Appendix

The Non-Condensed Version of the Model

The complete notation for the non-condensed model is presented in alphabetic order in Table A-1, and the complete set of equations for the non-condensed model is presented in Table A-2. The specification in Table A-2 is based on the assumption of two identical banks, two identical firms, one creditor household, and one debtor househood. However, some remarks are presented in the table on how the model can be generalized. For ease of reference, the numbering of the equations or statements in Table A-2 corresponds to the numbering in Table 6-2 for the condensed model. Table A-2 should be self-explanatory, given the remarks in the table and the discussion of Table 6-2 in Chapter Six. In Table A-3 the flow-of-funds accounts for the non-condensed model are presented, and in Table A-4 the national income accounts for the non-condensed model are presented. Tables A-3 and A-4 are analogous to Tables 6-3 and 6-4 for the condensed model.

Table A-1. The Complete Notation for the Non-Condensed Model in Alphabetic Order

Subscript t denotes variable for period t. A p superscript in the text denotes a planned value of the variable, and an e superscript denotes an expected value of the variable.

A_{it}	= value of non-demand-deposit assets or liabilities of household i
$BONDB_{it}$	= number of bonds held by bank i
$BONDD_t$	= number of bonds held by the bond dealer
$BONDG_t$	= number of bonds issued by the government
BR_{it}	= actual reserves of bank i
BR^*_{it}	= required reserves of bank i $[g_1 DDB_{it}]$
BR^{**}_{it}	= desired reserves of bank i $[g_1(DDB_{it} - EMAXDD_i) + EMAXDD_i + EMAXSD_i]$

Table A-1. (continued)

CF_{it}	= cash flow before taxes and dividends of firm i
$\overline{CF}_{it}$	= cash flow net of taxes and dividends of firm i
CG_{it}	= capital gains or losses on stocks of household i
CGB_{it}	= capital gains or losses on bonds of bank i $[BONDB_{it}/R_{t+1} - BONDB_{it}/R_t]$
CGD_t	= capital gains or losses on bonds of the bond dealer $[BONDD_t/R_{t+1} - BONDD_t/R_t]$
d_1	= profit tax rate
d_2	= penalty rate on the composition of banks' portfolios
d_3	= personal tax rate
DDB_{it}	= demand deposits of bank i
DDD_t	= demand deposits of the bond dealer
DDF_{it}	= actual demand deposits of firm i
DDF_{1it}	= demand deposits set aside by firm i for transactions purposes
DDF_{2i}	= demand deposits set aside by firm i to be used as a buffer to meet unexpected decreases in cash flow
DDH_{it}	= demand deposits of household i
DEP_{it}	= depreciation of firm i
DIV_t	= total dividends paid and received in the economy
$DIVB_{it}$	= dividends paid by bank i
$DIVD_t$	= dividends paid by the bond dealer
$DIVF_{it}$	= dividends paid by firm i
$DIVH_{it}$	= dividends received by household i
$EMAXDD_i$	= largest error bank i expects to make in overestimating its demand deposits for any period
$EMAXHP_i$	= largest error firm i expects to make in overestimating the supply of labor available to it for any period
$EMAXMH_i$	= largest error firm i expects to make in underestimating its worker hour requirements for any period
$EMAXSD_i$	= largest error bank i expects to make in overestimating its savings deposits for any period
$EXBB_t$	= excess supply of bills and bonds $[(VBILLG_t + BONDG_t/R_t) - (\sum_{i=1}^{NB} VBB_{it} + VBB^*)]$
$FUNDS^e_{it}$	= amount that bank i knows it will have available to lend to households and firms and to buy bills and bonds even if it overestimates its demand and savings deposits by the maximum amounts
g_1	= reserve requirement ratio
g_2	= no-tax proportion of banks' portfolios held in bills and bonds
$\bar{H}$	= maximum number of hours that each machine can be used each period
HP_t	= total number of worker hours paid for in the economy
HPF_{it}	= number of worker hours paid for by firm i
$HPFMAX_{it}$	= maximum number of worker hours that firm i will pay for
$HPFMAXUN_{it}$	= maximum number of worker hours that firm i would pay for if it were not constrained
HPG_t	= number of worker hours paid for by the government
HPH_{it}	= number of hours that household i is paid for

Table A-1. (continued)

