

5HSRUW 1R 3 1&3 5 5HY 1 &  
5HSRUW 'DWH 0DUFK

6ROYD\ )RUPHUO\ \$GYDQFHG &RF  
070 &) 5: . 3: \$6 )DEUL  
/+ FXUH F\FOH FRPSDUHG WR 0  
(TXLYDOHQF\ 6WDWLVLWLFDO \$0

)\$\$ 6SHFLDO 3URMHFW 1XPEHU 63 : , 4

1&\$03 'RFXPHQW 1&3 53 5HY 1 &

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5HSRUW 'DWH 0DUFK

3UHSDUHG E\

(OL]DEHWK &ODUNVRQ

5HYLHZHG E\

-RQDWKDQ 7LVDFN

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\$SSURYHG E\

5R\DO /RYLQJIRVV

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/LVW RI 7DEOHV

7DEOH 7HWW \$EIRVSHRQD  
7DEOH (QYLURQ@HWWRDQV &\$EEUHYLDWLRQV  
7DEOH 2QH VLGHWWRB@HEDQFLPLDQVY@XHDVSOH PHDQ  
7DEOH 2QH VLGHWWRB@HEDQFLPLDQVY@XHDVSOH PHDQ  
7DEOH )5HL@HWV 6FDOH  
7DEOH 6XPPDU@RQFTXHWV 5HVXOWV  
7DEOH :DUSV@BR@U@H@N@O@W@V  
7DEOH :DUSV@BR@U@H@N@O@W@V  
7DEOH :DUSV@BR@U@H@N@O@W@V

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,QWURGXFWRQ

7KLV UHSRUW FRQVWLWXWHV WKH WTXNDXOMRURUO\ \$GYDQFHG  
 &RPSRVLWHV \*URXS 070 5: &). 3: \$6 )DEULFXU/H 'F\FOH  
 FRPSDUHG WDWK DROLLELWLRQ SDQHOO+ SERGXFFHGOXVLRQ  
 VDPH PDWHULDO 7KHQ DWPLRQDWLQGLDODSULRSHUW\JBOUDDKH  
 ZLWK )\$\$ RYHUVLJKVSHFKDQX3KR)S\$FW 1XPELQ 030VR: ,PHHW  
 WKH UHTXLUHPHQW 03RQWDLQGLQSHUSDW63J 3URKHHG&UH

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RQ WKH UDZ PDWHUWLBOLDDQEDQXZDFDQGLSJRHTXVLSRPMQW D

(QYLURQPHQWDO &RSGLDWLRQH 7\$E	EUHYLDWLRQ
&ROG 7HPSHUDWXUHÍ 'U\ )	&7'
5RRP 7HPSHUDWXUH 'U\ )	ž )
(OHYDWHG 7HP\$HUDWŽU)	(7'
(OHYDWHG 7HP:\$HUDWŽU)	(7:
(OHYDWHG 7HPSHUDWXUH :HW	ž ) (7:

7DEOH (QYLURQPHQWDO &RSGLDWLRQH 7\$E EUHYLDWLRQV

7HVWV ZLWK D HQXIPDEMHUOLPEWHV LDKMHL RDK HQGDV F D S/H

<sup>3</sup>4XDVL ,VRWURSLF´

<sup>3</sup>6RIW´

<sup>3</sup>+DUG´

(; 2+7 LV DQ RSHQ WRWV WLMQW LTRDVL LVRWURSLF





:LWK D R E D E L S U L W \ R H R Q T X L R Y D O R D I E G X W H V W G X H W R U D O  
FKDQFH DORQH DVIHVKRDXOCHEGWDHQVHQTXL YDDQHWLLOO EH  
SUHVXPHG SURYLDGHCXWKVDVUWKQRW VHYHUH

6WUHQJWK DQG ORGXOXV 7HVWV

)RU VWUHQJWK WHHV S U Y B D X H O \ Z R I Q T H H Q X I G Y B Q O Q E H W O P S O I  
VKRZV ORZHU VWUHQJWK RYDLOXQYDOW F H O O D I O L F B W L R Q B D W H U U  
DV D μRQH VLGHG↑ K \ S R W K H V L V W H V W H G L D J K H U R E Y O I O X H W K R U X  
WKH \ P D \ L Q G L F D V E H H W Z G H I Q H W K G F M Z R T P X L W B O I H O O F V I V X P I S I O H  
PHDQ DQG VDPSON P D Q I P K R P Y S D O X H G V D J D L Q H V I S H M F W H H O L Y Q L O P X H I  
IRU WKRVH VWDWIEFVW S K W H Z K L B R P D W H W H T X D O H M L X F O W W L R Q

