

7KH XVH RI&R[LGHV DV D FDWDO\WV IRØ WKH U HPLVVLRQ

ODULD 5DM%NDWRV] :yNWRZVF].DXMDV] ÆG 5DIDá =\EDáD

\$*+ 8QLYHUVLW\ RI 6FLHQFH DQG 7HFKQRORJ\)DFXOW\ RI 0DWHULDOV 6FLHQFH DQG &H
)DFXOW\ RI 0DWHULDOV 6FLHQFH DQG (QLQHULQJ :DUVDZ 8QLYHUVLW\ RI 7HFKQRORJ

SEVWUDFKW PRUSKRORJLFDO FKDUDFWHUL]DWLRQ RI D VHULHV RI FRED
E\ WKH GHSRVLWLRQ ERZHU ZLWK D PRODU UDZLW RWKHHUDXQJHR [LGHWWR
ZDV SHUIRUPHG 7KH SRZGHUV ZHUH DOVR WPSURHEJODLQHG KZLWKKHURUHRW&FV
RI SRWDVVLXP DWRPVQYHWÁQBDWH WKH HIIHFW RRQD&KHFJ DWS&GLWLF DFFRVL
WKH ; UD\ GLIUDFWLRQ 6(0 ('; ODVHU SDUWLFOH VL]H GLVWULEXWLRQ D
7KH FDWDO\WV ZHUH WHVWHG WKURXJK WKH ORZ WHPSHUDWXUH GHFRPS
RI f& WR f& 7KH DGGLWLRQ RM&RYHG WKH WHPSHUDWXUHRIWRZ&R
ORZHU WHPSHUDWXUHVf& f& f&WKVHVW FDWDO\WLF SURSHUWLHV ZHUH
LQ ZKLFK WKH UDWLR RI FHULXP R[LGHWWR FREDOW R[LGHWUDQJHG IURP

,QWURGXFWRQ

/RZHULQJ RI WKH WHZSHHG&FXWLRQ

12 HPLVVLRQ WR WKH DWPRVSKUHDFWLRQ LV HERORRPLFDOO\ DGYDQ
LQWHQVH WKDQ LQ WKH FDVH RIRWKHUWKHURKXVHFDQFRPSRVL
EXW WKH *:3 *OREDO :DUPLQJ RIRWKHUFDVHRIKXVHFDQFRPSRVL
R[LGHLV WLPHV KLJKHU WKDORWKHUFDVHRIKXVHFDQFRPSRVL
,W LV HVWLPDWHG WKDW WKHLEXUWHUFDVHRIKXVHFDQFRPSRVL
WR WKH WRWDO JUHHQKRXVH HIIHFWLVWLPDWHGWRWKHUFDVHRIKXVH
> @ 1LWURXV R[LGHKDV WKH DFWLRQRIWKHUFDVHRIKXVHFDQFRPSRVL
UDGLDWLRQ DQG LQGLUHFWO\ GHVWURSUWKSDFH&KODDONDOWKHUFDQ
WKH FKHPDFDO UHDFWLRQV RI VDFWURSUWKSDFH&KODDONDOWKHUFDQ
,Q WKH XSSHU VWUDWRVSKHUH WHPSHUDWXUHRIWKHUFDVHRIKXVHFDQ
QLWURXV R[LGHWUDFWLRQ UHDFWLRQVRIWKHUFDVHRIKXVHFDQFRPSRVL
WKXV GHVWUR\QJ WKH QDWXUDQGURWHFWL&H&DU\RUWKHUFDVHRIKXVH
> @

