

7KH ,PSDFW RI 'LJLWDXO O HGHDDO L9WU D Q GU& R  
DWHG DUW RQ 7UDGLWLRQDO \$UW )RUPV

/DQ .RQJLQ\L <sup>®</sup> XRXKDQ /LX

&KHQJGX 8QLYHUVLW\ 6LFKXDQ &KLQD  
4XDQ]KRX 1RUPDO 8QLYHUVLW\ )XMLDQ &KLQD  
1RUWKZHVW (8QDQWURQ W8QLWHG 6WDWHV

\$EVWUDFLW SDSHU H[SORQH OXWKFH SRIRGLWDXDD UPHDQ LDWYL95 DQG FRP  
JHQHUDWHG DUW RRUWVDGLWLRQLD ODFDQ GW D QKQRLD O VPKHGLX PV KDYH  
QRW RQO\ UHGILQH O WKHVWLXONHS D D VRLW Q DEQWR RUPHG KRZ DXGLHQFH  
DUW 7KLV VWXG\ GHYHV LQWRHW O H HPSYRDXWLJ RQJ RW KHU WDLQ WQK H KLFJK  
IRUPV DUH DGDSWLQJ FRQYHUJLQDDQG GFW & H L V WOXGZHW K BQ WWRHU IGLD  
DQDO\VLV DQG FULWLFDO H[DPLQDWHIR QP SDHF OHRIR O K W WID VGH JWWID O X O  
WUDGLWLRQDO DUWV :H DOVR KILW X O H QK O L JLVHD SRDQHQ W IUDG L RUL RQQ O U  
HUD RI FUHDWLYVWLFD O SORUDWLRQ

,QWURGXFWRQ

7KH GLJLWDO UHYROXWLRQ PDUNRXZEH DGG ZKLV QHZIRXQG DFEHYVLELOL  
LWDO PHGLD DQG YLUWXDO UHDOUW HQWKYR OXWV O F W O O F V R U P V D Q Q  
WUDGLWLRQDO DUW IRUPV OLNH Q E H V R Y W K H W O F W O O F V R U P V D Q Q  
OLWHUDWXUH 7KLV WUDQVIRUPDWLRQWKH O D D V R L W Q D E Q W R R U P H G L D D Q G R  
ORJLFDQ LQWHJLQDGLRQHQWSDO NIKO H D Y H O D D V R L W Q D E Q W R R U P H G L D D Q G R  
WLF FUHDWLRQ DQG DXGLHQFH YDWH D GHGLF DWHG IRQRZLQJ 6XFFH  
ULHV EHWZHHQ GLJLWDO DQG WUDGLWLRQDO DUW EOXU KQHZ JURLO  
WLHUV RI FUHDWLYVWLWLVWV R I S D O V L Y H K R  
UL]RQV IRU H[SUHVVRQ 7KLV F R O Y H U J H Q F H L K D O O H G J H V H Y W W K D  
WDEOLVKHG QRUPV HOLFLWLQJ E D O H Y R O G X W L R Q J H O L E R W K D E R H W V W K D  
DQG SHUFHSWLRQ RI DUW ZKLO O D E O K O I 7 K H W H O S O P W I R U P V D Q V E H Q D  
G\QDPLF QDWXUH RI DUWLWLVF R O O L O H Y V D W F B P W K H Z W W W R I O D F E R I U  
> @ H Y H Q V H O O W K H W K L Z R X N K V H G E B P W O R H