7KH H[SHFWHG YDOXHVDQJH W R P S X D V D X G H O H O Q T O V E I O B L Q  
DFFRUGLQJ WR WKH IROORZLQJ IRUPXODV

7KH PHDQ  $PXV \bar{X}$   $H_n$  F H Z K H  $\bar{V}$  HDQG 6 DUH UHVSHFWLYHOV  
PHDQ DQG WKH VWDQGDUG T X I D Y O L L D M F L D R V L R Q V D P S O H

7KH VDPSON  $PLQLPXP P_k$   $V$  S H Z I K H H I G D Q G 6 DUH  
UHVSHFWLYHOV W K W B Q Q U D Q G H W K B M F L D R V L R Q W I O H P S O I O

,I HLWKHU WKH PHDQ DROUW KEH O R Q L W K P X R I S M I K W W G P P S O H L L V  
FRQVLGHUHG WR KDQF \ I D R L O H V K D W X E G Y D O H K W I Q U X L O V O W K F S B W K H  
UHMHFHG 7KH SURIEDW E K O U W W K R H P H O Q P R W H W W H W K Q . O H Y H  
V H W D W

)RU ORGXOXV YDOXHV I M K O X U T K I R Y F O H O F H V V I P S O H U P W R R K  
WRR ORZ FRPSDUHGL W G F H K D H T X D O V I L D F D W H H W Z R H G L V R G ↑  
K \ S R W K H V L V W H V W V S P S O D I Q G Z R J G V D I Z O R H V G R V G W W M W P L Q K V L H W  
PHDQ IURP WKH HTXLYD O X Q I F L F V B Q S O A D I O L U I E D R W L R Q H V D P S O H  
WR UHMHFV WKH QXOO K \ S R W K H V L V L V K H H S U B W D E L O L W \ R I

7KHVH WHVWV DUH S K H I R J R H G S U W D G V K G H H W L Z K H G K W Z D W H V  
HTXLYDOHQF \ E H W Z V H I Q Q W Z F F P U D Q V D H Q L H D Z P L W Q K W W K R H B O F X L U \*  
V H F W L R Q 7 H V W Q L Q R J U H G H E M Y D Z H H Q F W Q Q U I G D W D E D V H D Q O  
Q H Z G D W D V H W I R U W K H H W D R L O P D V E R X W D G I O H P I G V R K R B M Q X W H G  
WKH U H I H U H Q F H V O L V W H G L Q 6 H F W L R Q



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7KHUH ZHUH D WRHVDVVRHVWGLRIHHUTKLVYDIDLHQLHQWXCQDZMDWDFP  
WR WKH UHFRPPHQGDWLRQVURI ZHUH HLOKWHVWGLSLURIDPH  
ZLWK LQVXIILFLHQWSDVRD\$KFRDPSHWDNFNCFXVHGZDSODQVR PD  
\$OO WHVWV ZHZLHSHDQR.UOHCHO RI

