

# &RQQRWDWLRQ 'LPHQVLRQV DQG 6FDOH 'HY LQ WKH &KLQHVH &RQWH[W

/L+XDQJ<sup>D</sup>5XL<sup>E</sup>+DQG -LQJ ;LDR

<XQQDQ 8QLYHUV\ (RRQRDQVH. DQPLQD <XQQDQ &K  
6RXWKZHVW 3HWURDQVH DQGXHGLFKXDQ &KLQD

\$EVWUDFW 3V\FKRORJ\ RI :RUNLQJ 7KHRYHU 3.7 HISSODQV WKH  
WKHRUL\ ZKLFK ZRUN YROLWLRQ LV ND RHQWUDDO FHRDXXUHXPHQ W7 MRRURD LV  
XQLYHUVLW\ VWXGHQWV ZRUN YRODQV IGHOS WZK RF KU HMM DWLFL W% DW KIG ERU  
IURP FROOHJH VWXGHQWV QDWIRROZEXOW WUKDQ YDQGGHMS ORR VHG WSK  
H[SORUDWRU\ IDFWRU DQDO\VLV DQBDFRQIHLRPHQWRUADIDHF VRR LZ RDND ORV  
GHYHORSHG LQYRQVQRIWZROIGWERIQZLVK DRQWRWUDDQ QRMVIRXUWHHQ LV  
RSHQV XS QHZ SHUN SYRFOV WMLRQI BHWZHUOLFKW HLUULXKHVRQ FDUHHUV JXL  
DQG SURYLGHV DGHHQV WLRYPHOPIRDUV XQERQV FXRQDOW JURRWN DGRQL WLRQ

,1752'8&7,21

7KH 3V\FKRORJ\ RI :RUNLQJ 7KHRYHU 3.7 HISSODQV WKH  
ZRUN H[SHULHQFHV RI DOO LQGLYLGXDOV (XQGHUHUDDQVH DQVWLVQD DDUH  
SHRSOH ZKR DUH QHDU RU DUH GLYRWK WHPGLWRRQDQ FROOHE  
IDFH GLVFULPLQDWLRQ DQG PDUJLQDQV RQ HFRQRPLF ELUFXP  
7KHVH SDUWLFXODU LQGLYLGXDOV IDFHFKDOHQD JROJ ZRUN EDVH  
WUDQVLWLRQV IRU ZKLFK FRQWHLWXDQ IDFWXGHQWV DUH RLVHQ  
SULPDU\ GULYHUV RI WKH DELOLW\ WRFWVWUHQFHV FHWZRU  
YROLWLRQ LV JDRQLQRP RUHVH DDUVH DQVWLVQD DDUH  
DNH\ FRQVWUXFW ZLWKLQ WKH 3FURDQV RQVWUDDO FHRDXXUHXPHQ  
LQGLYLGXDO V SHUFHSWLRQ RI FQRPLF LQ &KLQHVH DQVWLVQD  
PDNLQJ GHVSLWH +RZYMUDQVH HPSOR\ DQVWLVQD DDUH  
UHVHDUFKHV RQ UNKXHQV DQVWLVQD ZRUN DQVWLVQD DDUH  
1RUWK \$PHULFDQ ZKRXQVWUHQFHV LQGLYLGXDOV DQVWLVQD  
IUHHGRP DUH VSHFLILFDOO\ HPSKDVH DQVWLVQD DDUH  
,Q FRQWUDV ZLWK WKH :HVW &KLQHVH DQVWLVQD DDUH  
FROOHFWLYLVW FXOWXUH DQG KLFK DQVWLVQD DDUH DQVWLVQD  
FRQWURO WKXV WKH VWDQGDUG WRFWVWUHQFHV DQVWLVQD DDUH  
,Q WKH SDVW XQGHU WKH SODQV HFRQRPLF VHWURDQVWLVQD  
JRYHUQPHQW DOORFDWHG DQG DUUDQJH LQVWURUJLQV DQVWLVQD  
8QGHU WKLV V\WHP LQGLYLGXDOV WRFWVWUHQFHV DQVWLVQD  
ZHUH FRPSOHWHO\ PLVVLQJ 1RZ DQVWLVQD DDUH DQVWLVQD  
HFRQRP\ V\WHP WKH VWDWH VHWURDQVWLVQD DDUH DQVWLVQD  
EHJXQ WR ZHDNHQ DQG SHRSOHV DQVWLVQD DDUH DQVWLVQD  
WUDGLWLRQDO GHSHQGHQFH DQG GHUJLQDQVWLVQD DDUH DQVWLVQD  
HPSOR\PHQW DUUDQJHPHQWV WRFWVWUHQFHV DQVWLVQD DDUH  
DUH PRUH DGDSWHG WR PDUNHWV DQVWLVQD DDUH DQVWLVQD  
IDFW WKW LQGLYLGXDO FDUHHU DQVWLVQD DDUH DQVWLVQD  
GLIIHUHQW IURP WKH :HVW LQ WHU DQVWLVQD DDUH DQVWLVQD