$HPHMAX_{it}$	= maximum number of hours that household i can be paid for
$HPHUN_{it}$	= unconstrained supply of hours of household i
$HPUN_t$	= total unconstrained supply of hours in the economy
I_{nit}	= number of machines of type n purchased by firm i ($n=1,2$)
INV_{it}	= number of goods purchased by firm i for investment purposes
$INVUN_{it}$	= unconstrained demand of firm i for goods for investment purposes
IUN_{nit}	= unconstrained demand of firm i for machines of type n ($n=1,2$)
K^a_{nit}	= actual number of machines of type n held by firm i ($n=1,2$)
KH_{nit}	= number of machine hours worked on machines of type n in firm i ($n=1,2$)
$KMIN_{nit}$	= minimum number of machines of type n required to produce Y_{nit}($n=1,2$)
L_t	= total value of loans
LB_{it}	= value of loans of bank i
$LBMAX_{it}$	= maximum value of loans that bank i will make
LF_{it}	= value of loans taken out by firm i
$LFMAX_{it}$	= maximum value of loans that firm i can take out
$LFUN_{it}$	= unconstrained demand for loans of firm i
LH_{it}	= value of loans taken out by household i
$LHMAX_{it}$	= maximum value of loans that household i can take out
$LHUN_{it}$	= unconstrained demand for loans of household i
LUN_t	= total unconstrained demand for loans
m	= length of life of one machine
MH_{nit}	= number of worker hours worked on machines of type n in firm i ($n=1,2$)
MH_{3it}	= number of worker hours required to handle deviations of inventories from β_1 times sales in firm i
MH_{4it}	= number of worker hours required to handle fluctuations in sales in firm i
MH_{5it}	= number of worker hours required to handle fluctuations in worker hours paid for in firm i
MH_{6it}	= number of worker hours required to handle fluctuations in net investment in firm i
MH_{it}	= total number of worker hours required by firm i
PF_{it}	= price set by firm i
$\overline{PF}_t$	= average price level in the economy
PFF_{it}	= price paid for investment goods by firm i
$PFUN_{it}$	= price that firm i would set if it were not constrained
PG_t	= price paid by the government
PH_{it}	= price paid by household i
PS_t	= price of the aggregate share of stock
r_t	= bill rate
R_t	= bond rate
RB_{it}	= loan rate set by bank i
$\overline{RB}_t$	= average loan rate in the economy
RF_{it}	= loan rate paid by firm i

Table A-1. (continued)

RH_{it}	= loan rate paid by household i
S_{it}	= fraction of the aggregate share of stock held by household i
SAV_{it}	= savings net of capital gains or losses of household i
SDB_{it}	= savings deposits of bank i
SDH_{it}	= savings deposits of household i
TAX_t	= total taxes paid
$TAXB_{it}$	= taxes paid by bank i
$TAXD_t$	= taxes paid by the bond dealer
$TAXF_{it}$	= taxes paid by firm i
$TAXH_{it}$	= taxes paid by household i
V_{it}	= stock of inventories of firm i
VBB_{it}	= value of bills and bonds that bank i chooses to purchase $[VBILLB_t + BONDB_t/R_t]$
VBD^*	= value of bills and bonds that the bond dealer desires to hold
$VBILLB_{it}$	= value of bills held by bank i
$VBILLD_t$	= value of bills held by the bond dealer
$VBILLG_t$	= value of bills issued by the government
WF_{it}	= wage rate set by firm i
$\overline{WF}_t$	= average wage rate in the economy
$WFUN_{it}$	= wage rate that firm i would set if it were not constrained
WG_t	= wage rate paid by the government
WH_{it}	= wage rate received by household i
X_t	= total number of goods sold in the economy
XF_{it}	= number of goods sold by firm i
$XFMAX_{it}$	= maximum number of goods that firm i will sell
XG_t	= number of goods purchased by the government
XH_{it}	= number of goods purchased by household i
$XHMAX_{it}$	= maximum number of goods that household i can purchase
$XHUN_{it}$	= unconstrained demand for goods of household i
XUN_t	= total unconstrained demand for goods
Y_{nit}	= number of goods produced on machines of type n by firm i (n=1,2)
Y_{it}	= total number of goods produced by firm i
YG	= minimum guaranteed level of income
YH_{it}	= before-tax income excluding capital gains or losses of household i
Y^pUN_{it}	= number of goods that firm i would plan to produce if it were not constrained
δ_n	= number of goods it takes to create a machine of type n (n=1,2)
λ_n	= amount of output produced per worker hour on machines of type n (n=1,2)
μ_n	= amount of output produced per machine hour on machines of type n (n=1,2)
ΠB_{it}	= before-tax profits of bank i
ΠD_{it}	= before-tax profits of the bond dealer
ΠF_{it}	= before-tax profits of firm i

Table A-2. The Complete Set of Equations for the Non-Condensed Model

Under the assumption of two identical banks, two identical firms, one creditor household, and one debtor household. Remarks are also presented on how the model can be generalized to include NB banks, NF firms, and NH households.