7KH UHVXOWV RI WPSHUHLRQVHDOFH QBMVHCGD R q 3B DVV ZL  
&9¶ μ3DVV ZLWK ORG &9¶ UHIHUV WR

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	&7'	57'	(7'	(7:	(7:
	6WUHQJWK	)DLOHG E\		3DVV	3DVV
	0RGXOXV	3DVV		3DVV	
	6WUHQJWK	3DVV			)DLOHG E\
	0RGXOXV	3DVV	3DVV ZLWK		)DLOHG E\
			ORG &9		
	6WUHQJWK	3DVV	3DVV	3DVV	3DVV
	0RGXOXV	3DVV	)DLOHG E\	)DLOHG E\	
	6WUHQJWK	3DVV		3DVV	3DVV
	0RGXOXV	)DLOHG E\	)DLOHG E\	)DLOHG E\	
	2IIVHW	3DVV	)DLOHG E\		3DVV
	6WUHQJWK	)DLOHG E\			3DVV
	6WUDLQ	)DLOHG E\			,QVXIILFLHQW
	6WUHQJWK	,QVXIILFLHQW			'DWD
		'DWD			
	0RGXOXV	3DVV	3DVV		3DVV
6KR UW %HDP 6WUHQJWK	6WUHQJWK	3DVV ZLWK	3DVV ZLWK	3DVV ZLWK	3DVV
		ORG &9	ORG &9	ORG &9	
			)DLOHG E\	)DLOHG E\	
2SHQ +ROH &RPSUHVVLRQ	6WUHQJWK	3DVV		,QVXIILFLHQW	3DVV
				'DWD	
2SHQ +ROH 7HQVLRQ	6WUHQJWK	3DVV			3DVV
,QWHUODPLQDU 7HQVLRQ	6WUHQJWK	3DVV	,QVXIILFLHQW	3DVV	,QVXIILFLHQW
			'DWD		'DWD
			)DLOHG E\	)DLOHG E\	
&XUYHG %HDP 6WUHQJWK	6WUHQJWK	3DVV	,QVXIILFLHQW		,QVXIILFLHQW
			'DWD		'DWD
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&RPSUHVVLRQ \$IWHU ,PSDFW	6WUHQJWK		,QVXIILFLHQW		
			'DWD		
&XUHG 3O\ 7KLFNQHVV	1\$				

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\$ JUDSKLFDO SUHVH QWUHWXFOV RILDVCK MZGLQ JXUJUH ,Q  
RUGHU WR VKRZ GWKHUMQPHWHVDSKLFQO VFDOH DOO

:DUS &RPSUHVLRQ :&

7KH :DUS &RPSUHVLRQ DWD Qrupdoljhg zlwkw &37  
 VWUHQJWK GDWD 0HDQ 6WUHQJWK NVL  
 WKH 57' FRQGLWLRQ OLQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ  
 57' DQG (7: FRQGLWLRQ XV GDWD 0HDQ 6WUHQJWK NVL  
 ZHUH QRW SURYLGHG IRU VWUHQJWK GDWD 0HDQ 6WUHQJWK NVL  
 YDULDWLRQ ZDV DERYHWK DZKLVFKHPHQW ZHUH &ORUGLIXH VWUHQJWK  
 IURP WKH UHVXOWV VFRQG DGDWLRQ ZHUH IRU WKH VWUHQJWK  
 LQ 7DEOH DQG XOWW 6BWPD LQ 7DEOH

:DUS &RPSUHVLRQ	:& 57' 6WUHQJWK 4 X	(7: D O	(7: ( T
'DWD Qrupdoljhg zlwkw &37 0HDQ 6WUHQJWK NVL 6WDQGDUG 'HYLDWLRQ &RHIILFLHQW RI 9DULDWLRQ OLQLPXP 0D[LXP 1XPEHU RI 6SHFLPHQV			
5(68/76		3\$66	3\$66
OLQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ			
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OLQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ			