7KH UHGXFWRQREH1FDUULHGPHWDOV 7KH DONDOL PHWDOV PD\ DI
GLIIHUHQW WHPSHUDWXUH UDQJHV DQGZKLFKUHFXOG EHLPSURYHG WKJ
FDWDO\WV VXLWDEOH IRU WKH SUHDGOLWGHG SUHDGOLWGHGFRQGLWLRQ
,Q WHUPV RI KLJKHU WHPSHUDWXUHRIWKHUFDVHRIKXVHFDQFRPSRVL
f& WR f& IRU WKH UHGXFWRQREH1FDUULHGPHWDOV 7KH DONDOL PHWDOV PD\ DI
FKDUDFWHUL]HG E\ JRRG WKHUPDOVRIWKHUFDVHRIKXVHFDQFRPSRVL
SHURYVNLWHV DQG PD\HQLWH > WKH&REHUYHG)SKH&R&HQW
WHPSHUDWXUH UDQJH EHWZHHQDFW&DOV&R&M&Z&F&DOVDF&Z&W
NQRZQ DV R[LGHWDO\WV ZLWKDFW&DOV&R&M&Z&F&DOVDF&Z&W
DQG D VPDOO DPRXQW RI SUHFLRXVPHWDOVRIWKHUFDVHRIKXVHFDQFRPSRVL
R[LGHV DUH DSSOLHG > @ ,WZDV IRXQG&W&DWUDQVSHUWLVWZ
FRXOG EH D YHU\ JRRG FDWDO\WVRIWKHUFDVHRIKXVHFDQFRPSRVL
FDWDO\WLFDOO\ DFWLRQRIWKHUFDVHRIKXVHFDQFRPSRVL
7KLV NLQG RI FDWDO\WV EDVHG@RQVSLQHO&R&R
DUH VFFHVVIXOO\ FKHFNHG LQFRSTORW&SODORZ&W&R&R&R&R&R&R&R
ZLWK PDLQWDLQLQJ WKHUPDOVWDFRSTORW&SODORZ&W&R&R&R&R&R&R&R
DQG KLJK FDWDO\WLF DFWLRQVRIWKHUFDVHRIKXVHFDQFRPSRVL
> @

&RUUHVSRQGLQJ DXWKRU UDMVND#DJK HGX SO

> @ +RZHYHU UHVHDFK LQWDRQQLKH FQREDOVWREDPHBURVFRS\ Z
FDWDO\VWV DQG SURPRWHG VDSNFVQURVFRVSDO6\WKN;RICKALD\$12 6(0
DQG SRWDVVLXP VKRZV WKDW LW VFDQRVQLQLEOHHFWRUDEKRLHFYHRVFRS
FRPSOHWH FRQYHUVLRQ DW D WIKHSHUDDWDOBLEHOVLZJH R1&WKH SRZC
> @ 6XFK FDWDO\VWV DUH YHQRDFW DYHGLQWDFLWL BQDFMDL RXUBIQBQ
GR QRW FRQWDLQ SUHFLRXV PHWDQV WKKLBKLEBQVHSDXHQWDFDO ;13
IXUWKHU UHGXFHV WKHLU FRVW ZLWK7DQ SDGHSQHFH RRSRDVDRZXBQJ
LRQV VLJQLILFDQWO\ LPSURYHV7WKKMSHDMDE\WLFIDFURSHUHWIRH WKH
RI FREDOW FRQWDLQLQJ FDWDOE VWKH\WPHVWRKRGDQLDQLWURJHC
VSLQHGV > @ 3RWDVVLXP SURPRWHGPFREDOV\$6\$S LQHOLFURPHV
FDWDO\VWV REWDQSHUHFHPRWKKIDLYH BRLWVULEXWLRQ '/6 ZDV FKDU
KLJK VWDELOLW\ DQG ORZ ZRUN IRXUWV BQVPSOR\LQJ WKH ODOYHUQ OD
,Q WKH SUHVHQW ZRUN ZH UHSRUW RQ WKH FDWDO\WLF DFWLYLW\
RI D VHULHV RI . SURPRWHG &R &H R\LGHF RPSRVLWHV ZLHWV
WKH PRODU UDFRFLCB&H2DQJLQJ \$URF[HQREHG TXDUW] IORZ UHDF
UHVSHFWLYHO\ :H WU\ WR ILQG WKHRXWLGUXSBOJHFDVVPKSHUWURP
SDUWLFLSDWLRQ RI WZR R\LGHV RPLQJ %\$R(5SRVZDWHYDNGHULQOWKH
FDWDO\WLF WHVWV %HIRUH SURSHU
([SHULPHQWDO HDFK VDPSON J D VWDQGDUG
\$ VHULHV RI &R &H FRSRVLWH FROVLYWLFQJ R\NHHSLOJ WKH VDPSON
SUHSDUHG E\ WKH GHVFRSLRZCHY &H2ZDV IORZLRIRU FPPLQ XQWLO U
OHUF DV VKRZQ LQ 7DEOH f& 6DPSOHHG \$IWHU WKLW WU
REWDLQH WKURXJK WKH SUHFLRQV RZQJ WRKURRPHWPSHUDWX
RI &H2&H1A 2 RQ WKHFRZGHU DW FSDQJHG WR WKH WDUJHW PLWXUH
“ XVLQJ D O DPPRQLD VROXWLRQ > WKH FDWDO\WLF WHVWV ZHUH FDU
SUHFLSLWDWH ZDV DJHG IRU WZR R\KRXU\ DWLQ R\PHWPSHUDWXUH U
DQG WKHQ VHYUDO WLPHV HOXWHG &R &H2R\LGHF RPSRVLWHV ZLHWV
RI KIGUR\LGH LRQV WR REWDLQ RQ WKH R\HBU OHXWFRPSOHWH FKDUD
7KH VOXUU\ SUHSDUHG LQ WKLW PDQGHUHQWV ZHUH SHURURPHG W
DW f& DQG FDOFLQH IRU KRPSOH ZR FKDUDFW\HULJH WKH FDU
7KH UHVXOWDQW SRZGHUV KDYH R\GLLH HQW\ PRODU FROVHQW
RI &H2URP WR PRO DQG D FROVW DQG ZDV UHVSHFWLYHO\ ZDV GHWHUPLQH
RI &R PRO UHVSHFWLYHO\ ZDV GHWHUPLQH

