1309.2 1300.8 1312.8 1301.5 1278.6 1447.1 -0.64 0.28 -0.58 -2.34 10.53 0.0118 0.4628 1318.4 1309.2 1322.0 1310.0 1283.4 1470.7 -0.70 0.28 -0.63 -2.66 11.55 0.0128 0.6568 1326.0 1337.5 1326.9 1299.2 1475.3 -0.65 0.21 -0.58 -2.65 10.54 0.0017 0.7510 1344.8 1334.4 1334.6 1334.5 1334.5 1334.5 1334.5 1334.5 1334.2 1334.8 0.003 0.011 -0.35 -1.79 6.34 0.0071 0.9208 1354.4 1351.4 1350.0 1360.0 1360.0 1360.0 0.00 <	0.2442	1299.1	1292.5	1302.2	1293.0	1275.8	1407.2	-0.50	0.24	-0.47	-1.79	8.32	0.0094
0.4628 1318.4 1309.2 132.0 1310.0 1283.4 1470.7 -0.70 0.28 -0.63 -2.66 11.55 0.0128 0.6597 1334.6 1330.0 1318.5 1290.2 1479.6 -0.70 0.25 -0.63 -2.76 11.51 0.0128 0.6597 1344.6 1334.0 1335.2 1310.5 1459.5 -0.65 0.21 -0.63 -2.65 10.54 0.0117 0.7510 1341.8 1334.4 1340.6 1360.0 1360.0 1360.0 1360.0 0.00 0.	0.3565	1309.2	1300.8	1312.8	1301.5	1278.6	1447.1	-0.64	0.28	-0.58	-2.34	10.53	0.0118
0.5638 1326.8 1317.6 1330.2 1318.5 1290.2 1479.6 -0.70 0.25 -0.63 -2.76 11.51 0.0128 0.6597 1334.6 1326.0 1337.5 1326.9 1299.2 1475.3 -0.65 0.211 -0.58 -2.65 10.54 0.0117 0.7510 1341.8 1334.4 1335.2 1310.5 1459.5 -0.55 0.16 -0.49 -2.33 8.77 0.0098 0.8379 1344.8 1342.5 1343.6 1324.2 1433.8 -0.40 0.11 -0.35 -1.79 6.34 0.0071 0.9208 1360.0 1360.0 1360.0 1360.0 1360.0 1360.0 0.00	0.4628	1318.4	1309.2	1322.0	1310.0	1283.4	1470.7	-0.70	0.28	-0.63	-2.66	11.55	0.0128
0.6597 1334.6 1326.0 1337.5 1326.9 1299.2 1475.3 -0.65 0.21 -0.58 -2.65 10.54 0.0117 0.7510 1341.8 1334.4 1334.0 1332.2 1310.5 1459.5 -0.55 0.16 -0.49 -2.33 8.77 0.0098 0.8379 1348.3 1342.9 1343.6 1342.2 1433.8 -0.40 0.11 -0.35 -1.79 6.34 0.0071 0.9000 1360.0 1360.0 1360.0 1360.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.000 <td< td=""><td>0.5638</td><td>1326.8</td><td>1317.6</td><td>1330.2</td><td>1318.5</td><td>1290.2</td><td>1479.6</td><td>-0.70</td><td>0.25</td><td>-0.63</td><td>-2.76</td><td>11.51</td><td>0.0128</td></td<>	0.5638	1326.8	1317.6	1330.2	1318.5	1290.2	1479.6	-0.70	0.25	-0.63	-2.76	11.51	0.0128
0.7510 1341.8 1334.4 1344.0 1335.2 1310.5 1459.5 -0.55 0.16 -0.49 -2.33 8.77 0.0098 0.8379 1348.3 1342.2 1433.8 -0.40 0.11 -0.35 -1.79 6.34 0.0071 0.9208 1354.4 1351.4 1355.2 1351.8 1340.6 1400.1 -0.22 0.06 -0.19 -1.02 3.38 0.0030 1.0000 1360.0 1360.0 1360.0 1360.0 0.00 0.00 0.00 0.00 0.000	0.6597	1334.6	1326.0	1337.5	1326.9	1299.2	1475.3	-0.65	0.21	-0.58	-2.65	10.54	0.0117
0.8379 1348.3 1342.9 1349.8 1343.6 1324.2 1433.8 -0.40 0.11 -0.35 -1.79 6.34 0.0071 0.9208 1354.4 1355.2 1351.8 1340.6 1400.1 -0.22 0.06 -0.19 -1.02 3.38 0.0030 1.0000 1360.0 1360.0 1360.0 1360.0 0.0	0.7510	1341.8	1334.4	1344.0	1335.2	1310.5	1459.5	-0.55	0.16	-0.49	-2.33	8.77	0.0098
0.9208 1354.4 1351.4 1351.2 1351.8 1340.6 1400.1 -0.22 0.06 -0.19 -1.02 3.38 0.0038 1.0000 1360.0 1360.0 1360.0 1360.0 1360.0 1360.0 0.00	0.8379	1348.3	1342.9	1349.8	1343.6	1324.2	1433.8	-0.40	0.11	-0.35	-1.79	6.34	0.0071
1.0000 1360.0 1360.0 1360.0 1360.0 1360.0 0.000 0.000	0.9208	1354.4	1351.4	1355.2	1351.8	1340.6	1400.1	-0.22	0.06	-0.19	-1.02	3.38	0.0038
x1 EXP NOM IMP VDV JUN RAO %NOM %IMP %VDV %JUN %RAO a 0.0000 1269.0 1269.0 1269.0 1269.0 1269.0 0.000 <t< td=""><td>1.0000</td><td>1360.0</td><td>1360.0</td><td>1360.0</td><td>1360.0</td><td>1360.0</td><td>1360.0</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.0000</td></t<>	1.0000	1360.0	1360.0	1360.0	1360.0	1360.0	1360.0	0.00	0.00	0.00	0.00	0.00	0.0000