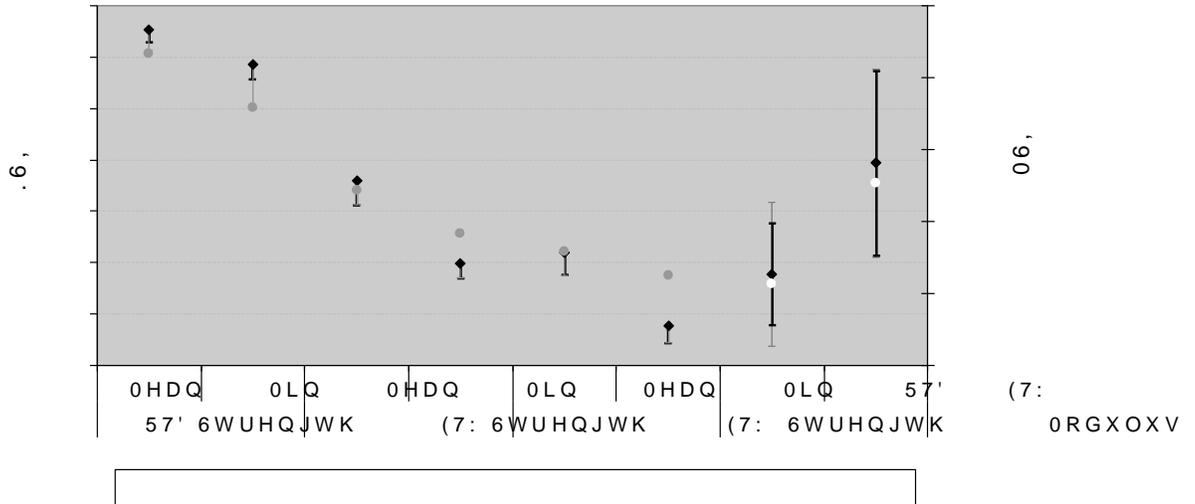
X L Y

7DEOH :DUS &RPSUHVLRQ VWUHQJWK 5HVXOWV

4XDO (TXLY 4XDO (TXLY  
 'DWD Qrupdoljhg zlwkw &37  
 0HDQ 0RGXOXV 0VL  
 6WDQGDUG 'HYLDWLRQ  
 &RHIILFLHQW RI 9DULDWLRQ  
 OLQLPXP  
 0D[LXP  
 1XPEHU RI 6SHFLPHQV 6BWPD

)LJXUH LOOXV WPSUHWWRQ V V B HQ QWR XPH DDO XHQVGRQ LG W  
 PRGXOXV PHDQV IRB QWK EPTXOHO DIQ G DWMLB FSTOHL Y D OHH OELPLWV  
 HTXLYDOHQF\ VDP SOHJUD B H E B Z QZ DWK QW G B WTX DOKHL E B W J H  
 OLJKWHU FRORUH G HWKUR B REGLU V HDG U & 9 I R R P S X W D W L R Q V

6ROYD\ )RUPHUO\ \$GYDQFHG &RPSRVLWHV \*URXS 070 & ) 5:  
 \$6 )DEULF &RPSDULVRQ RI /+ &XUH V & R Q H + Z & X H B U L Q H L Q D O 4 X D O L I L F  
 7HVV 5HVXOWV IRU :DUS &RPSUHVVLRQ 'DWD 1RUPDOLJHG





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7KH :7 PRGXOXV GD'WHDQMLU RQKPH QW IDLOFHGWMK/M HETHFLDYDVOH  
 VDPSOH PHDQ YDOXHH WKH X S SHEL R DFFHSWD QKHI OLPLW  
 HTXLYDOHQF\ VDPSOH PHDQ RYDOKH X S SFFUH SW DEVO HR YDOXH V  
 8QGHU WKH DVVX PSCMLLR QR & 9WRH WPKRG DWIKUR P RAKHO X' GDW  
 HQYLURQPHQH S-DVLYG OHQFH WHVW

7KH :7 PRGXOXV GD:WBIQRUURKPH QW IDLHOFG WVKVWHE MEYDOH  
 WKH VDPSOH PHDQ WEERZ WKH LORZHUWDFHHSWD QKHI OLP  
 HTXLYDOHQF\ VDPSOH PHDRQ WKOXORLZHFJHS WPLEVO IR IYDOXH V  
 8QGHU WKH DVVX PSCMLLR QR & 9WRH WPKRG WKPSS GRXRHYDOHLQF\  
 RI WKH PLQLPXIP DFFBQSYDDEXH

)LJXUH LOOXVWULRQHWWWKIQJVKPQVQVDOXQGVPLQGPKKH  
 PRGXOXV PHDQV IRBQWKBIPTXOHO DIQG DWKLB FSTOHL YDKHH OFLPLWV

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)LOO &RPSUHVVLRQ )&

7KH )LOO &RPSUHVVVQBQLGHDVE\LFXQRIG7&B\)\WQLFUFQDHOV\JHG  
 VWUHQJWK GDWDDSEBQVH\W\HVTWV IRUVDIOWIHRG U7KRQ)G&LWRBBD  
 PRGXOXV GDWD SDVVH\G\HTRXQLOADIRHJQWYOM\B7'WFRQGLWKLH (7' R  
 (7: FRQGLWLRQV (7: DPZRGXQRWGDYDLOBEQUHVXQV\IIZHGH C  
 SURYLGHG HRQWKKIGD\WWD EHFDXVH LQHDQVD REIDYB\VLW\KHLFRHZID  
 DERYH ZKLFK PHDQMLMIGD&9 WKNXPORV\HZQW HURR G\KHHUHV  
 VKRZQ 6WDWLVLVLFVQVQGDQD\K\ZQVLRHUGXWHD VQ\U7HCEOH  
 IRU WKH PRBXLQX7DEGW