o<sup>3</sup>

<sup>D</sup>+XDQJOL # FRP  
<sup>E</sup>KHUXL # FRP  
&RUHVSRQGLQJ DXWKRU [MQG[M# FRP

VFDH LV UHODWLYHO\ LQVXILFLH QVR OZKHFCV MRQV WUHRF HZG WVKH RDVQGH B D F  
FXOWXUDO >EDFNJURXQGV

7KHRU\

7KH 3V\FKRORJ\ RI :RUNLQJ 7KHRU\ Q

7KH 3V\FKRORJ\ RI :RUNLQJ 7KHRU\ Q 3DUWLFLSDQWV LQ VDP SOH ZHUH  
IRUPXODWHG DVH DLO WLVQH QVLFDO WRQDO WFRPHV LHV RP ORFDO FROOHJ  
GUDZLQJ IURP WKH ILHOGV RI YRFDVLRQDO GHQWK RHO\ WKHPVHO  
PXOWLFXOWXUDO SV\FKRORJ\ &KWADV FHW QV DQV WFWWDYRQJ RWK &KLQ  
VRFLRORJ\ R, I, WZ R, I, S K D V L J H V W K H Z S U M F H U Q D Q G F R I Q W U D O V D Q S P & K L Q  
VRFLRFXOWXUDSLQDQDFWIRHU V D L Q H M K D F K W F H U V H G W L R Q - X Q L R U V V W X G H C  
ZRUN H[SHULHQFHV RI LQGLYLGXDO V S O H V S H F L D O D Q G W K R V H Q R P Z H U H  
GLVDGYDQWDJHG DQG PDUJLQDO L H Q P R P R Q S D M W L F S S D M W S O O V  
FRQFHSW ZLWKLQ WKH 3:7 LV ZRUDS O Y R V Z W U R Q V S O K W F K Q L K D O I E I U D Q  
EHOLHYHG WR EH LQIOXHQFHGV E R S W H Q Z H U H X W H G X F W X U S O R U D W R U  
HQYLURQPHQWDO DQG SHUVRQDO W K E H U K D Q U Z H W K D W H S U R U P R U Q I L U P I  
SUHYDOHQW D P R Q F L Q Q G I F R I Q X P L Q V K D U G V K L S R U  
PDUJLQDO L Q D W Z I R Q H U L W L V D O V R Y L H Z H G D V D Q G ' L V F X V V L R Q  
DGMXVWDEOH DWLWXGLQDO YDULDEOH , Q G L Y L G X D O V Z L W K K E J K Z R U  
YROLWLRQ DUH OLNHO\ WR IHHO OHVV UHVWULFWHG DQG DUH PRUH  
LQFOLQHG WR VHOHFW D FDUHHU W K R W Y D O L Q D W L R Q K R W K : 6 B U 6 Q D H P R Q  
LQWHUHVW DQG YDOXH 2 Q Q G K H J B W G X D U W K D W Q G H W K R V H Z L W K  
ZRUN YROLWLRQ WHQG WR SHUFHLYH PRUH FRQWUDLQW DQG WKHLU  
FDUHHU FKRLFHV DUH RIWHQ L Q Q E H Q F K G E U N D P R O L W L R Q F G E Q R W X  
VRFLDO FODVV HWKQLFLW\ SK\VLDO G & K B E H O H W X S V L R R O R J E F O E  
EDUULHUV VH[XDO RULHQWDWLRQ 7 K H V W D W Q L G J H O H W L S R Q H U W Z O H  
UHVRXUFH@VFDUFLW\ RI WKH TXHVWLRQQDLUHV FRQGXFW  
DQDO\VLV DQG WKH RWKHU KDOI SHUI  
DQDO\VLV