x1 EXP NOM IMP VDV JUN RAO %NOM %IMP %VDV %JUN %RAO a 0.0000 1269.0 1269.0 1269.0 1269.0 1269.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.000							AT 313.	15K					
0.0000 1269.0 1269.0 1269.0 1269.0 1269.0 0.00 0.00 0.00 0.00 0.00 0.000 0.000 0.1256 1280.1 1276.4 1281.6 1276.6 1267.4 1350.3 -0.29 0.12 -0.27 -0.99 5.49 0.0005 0.2442 1290.2 1283.8 1292.4 1284.2 1267.7 1412.2 -0.50 0.17 -0.46 -1.74 9.46 0.0093 0.3563 1399.3 1291.2 1310.1 1299.4 1274.0 1479.3 -0.68 0.19 -0.63 -2.267 13.08 0.0127 0.5538 1315.2 130.62 1317.4 1307.0 128.1 1487.2 -0.69 0.17 -0.62 -2.67 13.08 0.0127 0.5538 1321.2 1329.7 1322.0 128.5 1460.2 -0.54 0.10 -0.48 -2.25 9.93 0.0071 0.5208 1339.2 1336.4 1339.7 1326.1	x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.0000	1269.0	1269.0	1269.0	1269.0	1269.0	1269.0	0.00	0.00	0.00	0.00	0.00	0.0000
0.2442 1290.2 1283.8 1292.4 1287.7 1412.2 -0.50 0.17 -0.46 -1.74 9.46 0.0093 0.3565 1299.3 1291.2 1301.8 1291.8 1269.9 1455.0 -0.62 0.19 -0.58 -2.26 11.98 0.0116 0.4628 1307.6 1298.7 1310.1 1299.4 1274.0 1479.3 -0.68 0.19 -0.63 -2.27 13.13 0.0127 0.5638 1315.2 1306.2 1317.4 1307.0 1280.1 1487.2 -0.69 0.17 -0.62 -2.67 13.08 0.0126 0.5638 1315.2 1306.2 1314.5 1288.2 1480.1 -0.63 0.14 -0.57 -2.56 11.95 0.0116 0.7510 1328.3 1332.1 1329.7 1326.1 1390.2 -0.21 0.03 -0.19 -0.98 3.80 0.0078 0.9208 1334.0 1344.0 1344.0 1344.0 1344.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 <	0.1256	1280.1	1276.4	1281.6	1276.6	1267.4	1350.3	-0.29	0.12	-0.27	-0.99	5.49	0.0055
0.3565 1299.3 1291.2 1301.8 1291.8 1269.9 1455.0 -0.62 0.19 -0.58 -2.26 11.98 0.0116 0.4628 1307.6 1298.7 1310.1 1299.4 1274.0 1479.3 -0.68 0.19 -0.63 -2.57 13.13 0.0127 0.5638 1315.2 1306.2 1317.4 1307.0 1280.1 1487.2 -0.69 0.17 -0.62 -2.67 13.08 0.0126 0.5597 1322.1 1313.7 1323.9 1314.5 1288.2 1480.1 -0.63 0.14 -0.57 -2.56 11.95 0.0116 0.7510 1328.3 1321.2 1329.7 1322.0 1298.5 1460.2 -0.54 0.10 -0.48 -2.25 9.93 0.007 0.8379 1334.0 1328.8 1334.9 1336.7 1326.1 1390.2 -0.21 0.03 -1.92 -1.72 7.16 0.0070 0.9208 1339.2 1334.0 1344.0 1344.0 1344.0 1344.0 0.00 0.00 0.00 0.00	0.2442	1290.2	1283.8	1292.4	1284.2	1267.7	1412.2	-0.50	0.17	-0.46	-1.74	9.46	0.0093
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0.5638 1315.2 1306.2 1317.4 1307.0 1280.1 1487.2 -0.69 0.17 -0.62 -2.67 13.08 0.0126 0.6597 1322.1 1313.7 1323.9 1314.5 1288.2 1480.1 -0.63 0.14 -0.57 -2.56 11.95 0.0116 0.7510 1328.3 1321.2 1329.7 1322.0 1298.5 1460.2 -0.54 0.10 -0.48 -2.25 9.93 0.0097 0.8379 1334.0 1328.8 1339.7 1336.7 1326.1 1390.2 -0.21 0.03 -0.19 -0.98 3.80 0.0038 1.0000 1344.0 1344.0 1344.0 1344.0 1344.0 1344.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.000	0.4628	1307.6	1298.7	1310.1	1299.4	1274.0	1479.3	-0.68	0.19	-0.63	-2.57	13.13	0.0127
0.6597 1322.1 1313.7 1323.9 1314.5 1288.2 1480.1 -0.63 0.14 -0.57 -2.56 11.95 0.0116 0.7510 1328.3 1321.2 1329.7 1322.0 1298.5 1460.2 -0.54 0.10 -0.48 -2.25 9.93 0.0097 0.8379 1334.0 1328.8 1334.9 1329.4 1311.1 1429.6 -0.39 0.07 -0.35 -1.72 7.16 0.0070 0.9208 1339.2 1336.4 1339.7 1336.7 1326.1 1390.2 -0.21 0.03 -0.19 -0.98 3.80 0.0038 1.0000 1344.0 1344.0 1344.0 1344.0 1344.0 0.000 0.00 0.0081 </td <td>0.5638</td> <td>1315.2</td> <td>1306.2</td> <td>1317.4</td> <td>1307.0</td> <td>1280.1</td> <td>1487.2</td> <td>-0.69</td> <td>0.17</td> <td>-0.62</td> <td>-2.67</td> <td>13.08</td> <td>0.0126</td>	0.5638	1315.2	1306.2	1317.4	1307.0	1280.1	1487.2	-0.69	0.17	-0.62	-2.67	13.08	0.0126