(1) r_t, R_t, and PS_t are determined by the bond dealer at the end of period $t-1$. See (42) and (62) below for the determination of the values for period $t+1$.

(2) The government sets d_1, d_2, d_3, YG, g_1, g_2, XG_t, HPG_t, $VBILLG_t$, $BONDG_t$.

(3) The banks determine RB_{it}, VBB_{it}, and $LBMAX_{it}$ $(i=1,2)$ as described in Chapter Two.

(3)′ Since the banks are identical, $RB_{1t} = RB_{2t}$. Therefore, set $RF_{1t} = RF_{2t} = RH_{2t} = RB_{1t}$. In general, with NB nonidentical banks, NF nonidentical firms, and NH households, the values of RF_{it} $(i=1,\ldots,NF)$ and RH_{it} $(i=1,\ldots,NH)$ must satisfy, given RB_{it} $(i=1,\ldots,NB)$:

$$\sum_{i=1}^{NB} RB_{it}LB_{it} = \sum_{i=1}^{NF} RF_{it}LF_{it} + \sum_{i=1}^{NH} RH_{it}LH_{it},$$

i.e., the total interest revenue of banks must equal the total interest payments of firms and households.

(4) $$LHMAX_{2t} = \left(\frac{LHUN_{2t-1}}{LHUN_{2t-1}+LFUN_{1t-1}+LFUN_{2t-1}}\right)(LBMAX_{1t}+LBMAX_{2t}).$$

(5) $$LFMAX_{1t} = LFMAX_{2t} = \frac{1}{2}(LBMAX_{1t}+LBMAX_{2t}-LHMAX_{2t}).$$

In general, the values of $LFMAX_{it}$ $(i=1,\ldots,NF)$ and $LHMAX_{it}$ $(i=1,\ldots,NH)$ must satisfy, given $LBMAX_{it}$ $(i=1,\ldots,NB)$:

$$\sum_{i=1}^{NF} LFMAX_{it} + \sum_{i=1}^{NH} LHMAX_{it} \leq \sum_{i=1}^{NB} LBMAX_{it},$$

i.e., the allocation of the loan constraints among firms and households must not exceed the total loan constraint from banks.

(6) The firms determine PF_{it}, I_{1it}, I_{2it}, Y^p_{1it}, Y^p_{2it}, WF_{it}, LF_{it}, $HPFMAX_{it}$, $XFMAX_{it}$, IUN_{1it}, IUN_{2it}, and $LFUN_{it}$ $(i=1,2)$ as described in Chapter Three.

(6)′ $INV_{it} = \delta_1 I_{1it} + \delta_2 I_{2it}$, $(i=1,2)$.

(6)″ $INVUN_{it} = \delta_1 IUN_{1it} + \delta_2 IUN_{2it}$, $(i=1,2)$.

(6)‴ Since the firms are identical, $PF_{1t} = PF_{2t}$ and $WF_{1t} = WF_{2t}$. Therefore, set $PH_{1t} = PH_{2t} = PFF_{1t} = PFF_{2t} = PG_t = PF_{1t}$ and $WH_{1t} = WH_{2t} = WG_t = WF_{1t}$.

Table A-2. (continued)

In general, the values of PH_{it} $(i=1,\ldots,NH)$, PFF_{it} $(i=1,\ldots,NF)$, and PG_t must satisfy, given PF_{it} $(i=1,\ldots,NF)$:

$$\sum_{i=1}^{NF} PF_{it}XF_{it} = \sum_{i=1}^{NF} PFF_{it}INV_{it} + \sum_{i=1}^{NH} PH_{it}XH_{it} + PG_tXG_t,$$

i.e., the total revenue of firms from the sale of goods must equal the total amount paid by firms, households, and the government for goods.