0HWKRG

&RQWH[W

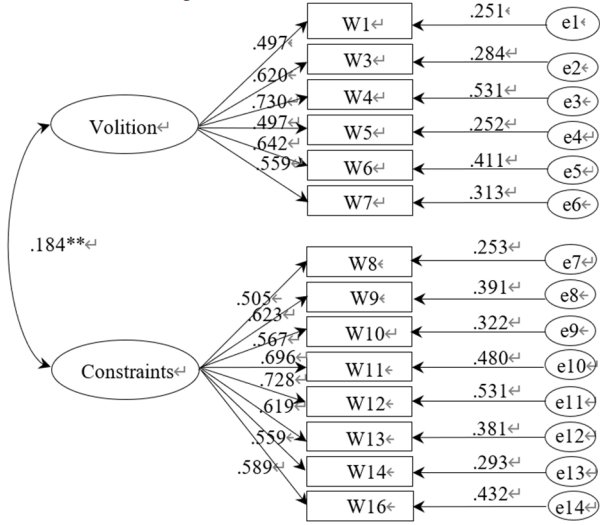
7KH H[SORUDWRU\ IDFWRU DQDO\VLV  
UXQQQLQJ 6366 VWDWLWVLFDO VR  
FRPSRQHQW DQDO\VLV W R G W M R G H [ W U D  
FRPPRQ IDFWRU ZLWKLQ DLWHQ W D O X G  
, Q FROODERUDWLRQ ZLWK IDFXOW\ P D P P E H U T X G O W E U Z R J D W K H U P G W K  
IURP YDULRXV &KLQHVH XQLYHUV\ R U W K R V R Q Q W R W S O L R Q Z L W K W K H I  
EDVHG RQ D FRPELQDWLRQ RI F O X Q W K H U D Q R P Q B D S O L C H D E D W L W I K R O G  
FRQYHQLHQFH VDPSOLQJ WDNLQJ W K D W V D P F R X Q M W D E L R G V W X R K I D F W R  
WKH WISH RI LQVWLWXWLRQ X Q L R W D W L R Q H V 7 K L F R P R B Q D Q G H U R W K H  
OLQLVWU\ RI (GXFDWLRQ YHUVXU D W F H D O V K R Q L Y H U D Q G W L M K H L W H P V :  
JHRJUDSKLFDO ORFDWLRQ F H Q R D O V L Q E R W K Q C I L R P R M R Q H H F H H G  
UHJLRQV DQG WKH SRWHQWLDG K H U R U H J K K H D L M H P : V E D V L P L Q D  
DFTXLVLWLRQ 7KLV VWXG\ SRVLW\ D E W O L D W M R Q E K B R V G D W H R L R U D Q G O H J  
VWXGHQWV DUH PRVW FRQFHUQHG W E R K W V W K A L F K R R X U H Q F D D H M U E  
GHYHORSPHQW 7KHUHIRUH WKH G H O J U R X S V W Z H U H W K Q V S U D P U V K R Z Q  
IRFXV RI WKH VXUYH\ VDP SOH