FDQ XSORDG KLJK UHVROXWLRQ LPDJH  
WXUHV> @ X B O F W K B W L R Q V W R S O D W I R  
DQG VKDUH YLGHRV GRFXPHQLQJ WK  
RXZXEH DGG ZKLV QHZIRXQG DFEHYVLELOL  
DUW HQWKYR OXWV O F W O O F V R U P V D Q Q  
S L O W L O G W K H W O F W O O F V R U P V D Q Q  
R S S R U W X Q L W I R U D U W L V W V W  
YDWH D GHGLF DWHG IRQRZLQJ 6XFFH  
HQJD JHGHV \$ V W K H E R X X G Q  
Z R U G L W L R Q D O D U W E O X U K Q H Z J U R L O  
D Q G F R Y L Y H K R  
F R O Y H U J H Q F H L K D O O H G J H V H Y W W K D  
E D O H Y R O G X W L R Q J H O L E R W K D E R H W V W K D  
O D E O K O I 7 K H W H O S O P W I R U P V D Q V E H Q D  
R O O L O H Y V D W F B P W K H Z W W W R I O D F E R I U  
H Y H Q V H O O W K H W K L Z R X N K V H G E B P W O R H

'LJLWDO OHGLD V ,PSDFW XOWRIG  
7UDGLWLRQDO \$UW

7KH DGYHQW RI GLJLWDO PHGLD D SXODLQJ > @ O L N H F R O Y H U J H Q F H L K D O O H G J H V H Y W W K D  
<RX7XEH DQG YDULRXV RQOLQHJUDQO H U Q W H O N F X W X O J S G R L S H W \ D C  
WUDQVIRUPDWLRQDGLRQHQWSDO NIKO H D Y H O D D V R L W Q D E Q W R R U P H G L D D Q G R  
IRUPV KDYH EHFRPH LQVWUXPHQW O L R S D F W K B I S G Q J L W W O Z H G L D S O D V  
DUWLWVW VKDUH WKHLU ZRUN Z X V O D U K W V Z R V S I C H L R X Q G S U H W K H H F R W W G R  
VWULNLQJ WUDQVIRUPDWLRQV I R U W D U H W L F P H V G W R F V C R Z F D V O R E D K O  
UHDFK WKDW DUW W K H V L Q R I Z Q K B W L V S H Y D E W Z L W K K W K Y H U H F R V Q D Q G R O D  
7UDGLWLRQDO O D U W L R Q D O D Y H K O L W G D R O I S K W L P X V W J U D S S O H Z L W K W  
FDO JDOOHULHV DQG H[KLELWL W O R Q W I R Q W K I Z F O L J H W D O H V S K Z R U N Z K L O H  
OLPLWLQJ WKHLU DXGLHQFH WR W K H R O M L Z K R V F R K O V K I S K U V D E W O O W D F W H Q G  
WHQG +RZHYHU G I L J L W V W K H P H U G M D R I U W L V W V F D Q  
QRZ WUDQVFHQG JHRJUDSKLFDQ ERXQGDULHV PDNLQJ WKHLU  
DUWZRUN LQVWUXPHQW O D U W L R Q D O D Y H K O L W G D R O I S K W L P X V W J U D S S O H Z L W K W

+RZHYHU WKHVH GLJLWDO DYHQXHV  
FKDOOHQJHV 7KH YDVWQHVV RI WKH G  
FRQWHQW ODLQWDLQLQJ D GLVWLQFWL  
LJDWLQJ WKURXJK WKH QRLVH RI WKH  
G S X O D L Q J > @ O L N H F R O Y H U J H Q F H L K D O O H G J H V H Y W W K D  
O L R S D F W K B I S G Q J L W W O Z H G L D S O D V  
S I C H L R X Q G S U H W K H H F R W W G R  
C R Z F D V O R E D K O  
I S K W L P X V W J U D S S O H Z L W K W  
F O L J H W D O H V S K Z R U N Z K L O H  
F R K O V K I S K U V D E W O O W D F W H Q G  
R I U W L V W V F D Q  
P D N L Q J W K H L U  
O L H Q F H 7KH\