0.7510 1328.3 1321.2 1329.7 1322.0 1298.5 1460.2 -0.54 0.10 -0.48 -2.25 9.93 0.0097 0.8379 1334.0 1328.8 1334.9 1329.4 1311.1 1429.6 -0.39 0.07 -0.35 -1.72 7.16 0.0070 0.9208 1339.2 1336.4 1339.7 1336.7 1326.1 1390.2 -0.21 0.03 -0.19 -0.98 3.80 0.0038 1.0000 1344.0 1344.0 1344.0 1344.0 0.0081	0.6597	1322.1	1313.7	1323.9	1314.5	1288.2	1480.1	-0.63	0.14	-0.57	-2.56	11.95	0.0116
0.8379 1334.0 1328.8 1334.9 1329.4 1311.1 1429.6 -0.39 0.07 -0.35 -1.72 7.16 0.0070 0.9208 1339.2 1336.4 1339.7 1336.7 1326.1 1390.2 -0.21 0.03 -0.19 -0.98 3.80 0.0038 1.0000 1344.0 1344.0 1344.0 1344.0 1344.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.000 0.000 0.00<	0.7510	1328.3	1321.2	1329.7	1322.0	1298.5	1460.2	-0.54	0.10	-0.48	-2.25	9.93	0.0097
0.9208 1339.2 1336.4 1339.7 1336.7 1326.1 1390.2 -0.21 0.03 -0.19 -0.98 3.80 0.0038 1.0000 1344.0 1344.0 1344.0 1344.0 1344.0 1344.0 0.0	0.8379	1334.0	1328.8	1334.9	1329.4	1311.1	1429.6	-0.39	0.07	-0.35	-1.72	7.16	0.0070
1.0000 1344.0 1344.0 1344.0 1344.0 1344.0 1344.0 0.00 <td>0.9208</td> <td>1339.2</td> <td>1336.4</td> <td>1339.7</td> <td>1336.7</td> <td>1326.1</td> <td>1390.2</td> <td>-0.21</td> <td>0.03</td> <td>-0.19</td> <td>-0.98</td> <td>3.80</td> <td>0.0038</td>	0.9208	1339.2	1336.4	1339.7	1336.7	1326.1	1390.2	-0.21	0.03	-0.19	-0.98	3.80	0.0038
x1EXPNOMIMPVDVJUNRAO%NOM%IMP%VDV%JUN%RAOα0.00001244.01244.01244.01244.01244.01244.00.000.000.000.000.000.000.12561255.21252.01257.61252.21243.11330.8-0.260.19-0.24-0.976.020.00480.24421265.51260.01269.31260.41244.01397.0-0.440.30-0.40-1.7010.390.00810.35651275.11268.11279.51268.71246.71442.8-0.550.35-0.50-2.2213.160.01010.46281283.91276.11288.41276.91251.41469.0-0.610.33-0.55-2.5314.420.01100.56381292.11284.21296.31285.11258.11477.5-0.610.33-0.55-2.6314.350.01100.65971299.71292.41303.41293.21266.81469.9-0.560.28-0.50-2.5313.100.01010.75101306.81300.51309.71301.31277.71448.8-0.480.22-0.42-2.2310.870.00850.83791313.41308.71315.41309.31290.91416.1-0.350.15-0.31-1.717.820.00620.92081319.51317.01320.51317.31306.6 <t< td=""><td>1.0000</td><td>1344.0</td><td>1344.0</td><td>1344.0</td><td>1344.0</td><td>1344.0</td><td>1344.0</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.0000</td></t<>	1.0000	1344.0	1344.0	1344.0	1344.0	1344.0	1344.0	0.00	0.00	0.00	0.00	0.00	0.0000
x1EXPNOMIMPVDVJUNRAO%NOM%IMP%VDV%JUN%RAOα0.00001244.01244.01244.01244.01244.01244.00.000.000.000.000.000.000.000.12561255.21252.01257.61252.21243.11330.8-0.260.19-0.24-0.976.020.00480.24421265.51260.01269.31260.41244.01397.0-0.440.30-0.40-1.7010.390.00810.35651275.11268.11279.51268.71246.71442.8-0.550.35-0.50-2.2213.160.01010.46281283.91276.11288.41276.91251.41469.0-0.610.33-0.55-2.6314.420.01100.56381292.11284.21296.31285.11258.11477.5-0.610.33-0.55-2.6314.350.01100.65971299.71292.41303.41293.21266.81469.9-0.560.28-0.50-2.5313.100.01010.75101306.81300.51309.71301.31277.71448.8-0.480.22-0.42-2.2310.870.00850.83791313.41308.71315.41309.31290.91416.1-0.350.15-0.31-1.717.820.00620.92081319.51317.01320.51317.3							AT 318.	15K					
0.00001244.01244.01244.01244.01244.00.000.000.000.000.000.000.000.000.0000.	x1	EXP	NOM	IMP	VDV	JUN	RAO	%NOM	%IMP	%VDV	%JUN	%RAO	α