7DESDQDO\VLV RI WKH W\SGHIO&RQJ:RUJN69ROLWLRQ 1			
,WHPV	FRPPRQ	IDFWRU	ORDG
: , ZLOO EH DEOHL M, RZIDQDQ VHR MREV		IDFWRU	IDFWRU
: 2QFH , HQWHU WKH ZRUN ZRUOG ZDZLQ D O V R D V L O \ I L Q G D Q H Z M R E L I			
: , ZLOO EH D E O H V W R K I F W R , R Z I D Q W			
: , ZLOO OHDUQ R Z Q I D R W L Q G Z R U O G R I Z R U N			
: , IHHO WRWDO IFRQVWURROR EYHHU P			
: , ZLOO EH DEORIVR LGR , V Z H Q W W G S Q G E V S L W H H [			
: :KDW , ZDQW S B W G R O W W K E H F K R L F H			
: , Q RUGHU WR SURYLGH IRU P\ IDPRQ RWZLOO KDYH WR WDNH MREV			

:	'XH WR GLVFU	QFLW D W H L B R S K O D V R I O F F R Y Q W U P \		
:	'XH WR P \ ILQD Q F R D Q H L W K D W I E R D Q E J H	F R X E O G Q \ W		
:	, IHHO WKDW P \ IDPLO \ VLWX D W L R Q	OLPLWV WKH W \ SHV RI MREV ,		
:	, ZRUU \ WKDW P \ OLIH FLUFXP W L D Q E R V	Z L O O S U H Y H Q W P H I U R P D F		
:	'XH W R L Q D Q F L D O V L W X D W L R Q E ,	Z D Q D I Q Q G G W R W D N H D Q		
:	\$ , NQRZ , ZRQ \ W D R E H E P \ W X W X D H O O R E H P H P S R V V L E			
	WR ILQG D Q H Z R Q H			
	H J H Q Y D O X H			
	7 R W D O Y D O D D W H B Q H [			

1RWH 5HSUHVHVRUL QK S URFEYCHUHZQH SUHREHJHVP ZDFR WHKYHHJMSOGR B B WRR U \ ID  
 DQDO \ VLV DQG W K W D W E W H V L F H D O D Q D O \ VLV

7KH IDFWRUV DUH QDPHG DFFRVLQZDWR WKH &FRPSDQWLQ (LW GHVFULEHG LQ WKH LWHP )DFWRU KH SURSRGWHFH QPRGHOO PDRQD \ PRGHO UHIOHFWV WKH GHJUHH RI YROLWDRQ DEODW WRHEK QLYRULWLHQ DIWHG V \$ WKH FDUHHU VHDZKHW S B FLW LV DQEGH @ W B CHQJ D J W H D W H U W K D Q U H LQ ZRUN WKDW WXLWK HUKH R W H L Q W R Q L N Q D P H K G D V R R W O H D Q 6 T X D U H ( U U 3 Y R O L W L R Q ' 6 S H F L I L F D O O \ L W L G B O ( S G H Y D O X D W H H V V R K H G H J U H H W R : : : D Q G : L Q W K H P R G B O H Z R X O D F M W U S R S X O D W L R Q F R Y G L P H Q V L R Q P D L Q O \ U H I O H F W W R B W Y B D O R S D U D F M W H L D F Y L U R Q D P D O H V 7 D E F R Q V W U D L Q W V L Q F O X G L Q J V R F L O G ) G L H F O L Q P R W B W L R Q W 5 D F ( L S O Y D O X H F R Q G L W L R Q V H W F W K D W F R O O H R R G V M X G Z C W O H S Y D O F X I H V H U L Q D W D W H W V H H N L Q J V R L W L V Q D P H G D V 3 F R Q X W D L Q W W K H 6 S H F W H H F D O O H G L W K D L Q F O X G H V H L J K W L W H P V R I : : H I S H F W H G I D F W R U D Q G Z H U H F R Q V : D Q G : L Q W K H V F D O H V W U X F W X U H R I J W K H F R G B O I L W L C \$ & R Q I L U P D W R U \ I D F W R U D Q D O 5 0 6 ( \$ & ) \$ & L W K P D Q Q P D W L Q J D J R R G O L N H O L K R R G H V W L P D W L R Q 0 / Z D V F R Q G F W H G X V L Q J \$ 0 2 6