WKH GDWD LV ELDVHG \$, JHQHUVDFXKOS WRUW V LYJKWL RQ USCHGV FDMV HWHV[P DQ  
LVWLQJ VWHUHRW\SHV DQG QDUVRXZQGHIS QHJVCHQWUDWLRG WWHFKQRORJLVV  
,Q FRQFOXVLRQ WKH DVFHQWHRUW\$WKH V Q E F Z H F U N C G W R R S E U R Q W R U X Q G V  
UHVKDSLQJ QRW RQO\ KRZ DUW WKH PDGH H E X P H Q Q V R Z R O O X Q Q H W D F W Z L  
VWDQGLQJ RI FUHDWLYLW\ DQG V D E X L S W X L F H H [ S R U H V L Q R Q D Q F H D V F X O S  
7KH &RQYHUJHQFH RI L J L W D O D Q G S O H L Q L W V Y L F L Q L W \ 6 R P H L Q V W D O O D  
7UDGLWLRQDO \$UW I D F W R U V V X F K D V O L J K W R U W H P S H U D  
7KH KDUPRQLRXV FRH[LVWHQFH R O G L U R O P D O D Q G W U D G L W R R Q D O D F U W  
UHSUHVHQWV D W K W K O Z R Q O G R Q F L E H D V L Q W H W U D E F W L Y H V F X O S W X U H V  
\$UWLWV DUH LQFUHDVLRQO\ H I S O R U L O U W K H S R V L E H Q W H H Y R I  
FRPELQLQJ WKHVH WZR VHHPLQJ O J K H D X G L G E W U H D O P Y W R I R U J H  
QHZ DQG LPPHUVLYH H[SHULHQFH S O R U D W L R Q D Q G S D U W L F L S D W L R Q W X  
\$XJPHQWHG 5HDOLW\ LQ 7UDGLWLRQDO H E R O H E J Q D W X U D O Q R L V H V  
7KH IXVLRQ RI \$XJPHQWHG 5HDOLW\ S W R Z L W K H W U D G L W R R Q D O D F U W R I W K  
SDLQWLQJ LV D JURXQGEUHDNLQX Q G Y H O G S I R H P W R \$ Q W K H Z D W H Q X H V  
ZRUOG RIIHULQJ DQ LQQRYDWL D Q Z D D W R D W K Y D W F H O R P P L X U H Z D W H V D Q G  
HU V H[SHULHQFH R Z K L W U D G L W R R Q D O D F U W R I W K H W U D G L Q Q H Q S R F W M G Z  
FHQG LWV VWDWLF QDWXUH EULQJLQJ D G I Q D P L F D Q G L Q W H U D F W L Y H  
GLPHQVLRQ WR SDLQWLQJV )R U H I D P S O H L P D J L Q H D F O D V V L F  
ODQGVFDSH SDLQWLQJ ZKHUH W K U R X J K \$ 5 W H F K Q R O R J \ W K H L T X H V  
GHSLFWHG VFHQH FKDQJHV IURP G D \ W R O L J K W R U Z K H U H K I G  
GHQ VWRULHV D Q G G H W D L O W K H U H I H Z H W E R U D W L R Q R I G L J L W D O W H F K  
DURXQG WKH FDQYDV 7KHVH \$ 5 W H F K Q R O R J \ W K H L T X H V D L Q G H  
WKURXJK VRSKLWLF W H G R J R I M D E F W K H D S K R O W R I F K D O O H Q J H V W K D W  
LQJ DQG RYHUODIV GLJLWDO D Q P D W H F O V R O G R P S O H L L V Q L W H R D Q G F U L  
UHDQ WLPH YLVLEOH WKURXJK V P D W S K G Z H W K W K H J O S D F W R I G L J L V  
7KLV WWHFKQRORJ\ QRW RQO\ U H Y R O X W P R Q L F X O D W K H I R F X V D R O L V V X H V  
LV FRQVXPHG EXW DOVR KRZ LW W L F F W D Q G L F H Y O D W K H I R F X V D R O L V V X H V  
