

1BUIPHFOFTJT PG #BSSFUU T &TPQIBHVT

+DR[LDQJ =KDQJ &DLIHL 6KHQ 3X :DQJ -L)HQJ <LQ ;X -LQJZHQ /L \$QUDQ =KDQJ <LMX ;LD :X <DQ DQG
'HSDUWPHQW RI *DVWRHQWHURORJ\ 6RXWKZHVW +RVSLWDO 7KLUG 0L0LWDO\ 0HGLFDO 8QLYHUVLW\ &KR
&RUUHVSQRGLQJLDXFKXQ)DQJ 'HSDUWPHQW RI *DVWRHQWHURORJ\ 6RXWKZHVW +RVSLWDO 7KLUG 0L0LWDO
&KLQD 7HO IDQJEDDQFKXQ#KRWPDLO FRP
5HF GDWH 0DU \$FF GDWH \$\$SU 3XE GDWH \$\$SU
&RS\ULJKW =KDQJ + HW DO 7KLV LV DQ RSHQ DFFHV DUWLFOH GLVWULEXWHG XQGHU WKH WHUPV RI
XVH GLVWULEXWLRQ DQG UHSURGXFWRQ LQ DQ\ PHGLXP SURYLGHG WKH RULJLQDO DXWKRU DQG VRXU

\$EVWUDFW

%DUUHHWwV HVRSKDJXV %(LV FRDUDFWHULHG DV KLVWRORJLF HYLGHQFH
HVRSKDJHDO HSLWKHOLXP DQG LV DQ LPSRUWDQW SDWKRSK\VRORJLF HYLGHQFH
DGHQRFDUFLQRPD (\$& ,WV ZHOONQRZQ WKDW WKURQLF PRWURHVRSKDJHDO
GHYHORSPHQW RI PHWDSODVLD +RSHULFDWHHG FHOXWKHU SDVGRSKHVKRORJH
HVRSKDJHDO HSLWKHOLXP ZLWK D FROXPQDU W\SHU RDUJHONSHORORJLF OVKRZ
DQG RWKHSRPSRQHQWV RQ HVRSKDJHDO
(IIRUWV WR XQGHUVDQG WKH SDWKRSK\VRORJLF DFWLYDWLRQ GLVSRUWLQJ
GHFDGHV 7KLV UHYLHZ DLPV WR HPSRUWHXHQGLQDWRPHYWKH PDWRUWKHMNV
DQ LQVLJKW LQWR WKH PROFXODU ELRPDUNHUV UHQWHXJZLWKW% (DQSWHLOH
SUHYHQW %(IURP SURJHVVLQJ WR SDWKRSK\VRORJ\ RI %(DQG (\$&

.H\ZRUG%DUUHHWwV HVRSKDJXV 3DWKR&HOFULU&HOQ RVL%LQ 6LJQDOLQJ
SDWKZD\ 'HYHORSPHQW

,QWURGXFWRQ
%DUUHHWwV HVRSKDJXV %(DOVR WHYPHGRSRQMDUHO SGRQHVRS&BUXWRIRG
PHWDSODVLD WKDW WKH HVRSKDJHDO &DQNHVVWMLQVRSKDJTXDPRXVWHSLOWFRQW
ZDV UHSODFHG ZLWK D FROXPQDU PXFRVSDLQ@VKW FHOXWKHU RDUJHONSHORJH D
fDQSDWKRJHQHVLV RI %(RQ H[SHULPHQWDO DQG FOLQLFDO HYLGHQ

ODMRU 5LVN)DFWRUV RI %(
ODMRU ULVN IDFWRUV IRU WKH GHYHORSPHQW RI %(LQFOXGH D ORQJ
VWDQGLQJ KLVWRU\ RI *(5' ! \HUV D ODUJH KLDWXV KHUQLD DQG RWKHU
UHSRUWHG ULVN IDFWRUV FRQWDLQLQJ REHVLW\ ZKLWH HWKQLFLW\ DOFRKR
FRQVXPSWLRQ WREDFFRJXVHGHG&HGHG&DUDQVLF
RI HVRSKDJHDO DFLG GHIHFWR ORZHU HVRSKDJHDO VSKLQFWHU DQG SURIRXQG
UH~XRI JDVWULF MXLFH LQWR WKH ORZHU HVRSKDJXV DQG XVH RI
DQWLFKROLQHUVLF PHGLFDWLRQV > @