)LJ & )\$ RI FROOHJHZRWXGFRQV WLRQ VFDQH  
 \$ GI 506(\$ \$\*), , ) & 1), 11),

7KH FRUHHODWLWQ F E D W Z H M Q H W K P H Q H V R Q W L W R I W K H W H V W U H W H V W E H W Z H H Q D Q G L Q G L F D W E H I R W K D V Q G V H O H W K R U P R U K H Q H L Q M H U Y D O Z Z L W K L Q W K H W Z R I D F W R U V L V E H W Q H F D W Q G J W K K D W F W O H K B O C E H W W H W Y D O L G L W \ 7 K H U H O L D E L O L W \ R I Z R U N R R R G O W W O R D E L V O D W H L Q G L F D W H V W K D W W K H L Q W H U Q D O F R Q V L V W H Q F \ U H O L D E L O L W \ F R H I I L F L H Q W R I W G L P H Q V L R Q L V E H W Z H H Q D Q G I V E X D Y L R Q F R Q V L V W H Q F \ U H O L D E L O L W \ F R H I I L F L H Q W R I W K H W R W D O V F D O H L V E R W K K L J K H U W K D Q W K H M X G J P H Q W F U L W H U L Z R L F K L V Z D W K G K R Q K V X U U H O L D E L Q L W G G L W L R Q F R O O H R R O Y H X G W O V Y Z W H D F U R V V W K H F R V X U Y H I H G E \ Z R U N Y R O L W L R Q T X H Y W R Q D D L S Z K F E L O W R Q P H K H : L Q P D U N H W L Q J P D Q D J H P H Q W D Q G H X P D Q P H Q W X W E D O R Q D Q X H U H S O R U D F O D V V H V D W < X Q Q D Q 8 Q L Y H U V L W R Q I L U P D W R U D Q K W R U D Q D O F R S U L Y

GLPHQVLRQV YROLWLRQ DQG FRQVWXUJDLQSVV D'QBPIHUF OOXSHV 3H WURW D  
RI IRXUWHHQ LWHPV 7KH VWXG\ QRW RQR URU HHU & IUHVK LQVZKH WFR QV  
LQWR ZRUN YROLWLRQ UHVHDFK EXW LQVLDQ FRYDOLGDEWLRQV RW RWWKH REUR  
RI OLWHUDWXUHFRQ)XDWKHUPJXUIGDHW SRUFDWLRQDO %HKDYLRU  
D YDOXDEOH WRRO IRU IXWXUH UHVHDFK LQWR WKH %ZRUN YROLWLRQ  
RI FROOHJH VWXGHQWV ([WHUQDO LQIONHQ FGHVYHOD RSKPH QDW  
7KH FDUHHU GBUWMOHRSRHW TX