WKH RSSRUWXQLW\ WR WKLQN EHRQG WKH SKIVLFDQ FDQYDV  
FRQVLGHULQJ KRZ GLJLWDO HOHPHQW S W I F D Q D X J P H O H Q J W H L U  
ZRUN 7KH SURFHVV RIWHQ LQYROYHV FORVH FROODERUDWLRQ EH  
WZHHQ WUDGLWLRQDO D U F L H D W R K H O S U R I X L O G L P S D F W R I G L J L W D O W  
VNLOOV IURP ERWK GLVFLSOLQHV Z R U Q G K P R O X E R U H W L R Q D Q I S I D G R I X Q  
DUWLWVLF ERXQGDLEMHSDORZ B O O R U D F L H V R L E L O L W \ + R Z H Y H U W K L V  
WKHPHV DQG Q D W U D O F I H Y H D Q D R U M L Q W F P R U W K D Y D O V R V X U J H G D J D L Q V  
DWH D SDLQWLQJ WKDW ZKHQ Y H O Z H G W K F R O O H O H Y \$ 5 W H W K K H D U W  
UHYHDOV D K L G L H Q W R D U L R D W D O F P H G W R Q F H W X H R I L Q W H O O H F W X D O S  
WKDW FRPSOHPHQW WKH SKIVLFDQ D W K L Z R G N J L K D O D Q W H W F W H L R Q H Z L  
EHWZHHQ WKH W D L W D O L H Q D Q G H W H E Y H F Q L Q K P U B L V H S P L Q D W H H D D Q G R  
D PRUH HQJDJLQYH D Q G S H R P H O F H V X E Y P D Q W I D O F R S I U L J K W F R Q F H U Q V  
LQJ WKHP WR H[SORUH PXOWLS O K H O L H W F I H M Z H O L Q W K H W R U L Q L Q D O D  
WKH DUWZRUN D F R P S O H [ Z H E R I L Q W H O O H F W X D O S U F  
WRUV DQG ULJKW KROGHUV JUDSSOH  
,QWHUDFWLYH 6RXQG ,QWSDOPDWLRQ DUH Q W S O L P D W L R Q D U H F R Q V W D Q W O \ W H V W  
6FXOSWXUH U H S O L P D W L R Q D U H F R Q V W D Q W O \ W H V W  
7KH HPHUJHQFHWR11 G L J L W R Q I X Q J L E C  
7KH LQWHJUDWLRQ RI LQWHUDEWLYH D Q G E O R F N E K D L O W H F K Q R O R J \  
VFXOSWXUH UHSUHVHQWV DQRWKHU H L F W L W R E R S V U H L J W F E K D O O H Q J H  
WUDGLWLRQDO DQG GLJLWDO DUW R U P D S H L W L Q D Y S U R H U B K D W V W L E X W H  
HPEHGGLQJ GLJLWDO VHQRUV D Q G K P R X Q G S U R G X G L O D W H G X Q D X W K R U  
ZLWKLQ VFXOSWXUH HQDEOLQW W K Q V P W P H U Y S R Q L G R W R W K R S Y R O G V V  
HQFH PRYHPHQW RU HYHQ WRXQDQGRZ WKRUW B X K W L O D W D O H Q I R U F H G  
ODWLRQV WUDQVIRUP VFXOSWXUH W H F K O R P R W H D O D Q G S W D W L R O W R R G I  
QDPLF LQWHUDFWLYH H[SHULHQFH T R D G G U H V Q J W K H W H V H F W R U F R S I U L  
HQJDJHPHQW ZLWK DUW P X V W H Y R O Y H W R D O L J Q Z L W K W K H G L  
7KH SURFHVV RVHFLQDWWIDODWWR PDQGV D G H O L F D W H E D O D Q F H E H W Z H H Q  
TXLUHV D PXOWLGLVFLSOLQDU\ DSSURDFK FRPELQLQJ WKH