*(5' LV WKH PRVW LPSRUWDQW HVRORJLFDO IDFWRU IRU %(
JDVWULF FRQWHQW LQWR WKH HVRSKDJXV KDV EHHQ FRQVLGHUHG DQVZHUDEOH
WKH RQVHM FRDMRU KDUPIXO FRPSRUDWLRQ RI
PDWHULDO DUH DFLG DQG ELOH VDOWV %RWK FOLQLFDO DQG H[SHULPHQWDO V
KDYH VKRZQ WKDW ELOH DFLGV DUHQR[LRXV WR WKH HVRSKDJHDO PXFRVD

5HFHQWO\ RQH QHZ PRXVH PRGHO LQ ZKLFK RYHUH[SUHVVLRQ RI
LQWHUOHXNLQ EHW D ,/

0LJUDWLRQ RI ERQH PDUURZ SURJHQLWRUV

,W KDV EHHQ VXJJHVWHG WKDW %(FRXOG RULJLQDWH IURP PDUURZ GHULYHG
VWHP FHOOV > @ DQG DOWKRXXJK FXUUHQWO\ WKHUH DUH OLWWOH GDWD RQ W
WKH FRQWH[W RI %(VLPLODU VLWXDWLRQ VXSSRUWLQJ WKLV K\SRWKHVLV KDV E
IRXQG LQ JQJUDWLRQ LQWHUWILFLDO WKSODVWV D\ @
PDUURZ VWHP FHOV PLJUDWLRQ LV HQFRXUDJHG E\ WKH REVHUYDWLRQ RI

WKDW ELOH DFLG LQGXFHG ./) H[SUHVVLQR IROORZHG E\ 08& SURGXFWLQR
PD\ SOD\ DQ LPSRUWDQW UROH LQ %(GHYHORSRPHQW

+HGJHKRJ SDWKZD\

H +HGJHKRJ VLJQDOLQJ SDWKZD\ SOD\ DQ LPSRUWDQW UROH LQ
HPEU\RQLF GHYHORSRPHQW FHOV SUROLIHUWLRQ WLVVXH SRODULW\ DQG
FDUFLQRJHQHVLV > @ :DQJ HW DO > @ VWXGLHG WKH +HGJHKRJ SDWKZD\
UHDFWLYDWLRQ LQ %(DQGGLWUHSORIBWLRQ FROXPQDU
HVRSKDJHDO HSLWKHOLXP 5HVXOWV VKRZHG WKDW HSLWKHOLDO +HGJHKRJ
SDWKZD\ V LQLWLDWHV %(RFFXUUHQFH E\ SURPRWLQJ VHFUHWLRQ RI
VWURPDO %03 ZKLFK WULJJHUV HVRSKDJHDO HSLWKHOLDO WUDQVIRUPDWLRQ W
D FROXPQDU SKHQRW\SH

6KK VLJQDOLQJ

6KK H[SUHVVLQR LQ QRUPDO HVRSKDJXV UHPDLQV FRQWURYHUVLDO
KRZHYHU DEHUUDQW 6KK VLJQDOLQJ PD\ FRQWULEXWH WR %(LQLWLDWLRQ DQG
VXEVTXHGW (\$ SURJUHVVLQR 6KK LV DEQRUPDO\ DFWLYDWHG LQ LQMXUH
HVRSKDJHDO HSLWKHOLXP H[SRVHG WR ELOH VDOW DQG DFLG 6KK VLJQDOLQ
FRQWULEXWHG WR %(GHYHORSRPHQW LQ WZR VHTXHQLDO VWDJHV)LUVW 6KK
VLJQDOLQJ DFWLYDWHV WKH WDUJHW %03 DQG VFRQG %03 VLJQDO DFWLYDW
62; RI HSLWKHOLXP > @ &OHPRQV HW DO > @ SURSRVH WKDW 6KK LQGXFHG
H[SUHVVLQR RI 62; PD\ UHSUHVHQW DQ HDUO\ PROHFXODU HYHQW LQ WKH
GHYHORSRPHQW RI HVRSKDJHDO FROXPQDU PHWDSODVLD &RQVLVWHQW ZLWK WKH
ZRUN D UHFHQW VWXG\ DOVR UHSRUWHG HYLGHQFH RI 6KK VLJQDOLQJ LQ %(DV
ZHOO DV (\$ > @