0.12561255.21252.01257.61252.21243.11330.8-0.260.19-0.24-0.976.020.00480.24421265.51260.01269.31260.41244.01397.0-0.440.30-0.40-1.7010.390.00810.35651275.11268.11279.51268.71246.71442.8-0.550.35-0.50-2.2213.160.01010.46281283.91276.11288.41276.91251.41469.0-0.610.35-0.55-2.5314.420.01100.56381292.11284.21296.31285.11258.11477.5-0.610.33-0.55-2.6314.350.01100.65971299.71292.41303.41293.21266.81469.9-0.560.28-0.50-2.5313.100.01010.75101306.81300.51309.71301.31277.71448.8-0.480.22-0.42-2.2310.870.00850.83791313.41308.71315.41309.31290.91416.1-0.350.15-0.31-1.717.820.00620.92081319.51317.01320.51317.31306.61374.2-0.190.08-0.17-0.974.150.00331.00001325.21325.21325.21325.21325.20.000.000.000.000.000.000	0.0000	1244.0	1244.0	1244.0	1244.0	1244.0	1244.0	0.00	0.00	0.00	0.00	0.00	0.0000
0.24421265.51260.01269.31260.41244.01397.0-0.440.30-0.40-1.7010.390.00810.35651275.11268.11279.51268.71246.71442.8-0.550.35-0.50-2.2213.160.01010.46281283.91276.11288.41276.91251.41469.0-0.610.35-0.55-2.5314.420.01100.56381292.11284.21296.31285.11258.11477.5-0.610.33-0.55-2.6314.350.01010.65971299.71292.41303.41293.21266.81469.9-0.560.28-0.50-2.5313.100.01010.75101306.81300.51309.71301.31277.71448.8-0.480.22-0.42-2.2310.870.00850.83791313.41308.71315.41309.31290.91416.1-0.350.15-0.31-1.717.820.00620.92081319.51317.01320.51317.31306.61374.2-0.190.08-0.17-0.974.150.00331.00001325.21325.21325.21325.21325.20.000.000.000.000.000.000	0.1256	1255.2	1252.0	1257.6	1252.2	1243.1	1330.8	-0.26	0.19	-0.24	-0.97	6.02	0.0048
0.35651275.11268.11279.51268.71246.71442.8-0.550.35-0.50-2.2213.160.01010.46281283.91276.11288.41276.91251.41469.0-0.610.35-0.55-2.5314.420.01100.56381292.11284.21296.31285.11258.11477.5-0.610.33-0.55-2.6314.350.01100.65971299.71292.41303.41293.21266.81469.9-0.560.28-0.50-2.5313.100.01010.75101306.81300.51309.71301.31277.71448.8-0.480.22-0.42-2.2310.870.00850.83791313.41308.71315.41309.31290.91416.1-0.350.15-0.31-1.717.820.00620.92081319.51317.01320.51317.31306.61374.2-0.190.08-0.17-0.974.150.00331.00001325.21325.21325.21325.21325.20.000.000.000.000.00	0.2442	1265 5	1260.0	1269.3	1260.4	1244.0	1397.0	-0.44	0.30	-0.40	-1.70	10.39	0.0081
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SYSTEM-I (OCP+MOE)												
	\mathbf{X}^2					SdU						
T(K)	NOM	IMP	VDV	JUN	RAO	NOM	IMP	VDV	JUN	RAO		
303.15K	0.10	0.09	12.09	1.52	679.51	-0.026	-0.025	-0.278	-0.097	1.598		
308.15K	0.01	0.01	8.86	0.66	770.34	0.004	0.004	-0.236	-0.062	1.693		
313.15K	0.27	0.27	6.10	0.17	852.03	0.042	0.042	-0.191	-0.021	1.775		
318.15K	1.20	1.20	4.08	0.24	910.20	0.089	0.089	-0.147	0.027	1.842		
	SYSTEM-II (OCP+EOE)											
	\mathbf{X}^2					SdU						
T(K)	NOM	IMP	VDV	JUN	RAO	NOM	IMP	VDV	JUN	RAO		
303.15K	0.83	0.39	7.22	5.26	367.97	-0.071	-0.049	-0.214	-0.182	1.251		
308.15K	0.74	0.36	6.71	4.82	401.15	-0.068	-0.047	-0.207	-0.175	1.306		
313.15K	0.51	0.17	6.36	4.45	471.95	-0.057	-0.032	-0.204	-0.170	1.407		
318.15K	0.42	0.10	6.20	4.20	531.93	-0.052	-0.025	-0.203	-0.166	1.490		
				SYSTE	EM-III (OC	P+BOE)			-			
	\mathbf{X}^2					SdU						
T(K)	NOM	IMP	VDV	JUN	RAO	NOM	IMP	VDV	JUN	RAO		
303.15K	0.40	0.01	0.35	4.86	74.18	-0.049	-0.005	-0.046	-0.175	0.615		
308.15K	0.35	0.05	0.29	5.45	93.83	-0.047	0.017	-0.042	-0.188	0.693		
313.15K	0.33	0.02	0.28	5.04	119.85	-0.046	0.012	-0.042	-0.181	0.778		
318.15K	0.26	0.08	0.21	4.82	141.60	-0.041	0.022	-0.036	-0.179	0.845		