WXDO SURSHUW\ ULJKWV DQG QXU & ROLFO XWLRQ SLULW RI DUWLVLWLF  
IUHHGRP DQG FROODERUDWLRQ ,W LQYROYHV UHGHLQLQJ ZKDW  
FRQVWLWXWHV IDLU XVH IDLU 7KH DQG QH QW D RG WKHD GVLJLWDFDQV DYH KDV  
ZRUNV LQ D ODQGVFDSH ZKHUH VLEJLW DOWW R ROW UDQG ISO D P W L R P W L Q  
RIIHU QHZ PHDQV RI FUHDWLYH H[SODJH VFLRWDLQ LQGLYLGXDOV PD\ H[S  
,Q WKLV VKLWLQJ SDUDGLJP SRVCHODVLRQ WURGLBWRV WLVFWKFRU  
LVWV OHJDO H[SHUW WHFKQRORJLW LDOQ W RDWRFRUJ Q D HG WSKROV FKHVH  
PDNHUV LV HVVHQWDO )LQGLQWHWIKHQ W L ZIKWK HLTQQ D Y E W L X P F H U H D W L Y  
WZHHQ IRVWHULQJ FUHDWLYLWV DQG JUHEHSHZFWLQ JG L Q L W D O O I F I G X D O Y I  
SURSHUW\ LV WKH NH\ WR QDY S X D W L L Q J H W K I H D F R I S G U D U K W K F K V D Q M H F V  
OHQJHV LQ WKH GLJLWDO WUDQW R K U P Q W R Q Q R O D U W I H S J H Z H I U H W D Q S H U V  
DW WKH LQWHUVHFWRQ RI DUW D X G Q G W H F K E X R O R D V D W K H R W L E K D L F D Q  
OHQJHV ZLOO FRQLQXH WR VKDSH R W K H W D Q G V F D S H R I F U H D W L Y L H  
H[SHUHVLRQ DQG RZQHUVKLS LQ W R H F R O F O X W L R R R H W LV S D U D P R X Q W  
SRUWDQFH RI H P L E W D G L Q U D W Z K I L G H J F R C  
\$XWKHQ W G F L H S U R G X F L E L O L W I V D I H J X D U G L Q J W K H L Q W U L Q V L F H V V H Q  
H[LVWHQFH RI WKHVH WZR SDUDGLJPV  
,Q WKH GLJLWDO HUD WKH YHU W R R W R R R I D U W L V W H F L I S A R Z I D W L R Q I  
WKH UHDOPI DUW LV XQGHUJRLV W U H D S W K Y R R Q F R W K W U D G L W R Q D O D  
7UDGLWLRQDO DUW IRUPV KDYH H P E R D U N E H Q Q H Z H U D R H B U D G L W L F L  
SULJHG IRU WKHLU LQKHUHQW X O L E R Y K K P D U B R T X D P X L W R Q G K H F L W L W Q  
WKHP DSDUW DV RULJLQDO FUHDWLRQV +RZHYHU ZLWK WKH DG  
YHQW RI GLJLWDO PHGLD WKH 5 F R Y Q G D U F H V R I D X W K H Q W L F L W I  
KDYH H[SDQGHG DQG LQ VRPH FDVHV EOXUHG  
'LJLWDO WHFKQRORJLWV R D W L N W S R Z H R U F L K D W H S H U I H E V A R P D X Q G L F J L W I D R Q I H D V  
UHSURGXFWRQV RI WKHLU RZQ ZRURV R E D W K H Z B U N L U R X B W K H U V H Q W H  
7KH OHYHO RI SUHFLVLRQ DQG ILG H P L X Q W K D W L R Q J W W Q R U N G L D R I  
IHUV LV WUXO\ UHPDUNDEOH RIWHQ BBNLQJ LW G L U E X O W W R G L Y  
WLQJXLVK EHWZHHN D O O B U L J L Q D W S O O T U H S U R  
GXFHG RQH 7KLV LQ WXUQ UDLV H V L Q W L F D S W H F W L X H V W L R Q V D E R X W S Y  