Also, in general, the values of WH_{it} $(i=1,\ldots,NH)$ and WG_t must satisfy, given WF_{it} $(i=1,\ldots,NF)$:

$$\sum_{i=1}^{NH} WH_{it}HPH_{it} = \sum_{i=1}^{NF} WF_{it}HPF_{it} + WG_tHPG_t,$$

i.e., the total wages of households must equal the total wages paid by firms and the government.

(7) The households determine $HPHUN_{1t}$, $XHUN_{1t}$, $HPHUN_{2t}$, $XHUN_{2t}$, and $LHUN_{2t}$ as described in Chapter Four.

(8) $$HPHMAX_{1t} = \left(\frac{HPHUN_{1t}}{HPHUN_{1t}+HPHUN_{2t}}\right)(HPFMAX_{1t}+HPFMAX_{2t}+HPG_t).$$

(9) $$HPHMAX_{2t} = (HPFMAX_{1t}+HPFMAX_{2t}+HPG_t) - HPHMAX_{1t}.$$

In general, the values of $HPHMAX_{it}$ $(i=1,\ldots,NH)$ must satisfy, given $HPFMAX_{it}$ $(i=1,\ldots,NF)$ and HPG_t:

$$\sum_{i=1}^{NH} HPHMAX_{it} \leq \sum_{i=1}^{NF} HPFMAX_{it}+HPG_t,$$

i.e., the allocation of the hours constraints among households must not exceed the total hours constraint from the firms and the government.

(10) $$XHMAX_{1t} = \left(\frac{XHUN_{1t}}{XHUN_{1t}+XHUN_{2t}}\right)(XFMAX_{1t} + XFMAX_{2t} - INV_{1t} - INV_{2t} - XG_t).$$

(11) $$XHMAX_{2t} = (XFMAX_{1t} + XFMAX_{2t} - INV_{1t} - INV_{2t} - XG_t) - XHMAX_{1t}.$$

In general, the values of $XHMAX_{it}$ $(i=1,\ldots,NH)$ must satisfy, given $XFMAX_{it}$ $(i=1,\ldots,NF)$, INV_{it} $(i=1,\ldots,NF)$, and XG_t:

$$\sum_{i=1}^{NH} XHMAX_{it} \leq \sum_{i=1}^{NF} XFMAX_{it} - \sum_{i=1}^{NF} INV_{it} - XG_t,$$

i.e., the allocation of the goods constraints among households must not exceed the total goods constraint from firms after meeting investment and government demand.

Table A-2. (continued)

(12) The households determine HPH_{1t}, XH_{1t}, HPH_{2t}, XH_{2t}, and LH_{2t} as described in Chapter Four.

(13) $XUN_t = XHUN_{1t} + XHUN_{2t} + INVUN_{1t} + INVUN_{2t} + XG_t$.

(14) $LUN_t = LFUN_{1t} + LFUN_{2t} + LHUN_{2t}$

(15) $HPUN_t = HPHUN_{1t} + HPHUN_{2t}$.

(16) $X_t = XH_{1t} + XH_{2t} + INV_{1t} + INV_{2t} + XG_t$.

(16)′ $XF_{1t} = XF_{2t} = \frac{1}{2}X_t$.

In general, XF_{it} $(i=1,\ldots,NF)$ would be determined according to the relationship between firm i's price and the other firms' prices, subject to the restrictions that:

$$\sum_{i=1}^{NF} XF_{it} = X_t \text{ and } XF_{it} \leq XFMAX_{it}\ (i=1,\ldots,NF).$$

(17) $L_t = LF_{1t} + LF_{2t} + LH_{2t}$.

(17)′ $LB_{1t} = LB_{2t} = \frac{1}{2}L_t$.

In general, LB_{it} $(i=1,\ldots,NB)$ would be determined according to the relationship between bank i's loan rate and the other banks' loan rates, subject to the restrictions that:

$$\sum_{i=1}^{NB} LB_{it} = L_t \text{ and } LB_{it} \leq LBMAX_{it}\ (i=1,\ldots,NB).$$

(18) $HP_t = HPH_{1t} + HPH_{2t}$.

(19) $HPF_{1t} = HPF_{2t} = \frac{1}{2}(HP_t - HPG_t)$.

In general, HPF_{it} $(i=1,\ldots,NF)$ would be determined according to the relationship between firm i's wage rate and other firms' wage rates, subject to the restrictions that:

$$\sum_{i=1}^{NF} HPF_{it} = HP_t - HPG_t \text{ and } HPF_{it} \leq HPFMAX_{it}\ (i=1,\ldots,NF).$$

(20) $K^a_{nit} = K^a_{nit-1} + I_{nit} - I_{nit-m}$, $(n=1,2;\ i=1,2)$.