TABLE 4 : Values of Chi-square and sigma relative deviation for all the binary mixtures of OCP at different temperatures

ture range 303.15K to 318.15K than other approaches in the binary systems. It is observed that the experimental values show deviation with the theoretical values of ultrasonic velocities which confirms the existence of molecular interactions^[36]. This may be due to interactions occurring between the hetero molecules of the binaries. Higher deviations are observed in Rao's specific and slight variations in Junjie's theories. There are higher variations in some intermediate concentration range suggesting the existence of strong tendency of association between component molecules as a result of hydrogen bonding. Nomoto's theory proposes that the volume does not change upon mixing. Therefore, no interaction between the components of liquid mixtures has been taken into account. Similarly, the assumption for the formation of ideal mixing relation is that, the ratios of specific heats of ideal mixtures and the volumes are also equal. Again no molecular interactions are taken into account. But upon mixing, interactions between the molecules occur because of the presence of various types of forces such as dispersion forces, charge transfer, hydrogen bonding dipole-dipole and dipole-induced dipole interactions. Thus, the observed

deviation of theoretical values of velocity from the experimental values shows that the molecular interactions are taking place between the unlike molecules in the liquid mixtures. From the Tables it is observed that maximum positive deviation at 0.5 mole fraction of all the 3 systems at all the temperatures. The ratio U_{exp}^2/U_{imx}^2 is an important tool to measure the non ideality in the mixtures especially in such cases where the properties other than sound velocity are not known.