62; LV DQ LPSRUWDQW LQGLUHFV WDUJHW RI 6KK VLJQDOOLQJ :DQJ HW DO
> @GHQWLVKHWUDQVFULSWLRQ IDFWRU 62; DV D SRWHQLDO GULYHU RI
%(H\ VKRZHG WKDW 62; LV H[SUHVHGH LQ WKH EDVDO HSLWKHOLDO FHOV RI
WKH GHYHORSRPHQW PRXVH HVRSKDJXV IURP HPEU\RQLF GD\ XS WR ELUWK
EXW GRHV QRW SUHVHQW LQ WKH HVRSKDJHDO HSLWKHOLXP RI DGXOW PRXVH
)XUWKHUPRUH 62; LV XQLYHUVDQO\ XSUHJXODWHG LQ %(DQG IUHTXHQWO\
H[SUHVHGH LQ (\$ EXW LV DEVHQW LQ QRUPDO KXPDQ VTXDPRXV
HVRSKDJXV &OHPRQV HW DO > @ GHPRQVUDWHG WKDW FR H[SUHVVLQJ &;
DQG 62; KDG D VLPLODU SKHQRW\SH WR VLQJOH H[SUHVVLQJ 62; RI
HSLWKHOLXP VXJJHVWLQJ WKDW 62; LQGHSHQGHO\ GULYHV FROXPQDU
GLVHUHQWLDVLRQV HSLWKHOLXP DQG H[SUHVVLQR RI LQWHVWLQDO
GLVHUHQWLDVLRQ UHPLQLVHFWXOWV %03 LQGLFDWH WKDW
6KK LQGXFHG H[SUHVVLQR RI 62; SOD\ DQ LPSRUWDQW UROH LQ HDUO\ VWDJH
RI %(GHYHORSRPHQW

%03 ZDV DOVR IRXQG D NH\ UHJXODWRU RI 6KK VLJQDOOLQJ 6KK LQGXFHV
%03 VHFUHWLRQV REURDQVHFWOEDFN WR WKH HSLWKHOLXP
ZKHUH LW FDXVHV WKH H[SUHVVLQR RI 62; DQG WKH LQGXFWRQ RI FROXPQDU
GLVHUHQWLDVLRQV > @

:QW SDWKZD\ V

:QW VLJQDOLQJ HPEU\RQLF GHYHORSRPHQW DW YDULRXV VWDJHV
DQG FRQWULEXWHG LQ MRHOV DFWLYDWHG HSLWKHOLXP
> @QW VLJQDOLQJ FRXOG FRGLWUHSORIBWLRQ FROXPQDU
WKURXJK DFWLYDWLRQ RI %03 VLJQDOLQJ ,W KDV EHQV VKRZQ WKDW
FRPSRQHQWV RI :QW VLJQDOLQJ SDWKZD\ SOD\ DQ LPSRUWDQW UROH
FRQWUROOLQJ WKH EDODQFH EHWZHHQ VTXDPRXV DQG JODQGXODU
GLVHUHQWLDVLRQV LQ QRUPDO FHOV VHFUHWLRQV @WKDW LV DFWLYDWHG
E\ :QW VLJQDOV LV WKH VWDELQJDLWRQ RI E FDWHQLQ DQG WKH VXEVTXHGW
IRUPDWLRQ RI QXFOHU E FDWHQLQ 7FI FRPSOH\HV WKDW FDQ GULYH
H[SUHVVLQR RI :QW WDUJHW JHQHV \$OWKRXJK DEQRUPDOLWLV LQ (FDGKHULQ

4XDQWH

&LWDWLRQ + 6KHQ & :DQJ 3)HQJ - ;X < HW DO

3DWKRJHQHVLV RI %DUUHHW V HVRSKDJXV \$P

3DJH RI

DQG PDOLJQDQW WUDQVIRUPDWLRQ PHKDFKPKVLODLGGIRWGHURDSKXQWUJFURQVRO 5
 RSSRUWXQLWLHV &ULW 5HY 2QFRO +HPDWRO \$FWLYDWLRQ RI EHWGL FDUWHQDQDQWUJQD
 &OHPRQV 1- &DURJDKLNR)HQQHO &0 HW YHUFUHWRU\ FUDQDQWGDVGHQFHQWLSVGLRUPLV DQG
 6R[GULYHV GHQXPHQDWRIDWLRGSKDJHDO VPHWFRQDVLDV 3URF 1DWO \$FDG 6FL 86\$
 HSLWKHSLVPLBOH UROH LQ WKH SDWKRJHQHVLV RI %DUUHHW V HVRSKDJXV \$P
 - 3K\VLRO *DVWURLQWHVW /LYHU 3K\VLRO *
 <DQJ / :DQJ /6 &KHQ ;/ *DWDOLFD = 4LX 6 HW DO +HGJHKRJ
 VLJQDOLQJ DFWLYDWLRQ LQ WKH GHYHORSHPHQW RI VTXDPRXV FHOO FDUFLQRPD DQG
 DGHQRFDUFLQRPD RI HVRSKDJXV ,QW - %LRFKHP 0RO %LRO