7KH LPSUHJQDWLRQ RI WKH FDWDO\WLF WHVWV ZDV PDGH XVLQJ
WKH GU\ LPSUHJQDWLRQ R\HWRG ZLWK
WR REWDLQ DQRPDQRQV XIILF5'HQW WR ILOO
WKH SRUHV RI WKH VXSSRUW >LJ@UH%HSRUHVHQW R\PHQJ' VSHFWU
WKH LPSUHJQDWLRQ RI HDFK VDPSONWDRQSWLKHQ EOBQMLW\HG
ZDV PHDVXUHG WZLFH E\ WLWUDWKRQJFEBOWDU\LHU, LQ[GMWSKOVHG
ZDWHU DQG WKH FHULXP GLR\LGH SKDVH ,&

7DEOH7KH VDPSON V\PEROV

6DPSOH	%HIRUH	\$IWHU	LPSUHJQDWLRQ
&R2	&R	&RB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	
&R2 &H2	&R &H	&R &HB.	

)LJXU7KH ;5' SDWW2H&Q12FBIW&RO\VWV EHIRU
LPSUHJQDWLRQ

,Q WKH ;5' VSHFWUD QR RWKHU S
DQG RU &H ZDV REVHUYHG 6LPLODU
VHH UHIOHFWLRQV IURP DOO SKDVH

0HWKRGV
7KH PRUSKRORJ\ RI WKH SDUWLFLSDWLRQ

IURP DQ\ RI WKH FRPSRXQGV FRQWUDLQ LQSJHSRHWV LKXPH VSHFLILF
 7KH &F2\ VWDOOLWH VL]H UHJDUGLGHV LQVWFRQWUDLQV LQ WKH FR
 VDPSOH ZDV DSSUR[LPDWHO\ WKHFRVFDQW WKHFRVFDQW WKHFRVFDQW
 VDPSOHV UHDFKLQJ DERXW QPXU7KHFRVFDQW WKHFRVFDQW WKHFRVFDQW
 RI &RZHUH FKDQJHG DIWHU WKHFRVFDQW WKHFRVFDQW WKHFRVFDQW
 ZHUH EURDGHQHG \$IWHU LPSUHJQDWLRQ WKH VSHFLILF
 IRU HDFK VDPSOH EHFDXVH RI ILO
 SRWDVV LXP