Figures 1, 2 and 3 represent the variation of U_{exp}^2/U_{imx}^2 with the mole fraction of OCP for all three binary systems studied, and the ratio of U_{exp}^2/U_{imx}^2 gives an idea of extent of interaction taking place between molecules of the mixtures. It is positive for three systems and infers strong interactions between the components. The percentage of deviation in velocity is reflecting both negative and positive magnitudes, indicating non ideal behaviour of liquid mixtures. The evaluated interaction parameters are positive for all the systems, indicating stronger interactions between the mixing molecules, which increase from BOE to MOE. This suggests somewhat stronger interaction of OCP with MOE in comparison to other components. The negative values indi-

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Figure 1 :Plots of U_{exp}^2/U_{imx}^2 vs X_1 for the studied system OCP+MOE, at temperatures 303.15K, 308.15K, 313.15K,318.15K



Figure 2 : Plots of U^2_{exp}/U^2_{imx} vs X_1 for the studied system OCP+EOE, at temperatures 303.15K , 308.15K, 313.15K,318.15K



Figure 3 : Plots of U^2_{exp}/U^2_{imx} vs X_1 for the studied system OCP+BOE, at temperatures 303.15K, 308.15K, 313.15K,318.15K

cate the dominance of dispersion forces arising from the breakage of hydrogen bonds in the associates. But a positive value of (α) in all the system clearly indicates the existence of strong tendency for the formation of association in mixture through dipole-dipole interactions higher values of percentage deviation indicates maximum departure of the particular theory from experiment at that particular concentration and magnitude of the chi-square value finally determines the overall validity of the theory. The chi square values along with average percentage error are given in TABLE-4.

CONCLUSIONS

From the values of experimental and evaluated velocity values, it may be concluded that, the Nomoto's

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