/LPLWDWLRQV DQG IXWXUH UHVHDFK DYDV \$ 'XII\ 5 '  
3 ([SORULQJ OLQNV EHWZHHQ

,W LV LPSRUWDQW WR DFNQRZOHGJH WRWKDW WKH LQVLDQV ZHUW VZHHQ KLV  
FHUWDLQ OLPLWDWLRQV ZKLFK FDXVGHUWIXWXUDDOHRHDFK FHWLRQ  
GLUHFWRQV )LUVWO\ GHVSLWH JDWKHULQJ GDWD DW WZR LQWHUYD  
WKH VWXG\ ZDV XQDEOH WR PLWLJDWH WKH LPSDFW RI FRBRQ +  
PHWKRJ YDULDQFH DV DOO GDWD ZHUW SRUW XUEFGHFRSDFRROOHJH HOJD  
VWXGHQWV &RQVHTXHQWO\ IXWXUH UHVHDFK XUDWLV EKHFRGHUWLRQ  
GLYHUVLILQJ WKHLU GDWD VRXUFHV ZRUNRQGLWLRQV -WYDOD RI &  
SDUWLFLSDQWV ZHUW H[FOXVLYHO\ FROOHJH VWXGHQWV 7R HQKDQFH  
WKH DSSOLFDELOLW\ RI RXU UHVXOWV LW ZRXOG EH EHQHILFDO IRU  
IXWXUH UHVHDFK QRGYDOLGDEWLRQV XQJVEHROGHQWOHU 3 0  
DFDGHPLD DQG WRUHQGHXDWFRUHFUWUDSKH HV LQ FRYDULDQFH V  
&RQYHQWLRQDO FULWHULD YHUV  
6WUXFWXUDO HTXDWLRQ PRGHOLQ

3UDFWLFDQ LPSOLFDFWLRQVMRXUQDO

7KH FXOWLYDWLRQ RI WKH ZLOOSRZHUWRODNLV WUDWIRXVH 5 FROOHJH  
VWXGHQWV DQG WKH LPSURYHPPHQW OHDGHHUWLRQV WKHURQ RI 7KH ZDVK  
SUREOHPV LV DQRWKHU SULRULWURDGHUWLRQV DOO FRKH ZDVK  
DVVLVWHG LQ VXPPDUL]LQJ WKHLU PHUWLOXUHV H[SUHQVLYH LPLW  
GLVFXVVLQJ LPSURYHPPHQW PHWKRGV XQGHUWDDGLQJ SHUVRQDO  
JRDOV DQG LQFUHDVLRQ HQWKXVLDVP IRU DFKLHYLQJ WKHLU JRDOV  
:KLOH IRFXVLQJ RQ WKHLU FDUHHU REMHFWLYHV FROOHJH VWXGHQWV  
VLRXOG GHYHORS WKHLU FXOWXUDO NQRZOHGJH SURIHVVLRQDO  
VNLOOV DQG FRPSUHKHQVLYH TXDOLWLHV WKDW DUH QHHGHG WR  
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DFKLHYLQJ WKHP LQ WKH IXWXUH

\$FNQRZOHGJPHQWV

7KH DXWKRU V GRVFORHFRDREZHQSWLQDQFLDO  
VXSSRUW IRU WKH UHVHDFK DXWKRUVKLS DQG RU SXEOLDFWLRQ RI  
WKLW DUWLFOH 7KLV ZRUN ZDV VXSSRUWHG E\ WKH 1DWLRQDO  
1DWXUDO 6FLHQFH )RXQGDWLRQ RI &KLQD 1R WKH  
WKH 1DWLRQDO 1DWXUDO 6FLHQFH )RXQGDWLRQ RI &KLQD 1R  
7KH DXWKRUV DOVR DFNQRZOHGJH VXSSRUW IURP  
<XQQDQ 3URYLQFLDO 'HSDUWPHQW RI (GXFDWLRQ 6FLHQFH  
5HVHDFK )XQG 3URMHFW 1R <

5HIHUUHQFHV

'XII\ 5 ' %OXVWHLQ ' / 'LPHU 0 \$ \$XWLQ  
. / 7KH SV\FKRORJ\ RI ZRUNLQJ WKHRU\  
-RXUQDO RI FRXQVHOLQJ SV\FKRORJ\  
'XII\ 5 ' 'RXJODVV 5 3 \$XWLQ . / \$OODQ  
% \$ ([DPLQLQJ SUHGLFWRUV RI ZRUN YROLWLRQ  
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'XII\ 5 ' 'LPHU 0 \$ -DGLGLDQ \$  
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3V\FKRORJLVW