)LJXUH7KH H[HPSODU\ LVRWKHUP DGVRUSW
 FXUYHV

)LJXUH7KH ;5' SDWWH2UQW2RDW&RO\WV
 LPSUHJQDWLRQ

)LJXUH LV D FROOHFWLRQ RI JUD
 DQG DGVRUSWLRQ IRU VDPSOHV &R
 ,W FDQ EH VHHQ WKDW DV D UHVXO
 RI VXUIDFH SRUHV ZDV VLPLODU DQ
 XQQRWLFHDEOH FKDQJH LQ WKH VSH
 UHPDLQLQJ VDPSOHV WKH K\VWHUH
 GHVRUSWLRQ UHVHPEOHG WKH UHVX
 7KH DYHUDJH DGVRUSWLRQ SRUH
 LPSUHJQDWLRQ ZDV FDOFXODWHG D
 LPSUHJQDWLRQ DW QP 7KH K\VWH
 WR WKH GH %RHU FODVVLILFDWLRQ
 ZKLFK KDYH DQ HORQJDWHG WXEX
 WLPH WKH K\VWHUHVLV ORRS RI D
 LVRWKHUPV UHSUHVHQWV WKH FDV
 LQYROYHV WKH IRUPDWLRQ RI D PX
 DFFRUGLQJ WR WKH SULQFLSOHV RI

3DUWLFOH VL]H GLVWULEXWLRQ

)LJXUH7KH FUI\WDOOLWH VL]H IRU &R 7KH SDUWLFOH VL]H GLVWULEXWLRQ
 ,W ZDV FDOFXODWHG WKDW WKHFRVFDQW WKHFRVFDQW WKHFRVFDQW
 FREDOW ,, ,, R[LGH SKDVH ZDV LPSUHJQDWLRQ WKHFRVFDQW WKHFRVFDQW
 DGGHG &W2ZDV UHGXFHG WR DERXW GHVFRUHLQGHU WKH EDVLV RI
 WUHQG IRU D V\WHPDWLF GHFUHDVH RI VDPSOHV &R WKH VL]H
 RI WKH FUI\WDOOLWH RI FREDOW WKHFRVFDQW WKHFRVFDQW WKHFRVFDQW
 LQFUHDVLQJ WKH FRQWHQW RI &R

%(7

7KH VSHFLILF VXUIDFH DUHD RI FDWV ZDV LPSUHJQDWLRQ WKHFRVFDQW WKHFRVFDQW
 RJ WR J EHIRUH LPSUHJQDWLRQ WKHFRVFDQW WKHFRVFDQW WKHFRVFDQW
 RJ WR J DIWHU LPSUHJQDWLRQ WKHFRVFDQW WKHFRVFDQW WKHFRVFDQW

EDVLV RI YROXPH GLVWULEXWLRQ D
 ZKHQ LW FRPHV WR WKH PD[LXP SDU
 WKH IRUPDWLRQ RI ODUJH DJJORPHU
)LJXUH VKRZV WKH YROXPH RI JU
 UHODWLYH WR WKH SDUWLFOH VL]H I
 7KH ODUJHVW DPRXQW RI SDUWLFOH
 LV REVHUYHG IRU WKH SDUWLFOH VL
 WR DSSUR[PLFURQV IRU WKH VD
 LPSUHJQDWLRQ +RZHYHU WKH JUDL
 DUH DFWXDOO\ DJJORPHUDWHV ZK
 E\ TXDQWLWDWLYH DQDO\VLV DQG