WKH IXQGDPHQWDO YDOXH RI WUDGLWLRQDO DUW R H V W K H L Q W U L O  
VLF ZRUWK RI DQ DUWZRUN UHVLGH V R O N H L L W D O R H G L D S U W & U H D V  
FDQ D SHUIHFWO\ UHSOLFDFWHG G L J L W D O Y H U V L R Q P D S W L X U H W K K U H V ) X  
VHQFH DQG VLJQLILFDQFH RI WKH R U L J L Q D W R Q V D Q G O R E L O H & R P S X W L  
\$UW FROOHFWRUV DQG FRQQRLV V H Q U V & Q R Z I L Q G W K H P O O H Q W Y L U W  
JUDSSOLQJ ZLWK WKHVH GLOHPPD W K H K W H P R K W Q Q D R Y L D D W H F W K D W L R Q D  
HYROYLQJ ODQGVFDSH RI DXWKHQWLYH W L V L Q G H V Y D O R X U Q D O R W L Q W H Q  
ZKHUH WUDGLWLRQDO DQG GLJLWDO ZRUOGV LQWHUVHFV 'HWHUPLQ  
LQJ WKH SURYHQDQFH DQG OHJLWLPDFR RI Q G L Q W D Q D L D Q G G K H Q 7KH  
WDOO\ LQIOXHQFHG ZRUNV EHFRRPHV R I F S W O H Q W Q G H W R H F R Q W H I W  
)DFWRUV VXFK DV DQ DUWLWV V L W L R Q W E W K H R P S O H W H W S U L W H Q G F L Q  
WLRQV DQG WKH SUHVHQFH RI D X D O L Y D W V L Y Q G W Q H E D O H S O A P S O H  
UROH LQ DVFULELQJ YDOXH WR W K L W H Z H O L V L Q X W H S U P R U H W K H  
UHGHLQLWLRQ RI DXWKHQWLFWLW\ S U R P S W V G L V F X V V L R Q V R Q W K H  
UROH RI WKH YLHZHU RU FROOHFWRUV W K H U D D W W L E X W L Q J P H D Q 5 E D W H G  
DQ DUWZRUN 7KH HPRWLRQDO D Q G H O W H O O H F L X D O F H Q G H F W L R J L F  
WKDW LQGLYLGXDOV HVWDEOLVK E P S X W L V L V D X Y E M F F W K H Q W Q G L W  
FDQ EH GHHSO\ SHUVRQDO )RU VRPH W K H H X W D O R F O L S W H B E W K H  
H[SHULHQFH LV QRW VROHO\ FRQLQJHQW R O W K H F U L S W H B E W K H H G L  
WKH SLHFH EXW L Q W K H O G W Z R W K Q D H W K H L U R Z Q S U L Q J H U ' Q W H U Q D W L R Q D  
OLYHV -H D Q % D S W L V W H 2 O L Y L D \$ X J P H Q W  
,Q WKLV HYROYLQJ ODQGVFDSH D W K H D O H Z Z R U G L H U B E F H J D O S U I  
ZLWK ERWK FKDOOHQJHV DQG RSS W U W D L E W L H Q W 7 P B G L Y L H Z D O D U W  
IRUPV URRWHG LQ PDWHULDOLW\ O R Q G L S K W L F O D E \ S U Z H O H F H D U G L Q J ' L J  
UHHYDOXDWHG LQ WKH FRQWH[W R S R X G O J L G W D I O & R P S W K L R Q W K R U W K H V 3 R Q  
UHSOLFDFWLRQ D Q G D E F H S D E B L Z K L W D Q G W R F I X O S Q V X U H  
FHSW RI DXWKHQWLFWLW\ FRQLQJXHV WR WUDQVIRUP GULYHQ E\ WKH  
LQWHUSOD\ EHWZHHQ WUDGLWLRQDO DQG GLJLWDO PHGLXPV DQG  
VKDSHG E\ WKH SHUFHSWLRQV DQG YDOXH RI DUWLWV FROOHF  
WRUV DQG DXGLHQFHV DOLNH