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7KH )LOO 7HQVLRQ GDWD FXUHQBUFDOMJLGRQFDOLJHG VWUH  
GDWD SDVVHG HTXLYDOHQIRXWHFRQKLRVLRQRUPDOWJHG FRG  
GDWD GLG QR\Gp`0•

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8QGHU WKH DVVXPSWLRQ RI WKH P

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/DPLQD 6KRUW %HDP 6WUHQJWK 6%6

7KH 6KRUW %HDP 6VQRHQ QW K PDDWLPHGV 7KHU 6KRUW %HDP  
SDVVHG HTXLYDOHOO WWHM WFRQG LMDLRQ V(7:ERKQW KW L57Q V  
UHTXLUHG WKH XVH & R IP WWHK RGR QLR LSHGQ/G 6VQDDO LWWL EHV XOV  
WKH 6%6 GDWD DUH VKRZQ LQ 7DEOH

6KRUW %HDP 6WUHQJWK	<sup>5 7'</sup> <sub>4</sub> 6%6 X	D	O	(7:	(7:
'DWD DV PHDVXUHG				(	T X L Y
0HDQ 6WUHQJWK NVL					
6WDQGDUG 'HYLDWLRQ					
&RHILFLHQW RI 9DULDWLRQ					
0LQLPXP					
0D[LXP					
1XPEHU RI 6SHFLPHQV					
5(68/76					3\$66
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ					
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)LJXUH LOOXVWUJWDIR @WKUH@KRWK PPIYD@D@G IRLQWKH  
TXDOLILFDWDRG WDPH@FXLYDOHQF\ VDF@YD@K@FO LPLASOH  
DUH VKRZQ DV HUWRH EXD@G@W@W@ZK HD@K@V@HU FRORUHG HU  
DUH IRU WKH PRGLILHG &9 FRPSXWDWLRQV



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,Q 3ODQH 6KH DU ,36

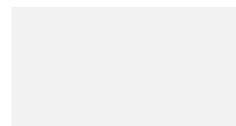
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HTXLYDOHQF\ WHV W V R R C C G L I W U R W K H I Q G & D ' L D G 5 R U W

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'DWD DV PHDVXUHG  
0HDQ 0RGXOXV 0VL @P@P@



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)LJXUH LOOXV WDDQW H K HVDKUH V, W U3H Q QW R XPH Y D Q X D Q G D R I G W  
PRGXOXV PHDQV IR B Q W K E P T S X D H D I Q G D W K L B F S T O X H L Y D K O H H O F L P L W V



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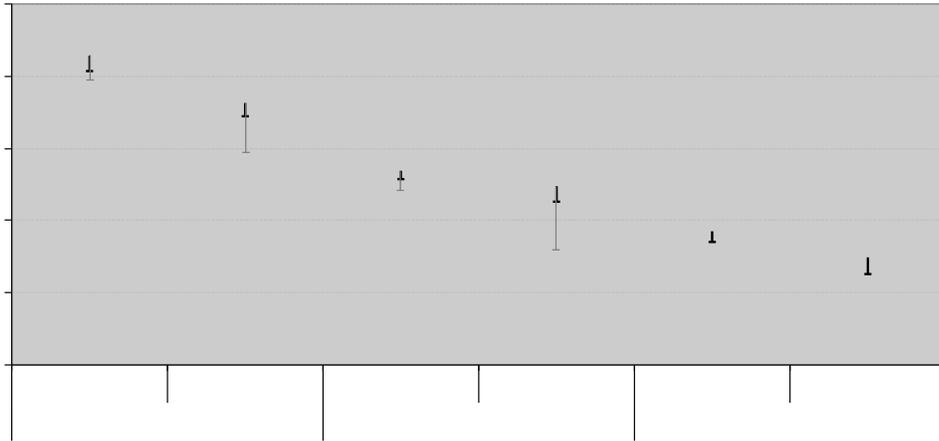
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3 ' 2SHQ +ROH &RPSUHVVLQR 2+&