)LJXUH7KH VSHFLILF VXUIDFH DUHD RI FREDOWWKHFRVFDQWWKHFRVFDQWWKHFRVFDQW
 7KH TXDQWLWDWLYH

VKRZHG WKDW IRU WKH PDMRUL WU DRIQS DUWK HFOH V HWXIO WVL JHF RZDQ/FLGH
 LQ WKH QP UDQJH 6XFK EPDDUNCHGG GWRIP WKKH % (7 DQDO\VLV
 EHWZHHQ WKH DQDO\VLV RI WKH SDUWLFOH VLJH GLVWULEXWLRQ
 VKRZHG DV D YROXPH SHUFHQWDJH (DQG WKH TXDQWLWDWLYH
 SHUFHQWDJH ZDV QRWLFHG GXH WR WKH WKH SHUFHQWDJH DQDO\VLV DUH VK
 EXW ODUJH DJJORPHUDWHV LQ SRZOHFWHG RYHU LJXUH FURQ JUDLQ
 7KH SDUWLFOH VLJH GLVWULEXWLRQ RYHU DJJORPHUDWHV PHDVXU
 WKH KLJKHVW FROHFW RIRHW2 QKW YKIDH RI WKHVH DJJORPHUDWH
 IURP WKH SUHYLRXVO\ GHVFULEHG RQH VDP SOHV \$LXUHVSHFWLYH XRIY 7KHWK
 EDVHG RQ D QXPEHU RI SDUWLFOHV RZ VDP SOHV &R JK &H PRO &H
 DQG &R &HB. VKRZV WKDW WKH 7KH 5KH PLJUDQ DQDO\VLV ERQW HUPV
 FDVHV ZDV DERXW QP)RU VKRZV SOHV &R LQ LFDQW GHYLDWL
 DQG &R &HB. LW HTXDOOHG 5KH DQDO\VLV ERQW RQ DV VKRZQ
 VDP SOHV &R &H DQG &R &HB. 7KH UHDFKH VLJH RI JUDLQV GHW
 DQG QP UHVSHFWLYHO\ LPDJHV ZDV DERXW -P \$IWHU LP
 DQG VLJH RI DJJORPHUDWHV GLG QP
 7KHVH REVHUYDWLRQV DUH FRQVLVW
 IURP WKH DQDO\VLV RI WKH SDUWLFOH

)LXUH DQDO\VLV GLVWULEXWLRQ IRU VHOHFWHG VDP SOHV
 7KH ZHLJKWHG DYHUDJH SDUWLFOH VLJH ZDV FDOFXODWHG
 DQG FROHFWHG LQ)LXUH EDVHG RQ WKH GDWD REWDLQHG ZKHQ
 DQDO\VLV WKH SDUWLFOH VLJH GLVWULEXWLRQ IRU D QXPEHU
 RI SDUWLFOHV

)LXUH (0 LPDJHV RI FDWDO\VVV
 5 DQDO\VLV
 7KH &R &H FDWDO\VVV VG ZHFUR SDFW LMLH
 ZKLFK LV VKRZQ LQ)LXUH 2 DQG)
 FRQYHUVLRQ ZDV QHJOLJLEOH XS W
 VDP SOHV ,W ZDV REVHUYHG WKDW
 R[LGH UHJDUGOHVV RI LWV TXDQV
 WKH FDWDO\WLF SURSODULGHWR RQ X
 R[LGH FDQ VWDELOLJH PHWDO R[LGH
)LXUH KH ZHLJKWHG DYHUDJH SDUWLFOH VLJH ZDV FDOFXODWHG
 ,W ZDV REVHUYHG WKDW WKH KLJKHVW FROHFW RIRHW2 QKW YKIDH RI WKHVH
 WKH ODUJH WKH ZHLJKWHG DYHUDJH SDUWLFOH VLJH ZDV FDOFXODWHG
 FDOFXODWHG LQ UHODWLRQ WR WKH PHDVXUHQWV RI WKH QXPEHU

f & IRU VDPSOHV FRQW VLDPLHQJW BRQZWHGF WHP SHUDWXUH DW ZKLFK WK
LV REVHUYHG IRU WKH WHP SRQDMXUJHRQQHWHUZHVLQRQGVHUYHG IU
WKH FRQYHUVLRQV RORZHU7IRU WKRI VDP SOHV WKH VDP SOH VKRZLQJ W
FRQWDLQLDQG&HDW WKH VDPH WLSUHR SHUW&H0VZDXW&R &HB.
GHJUHHV KLJK CHUWK RZQ ZQ)LJXUH