(21) $V^p_{it} = V_{it-1} + Y^p_{1it} + Y^p_{2it} - XF_{it}$, $(i=1,2)$.

(22) $MH^p_{nit} = \dfrac{Y^p_{nit}}{\lambda_n}$, $(n=1,2;\ i=1,2)$.

Table A-2. (continued)

(23) $MH^p_{3it} = \beta_2(V^p_{it} - \beta_1 XF_{it})^2$, $(i=1,2)$.

(24) $MH_{4it} = \beta_3(XF_{it} - XF_{it})^2$, $(i=1,2)$.

(25) $MH_{5it} = \beta_4(HPF_{it-1} - HPF_{it-2})^2$, $(i=1,2)$.

(26) $MH_{6it} = \beta_5(K^a_{1it} + K^a_{2it} - K^a_{1it-1} - K^a_{2it-1})^2$, $(i=1,2)$.

(27) $MH^p_{it} = MH^p_{1it} + MH^p_{2it} + MH^p_{3it} + MH_{4it} + MH_{5it} + MH_{6it}$, $(i=1,2)$.

(28) If $MH^p_{it} \leq HPF_{it}$, then $Y_{1it} = Y^p_{1it}$, $Y_{2it} = Y^p_{2it}$, $V_{it} = V^p_{it}$, and $MH_{it} = MH^p_{it}$, $(i=1,2)$.

(29) If $MH^p_{it} > HPF_{it}$, then $MH_{it} = HPF_{it}$; Y_{it} = maximum amount that can be produced given K^a_{1it}, K^a_{2it}, XF_{it}, and MH_{it};

$Y_{1it} = \min \left\{ Y_{it}\right.$, maximum amount that can be produced on machines of type 1 $\left.(\mu_1 K^a_{1it}\bar{H})\right\}$;

$Y_{2it} = Y_{it} - Y_{1it}$; $V_{it} = V_{it-1} + Y_{1it} + Y_{2it} - XF_{it}$, $(i=1,2)$.

(30) $KMIN_{nit} = \dfrac{Y_{nit}}{\mu_n \bar{H}}$, $(n=1,2;\ i=1,2)$.

(31) $DEP_{it} = \dfrac{1}{m}(PFF_{it}INV_{it} + \ldots + PFF_{it-m+1}INV_{it-m+1})$, $(i=1,2)$.

(32) $\Pi F_{it} = PF_{it}(Y_{1it} + Y_{2it}) - WF_{it}HPF_{it} - DEP_{it} - RF_{it}LF_{it}$
$\quad + (PF_{it} - PF_{it-1})V_{it-1}$, $(i=1,2)$.

(33) $TAXF_{it} = d_1\, \Pi F_{it}$, $(i=1,2)$.

(34) $DIVF_{it} = \Pi F_{it} - TAXF_{it}$, $(i=1,2)$.

(35) $CF_{it} = PF_{it}XF_{it} - WF_{it}HPF_{it} - PFF_{it}INV_{it} - RF_{it}LF_{it}$, $(i=1,2)$.

(36) $\overline{CF}_{it} = CF_{it} - TAXF_{it} - DIVF_{it}$
$\quad = DEP_{it} - PFF_{it}INV_{it} + PF_{it-1}V_{it-1} - PF_{it}V_{it}$, $(i=1,2)$.

(37) $DDF_{it} = DDF_{it-1} + LF_{it} - LF_{it-1} + \overline{CF}_{it}$.

(38) $VBILLD_t = 0$.

(39) $VBILLB_{1t} = VBILLB_{2t} = \frac{1}{2}VBILLG_t$.

(40) $BONDB_{it} = R_t(VBB_{it} - VBILLB_{it})$, $(i=1,2)$.

Table A-2. (continued)

In general, $VBILLB_{it}(i=1,\ldots,NB)$ would be determined according to the relationship between the value of VBB_{it} and the other banks' values of this variable, subject to the restriction that

$$\sum_{i=1}^{NB} VBILLB_{it} = VBILLG_t .$$

(41) $BONDD_t = BONDG_t - BONDB_{1t} - BONDB_{2t}$.