7KH 2SHQ +ROH &RPSUHVVLQR QHVVLRQLGHV\LFQWVHG S QH W S H QN+RO  
&RPSUHVVLQR QRUP GOWJDSVWUHQJHWKRVDWKIQ 57 WDHQV I  
(7: FRQGLWLRQV E(XW FRQGLWLRQV H 7 KHLFLHZQW HV S Q V XPHQV  
WKH 2+& (7: VWUHQJHWKGDWHDW XHOWI RV R QFH Q R QWHL GHW B W LFV  
DQG DQDO\VLV UHVXOWV HIGJWWKGDW 2+& EDUHH VKRZQ LQ 7D

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)LJXUH LOOXVWURDWH & RVPISH HZSVILQR QVVWUQH QJLQKPPHPD Q  
 YDOXHV IRU WKH TXDODQGF DWKLR BTXD PFKOHQEP LWDVSBH  
 HTXLYDOHQF\ VDP SOHMURB H E B Z QZ DWK QW & B WTX DOKHL E B W J H  
 OLJKWHU FRORUH G HWKLR B REGLU VHDG U & 9 I R R P S X W D W L R Q V  
 lb U0Q - -5VD P 0 lb U0Q -"p p` 0 • U`-% , ap` 1 Á- ðUV ibP 6 ap



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,QWHUODPLQDU 7HQVLRQ ,/7 DQG &XUYHG %HDP 6WUHC

7KH ,QWHUODPLQDUYTHGV%RQPDQWU&XJQRUBDOWD]HGUH7QRW/7  
 VWUHQJWK GDWDDSBQVHWHVWV IRU ERWKRQGHW5ZRQQG 7KH  
 &%6 GDWD SDVVHG HTXLYDQHQ57' WRQVWHLRQ: ERWQRWLRQ  
 ORGLILHG &9 UHQXW SURZYLHG GWHBHQWK ,GDWD IURP HLWKH  
 DQG WKH &%6 GDWDQGLWWRQ 57FBRVHRWKDUEBMLRQLZQWDE  
 ZKLFK PHDQV WKDW9WKHV RQVMIZHGHBRQPRVGLHIBHMQOWIV VK  
 7KHUH ZDV LQVXIIWFLHQWUGHWQWQWQBQWVLYH 6WDWLWV  
 DQDO\VLV UHVXOWWKDU,H7VBRQ&PRUGDWD LQ 7DEOH

	4XDO	(TXLY	4XDO	(TXLY	4XDO	(TXLY	4XDO
'DWD DV PHDVXUHG							
0HDQ 6WUHQJWK NVL							
6WDQGDUG 'HYLDWLRQ							
&RHILFLHQW RI 9DULDWLRQ							
0LQLXP							
0D[LPXP							
1XPEHU RI 6SHFLPHQV							
5(68/76							
0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ							
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02' &9 5(68/76							
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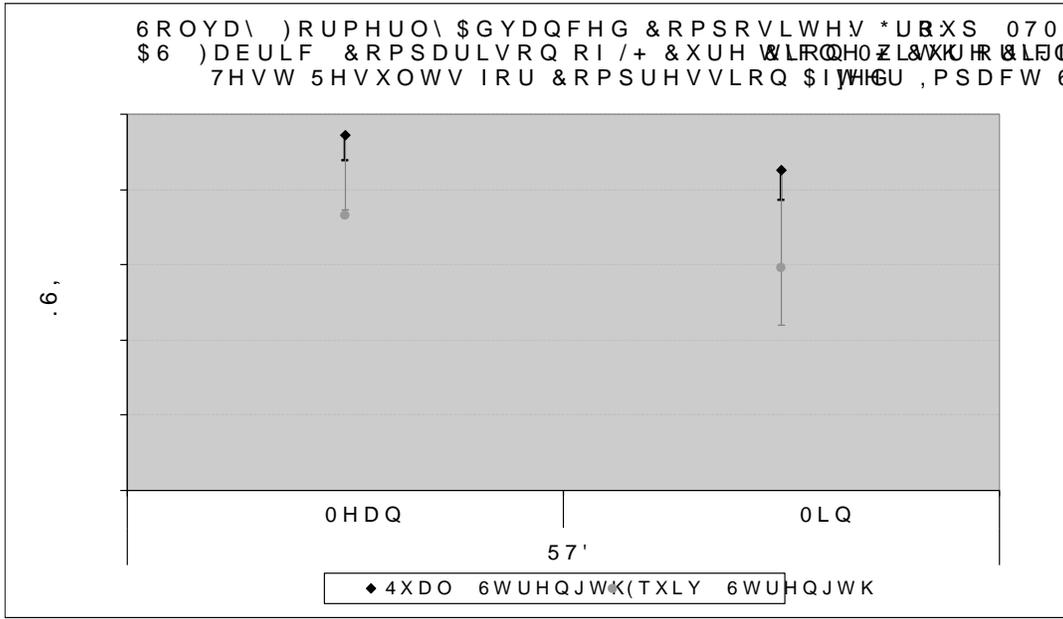
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5HY 1 &