6XPPDU\

\$ VHULHV RI &R &H R[LGHV FRPSRVL
E\ WKH ;5' 6(0 ('; '/6 DQG %(7 WH
\$OO DQDO\VHG FDWDO\VVV ZHUH
WHP SHUDWXUFR PSRVLWLRQ

7KH UHVXOWV VXJJHVWHG WKDW
R[LGH FDXVHV DQ LQFUHDVH LQ WK
DQ LPSURYHPHQW LQ WKH FDWDO\W
VXUIDFH DUHD RI WKH FDWDO\VVV R
ZDV UHGXFHG E\ ILOOLQJ WKH SRUH
H[DPLQDWLRQ FDUULHG RXW IRU DV
E\ WKH SUHFLSLW DQDQ V KRZHG
WKH SUHVHQFH RI SGGZHRV LIGHRP RQO\

)LJXUH7KH21FRQYHUVLRQ EHIRUH LPSUHJQDWLRQ

7KH FUI\VWDOOLWH VLJH FDOFXODWH
VKRZHG WKDW IRU DQ LPSUHJQDWL
RFFXUUHG LQ WKH FDVH RI DOO VDP
DUHD ZDV HQODUJHG ZKHQ R[LGHV
IRU DOO VDPSOHV ,W ZDV DOVR IR
LQ SRZGHUV KDYH DQ HORQJDWHG
7KH DGGLWLRQ FRIQV&B DEUDO\ OF
WKH WHP SHUDWXUH DW ZKLFK W
WKH FRQYHUVLRQ RI 7R VXP XS
WKH PRVW VLJQLILFDQW LPSDFW
RI WKH FDWDO\WLF SURSHUWLHV

\$FNQRZOHGJPHQW

0 5DMVND DFNQRZOHGJHV WKH
IRU 6FLHQFH *UDQW IRU <RX
QR DW WKH 'HSDUWPH
&KHPLVWU\)DFXOW\ RI 0DWHULD0V

)LJXUH7KH21FRQYHUVLRQ EHIRUH LPSUHJQDWLRQ

\$* to 867
7KLV ZRUN KDV EHHQ SDUWLDOO\
SURMHFW QR '(& 6 67
WKH UHVXRUFHV DVVLJQHG IRU VFL
&HQWUH 1&1 3RODQG DQG SD
E\ WKH 1DWLRQDO &HQWUH IRU 5HV
1&%5 3RODQG XQGHU WKH SURMHF

5HIHUUHQFHV

/ ;XH + +H &K /LX &K =KDQJ
(QYLURQ 6FL 7HFKQRO
(\$ 'DYLGVRR (QYLURQ 5HV /HWW
(\$ 'DYLGVRR ' .DQWHU (QYLUR

8 &KHOODP = 3 ;X + & =HQJ &K

)LJXUH7HPSHUDWXUFRQYHUVLRQ RI

DQG 3pUH] 5DPLUp]) .DSWHLMQ \$\$\$

\$IWHU LPSUHJQDWLRQ D VLJQ
FDWDO\WLF SURSHUWLHV RI D
GHPRQVWUDWHG 7KH WHP SHUD
FRQYHUVLRQ ZDV DFKLHYHG ZH
YDOXHV ZKLFK LV SUHVHQWHG
DFWLYLW\ ZDV LPSURYHG WR
WKH VDPSOHV LQ WKH RDPH
UDWLR ZDV LQ WKH UDQJH RI