(42) The bond dealer determines r_{t+1} and R_{t+1} as described in Chapter Five.

(43) $\Pi D_t = BONDD_t + \left(\frac{BONDD_t}{R_{t+1}} - \frac{BONDD_t}{R_t}\right).$

(44) $TAXD_t = d_1 \, \Pi D_t$.

(45) $DIVD_t = \Pi D_t - TAXD_t$.

(46) $DDD_t = DDD_{t-1} - \left(\frac{BONDD_t}{R_{t+1}} - \frac{BONDD_t}{R_t}\right).$

(47) $DDH_{1t} = \gamma_1 PH_{1t} XH_{1t}$.

(48) $DDH_{2t} = \gamma_1 PH_{2t} XH_{2t}$.

(49) $DDB_{1t} = DDB_{2t} = \frac{1}{2}(DDF_{1t} + DDF_{2t} + DDD_t + DDH_{1t} + DDH_{2t})$.

In general, DDB_{it} $(i=1,\ldots,NB)$ could be determined in other ways, subject to the restriction that:

$$\sum_{i=1}^{NB} DDB_{it} = \sum_{i=1}^{NF} DDF_{it} + DDD_t + \sum_{i=1}^{NH} DDH_{it} .$$

(50) $YH_{2t} = WH_{2t} HPH_{2t}$.

(51) $TAXH_{2t} = d_3(YH_{2t} - RH_{2t} LH_{2t}) - YG$.

(52) $SAV_{2t} = YH_{2t} - TAXH_{2t} - PH_{2t} XH_{2t} - RH_{2t} LH_{2t}$.

Table A-2. (continued)

(53)′ $S_{1t} = 1.$

In general, with more than one creditor household, S_{it} $(i=1,\ldots,NH)$ would have to be determined in some way, subject to the restriction that $\sum_{i=1}^{NH} S_{it} = 1$. For each fraction of the aggregate share transferred from one household to another, the household receiving the fraction would pay the other household the fraction times PS_t.

(53) $CG_{1t} = (PS_{t+1} - PS_t)S_{1t}$. [Equations (53)-(62) are solved simultaneously]

(54) $YH_{1t} = WH_{1t}HPH_{1t} + r_t SDH_{1t} + DIVH_{1t}.$

(55) $TAXH_{1t} = d_3(YH_{1t} + CG_{1t} - YG).$

(56) $SAV_{1t} = YH_{1t} - TAXH_{1t} - PH_{1t}XH_{1t}.$

(57) $SDH_{1t} = SDH_{1t-1} - (DDH_{1t} - DDH_{1t-1}) + SAV_{1t} - PS_t(S_{1t} - S_{1t-1}).$

(57)′ $SDB_{1t} = SDB_{2t} = \frac{1}{2}SDH_{1t}.$

(58) $$\Pi B_{it} = RB_{it}LB_{it} + r_t VBILLB_{it} + BONDB_{it} - r_t SDB_{it} + \left(\frac{BONDB_{it}}{R_{t+1}} - \frac{BONDB_{it}}{R_t}\right),\ (i=1,2).$$

(59) $TAXB_{it} = d_1 \Pi B_{it} + d_2\,[VBB_{it} - g_2(VBB_{it} + LB_{it})]^2,\ (i=1,2).$

(60) $DIVB_{it} = \Pi B_{it} - TAXB_{it},\ (i=1,2).$

(61) $DIV_t = DIVF_{1t} + DIVF_{2t} + DIVD_t + DIVB_{1t} + DIVB_{2t}.$

(61)′ $DIVH_{1t} = DIV_t.$

(62) $$PS_{t+1} = \frac{\frac{1}{5}(DIV_t + DIV_{t-1} + DIV_{t-2} + DIV_{t-3} + DIV_{t-4})}{r_{t+1}}$$

In general, with more than one creditor household, $DIVH_{it}$ $(i=1,\ldots,NH)$ would be allocated according to households' ownership of stock, S_{it} $(i=1,\ldots,NH)$, with the property that $\sum_{i=1}^{NH} DIVH_{it} = DIV_t$.

Also, in general, SDB_{it} $(i=1,\ldots,NB)$ could be determined in other ways, subject to the restriction that

$$\sum_{i=1}^{NB} SDB_{it} = \sum_{i=1}^{NH} SDH_{it}.$$

Table A-2. (continued)

(63) $TAX_t = TAXH_{1t} + TAXH_{2t} + TAXF_{1t} + TAXF_{2t} + TAXD_t + TAXB_{1t} + TAXB_{2t}$.