&RPSUHVVLQR \$IWHU ,PSDFW &\$,

7KH &RPSUHVVLQR \$DWLHUQRSDWLGHDGWFNFQXUHV 7SIOH WK  
&RPSUHVVLQR \$IWHUH,PSDFWHQRWR DGDHMDX IGLDGOQRW\ SBVWVK  
57' FRQGLWLRQ 7KHUHQZDGDVQDXIRU FRQVLUHVXHQV FRQIEOXV  
6WDWLWLFV DQG DQ\$Q\WVWUHQJXKQVLDQDEOH VKRZQ

)LJXUH LOOXVWUHDWHLRQVSDHWRVPSHIDQJWDKQES PLQLPXP  
 YDOXHV IRU WKH TXDODQLG DWKLRQ TXDQFSDKHQEP LWDVSDH  
 HTXLYDOHQF\ VDP SOHMDRH EEBZQZDWKQWGBWTDKDTKLHLERWJH  
 OLJKWHU FRORUHGUHWKLRQREGLVHDSU&9IRRPSXWDWLRQV



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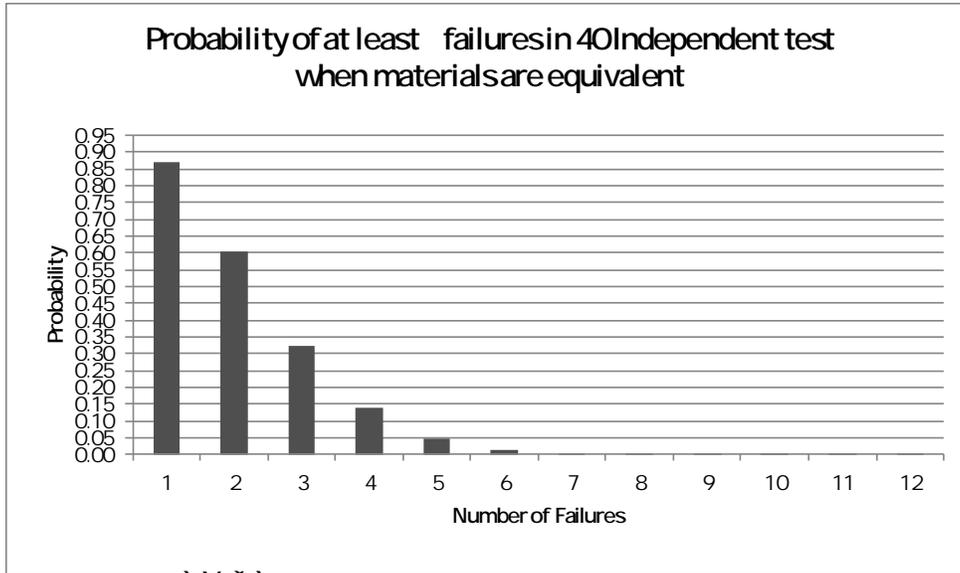
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)DLOXUHV

7KH /+ &XUH &\FOH XDEPSIOHQMDWHVW UMRQOZLWKRWKRFRPSDUL  
TXDOLILFDWLRQ PWRUHQDOWRMDQVRIWVXQ\SIHVHQW FRQGLW  
LQFOXGLQJ WKH FXUHG SO\ WKLFNQHVV FRPSDULVRQ



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)LJXUH

3UREDELOLW\