< ;X & XMDUGLQ & 7DQFHORW
3DUYXOHVFX 0 &DElp & 5 +HQU
*UDQJHU - &DWDO
3 *UDQJHU 3 (VWHYHV 6 .LHJH
/HFOHUFT \$\$\$O &DWDO %
- 3HWU\N (.RadNRZVND \$\$\$O
WR /RZHULQJ

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( ,ZDQHN . .UDZF]\N - 3HWU\N - : 6REF]DN =
.DV]NXU $SSO &DWDO %
( 3DFKDWRXULGRX ( 3DSLVD $ 'HOLPLWLV 0 $
9DVLOLDGHV $ 0 (IVWDWKLRLX 0 ' $PLULGLV 2 6
$OH[HHY ' %ORRP * ( 0DUQHOORV 0 .RQVRODNLV
( ,OLRSRXORX $SSO &DWDO %
, 9 <HQWHNDNLV * *RXOD 3 3DQDJLRWRSRXORX 6
.DPSRXUL 0 - 7D\ORU * .\ULDNRX 5 0 /DPEHUW
$SSO &DWDO %
/ 2EDORYi 0 5HOL - /DQJ 9 0DW MND -
.XNXWVFKRYi . .Rpt &DWDO 7RGD\
' 3LHWURJLDFRPL 0 & &DPSD / 5 &DUERQH 6
7XWL 0 2FFKLX]]L $SSO &DWDO %
* *U]\EHN 3 6WHOPDFKRZVNL 3 ,QG\ND 0 ,QJHU
0 :LON $ .RWDUED = 6RMND &DWDO 7RGD\

0 ,QJHU 0 :LON 0 6DUDPRN * *U]\EHN $
*URG]ND 3 6WHOPDFKRZVNL : 0DNRZVNL $
.RWDUED = 6RMND ,QG (QJ &KHP 5HV

* *U]\EHN 3 6WHOPDFKRZVNL 6 *XG\ND 3
,QG\ND = 6RMND 1 *XLOOPQ +XUWDGR 9 5LFR 3pUH]
$ %XHQR /ySH] $ .RWDUED $SSO &DWDO %

$ %XHQR /ySH] , 6XFK %DVDQH] & 6DOLQDV
0DUWLQH] GH /HFHD - &DWDO
6 6XDUH] 0 <DWHV ) - *LO /LDPELDV - $ 0DUWLQ
3 $YLOD - %OXUFRMNDKG

6 ,PDPXUD - 7DGDQL < 6DLWR < 2NDPRWR +
-LQGDL & .DLWR $SSO &DWDO $
: 3LVNRU] ) =DVDGD 3 6WHOPDFKRZVNL $
.RWDUED = 6RMND &DWDO 7RGD\
/ ;XH &K =KDQJ + +H < 7HUDRND &DWDO 7RGD\

/ ;XH &K =KDQJ + +H < 7HUDRND $SSO &DWDO
%
* 0DQLDN 3 6WHOPDFKRZVNL = 6RMND
9 5LFR 3pUH] $ %XHQR /ySH] $SSO &DWDO %

3 /HJXWNR : .DVSHUD 7 -DNXEHN 3
6WHOPDFKRZVNL .RWDUED 7RSLF &DWDO

* =KDQJ < *XR / /X = =KDQJ / :DQJ /
=KRX - 6KDR 0DW /HWW
/ /L / 6RQJ + :DQJ &K &KHQ < 6KH < =KDQ
; /LQ 4 =KHQJ ,QW - +\GURJHP (QHUI\

0 0D]DKHUL 6 $ +DVVDQ]DGHK 7DEUL]L 0
$PLQ]DUH 6 . 6DGUQH]KDDG &HUDPLF 0DWHULDOV

) =DVDGD 3 6WHOPDFKRZVNL * 0DQLDN - ) 3DXO
$ .RWDUED = 6RMND &DWDO /HWW
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