(64) $BR_{it} = DDB_{it} + SDB_{it} - LB_{it} - VBILLB_{it} - \frac{BONDB_{it}}{R_{t+1}}$, $(i=1,2)$

and

$$BR_{1t} + BR_{2t} = BR_{1t-1} + BR_{2t-1} + PG_t XG_t + WG_t HPG_t + r_t VBILLG_t + BONDG_t - TAX - (VBILLG_t - VBILLG_{t-1}) - \left(\frac{BONDG_t - BONDG_{t-1}}{R_t}\right).$$

The one item that does need to be discussed for the non-condensed model is the assumption that the banks, the firms, and the bond dealer reestimate some of the parameters each period. Consider first, Equation (2.11) for banks:

$$LUN_t^e = LUN_{t-1} \left(\frac{\overline{RB}_{t-1}}{\overline{RB}_t^e} \right)^{\alpha_3}, \alpha_3 > 0. \tag{2.11}$$

In the programming of the non-condensed model for the results in this Appendix, each bank was assumed to estimate α_3 on the basis of its past observations of the correlation between changes in the aggregate unconstrained demand for loans and changes in the average loan rate. Given observations on, for example, LUN_{t-1}, LUN_{t-2}, $\overline{RB}_{t-1}$, and $\overline{RB}_{t-2}$, an estimate of α_3 can be obtained as $[log(LUN_{t-1}/LUN_{t-2})]/[(log(\overline{RB}_{t-2}/\overline{RB}_{t-1})]$. At the beginning of period t, each bank was assumed to make estimates of α_3 in this way for the five periods, $t-1, \ldots, t-5$. The bank was also assumed, however, to have a prior view regarding the minimum and maximum values of α_3, a view that was assumed not to be subject to change based on further information. Therefore, if an estimate of α_3 for a particular past period fell below the minimum value, the bank was assumed to set the estimate at the minimum value. Likewise, if an estimate fell above the maximum value, the bank was assumed to set the estimate at the maximum value. The estimate of α_3 used for the decisions made at the beginning of period t was assumed to be the simple average of the five estimates. This procedure of estimating α_3 allows the program some flexibility in determining a value for α_3, while at the same time insuring that extreme values for α_3 are not chosen.

Table A-3. Flow-of-Funds Accounts for the Non-Condensed Model: Stocks of Assets and Liabilities

NB = number of banks
NF = number of firms
NH = number of households

	Households		Firms		Banks		Bond Dealer		Government	
	A	L	A	L	A	L	A	L	A	L
1. Demand Deposits	$\sum_{i=1}^{NH} DDH_{it}$	–	$\sum_{i=1}^{NF} DDF_{it}$	–	–	$\sum_{i=1}^{NB} DDB_{it}$	DDD_t	–	–	–
2. Bank Reserves	–	–	–	–	$\sum_{i=1}^{NB} BR_{it}$	–	–	–	–	$\sum_{i=1}^{NB} BR_{it}$
3. Savings Deposits	$\sum_{i=1}^{NH} SDH_{it}$	–	–	–	–	$\sum_{i=1}^{NB} SDB_{it}$	–	–	–	
4. Bank Loans	–	$\sum_{i=1}^{NH} LH_{it}$	–	$\sum_{i=1}^{NF} LF_{it}$	$\sum_{i=1}^{NB} LB_{it}$	–	–	–	–	–
5. Government Bills	–	–	–	–	$\sum_{i=1}^{NB} VBILLB_{it}$	–	$VBILLD_t$	–	–	$VBILLG_t$
6. Government Bonds	–	–	–	–	$\sum_{i=1}^{NB} VBONDB_{it}$	–	$VBONDD_t$	–	–	$VBONDG_t$
7. Common Stocks	$\sum_{i=1}^{NH} PS_t S_{it}$	–	–	–	–	–	–	–	–	–

Notes: Total Assets $- \sum_{i=1}^{NH} PS_t S_{it} =$ Total Liabilities

$$VBONDG_t = \frac{BONDG_t}{R_t}; \; VBONDB_{it} = \frac{BONDB_{it}}{R_t} \; (i=1,\ldots,NB); \; VBONDD_t = \frac{BONDD_t}{R_t}$$

Table A-4. National Income Accounts for the Non-Condensed Model

NB = number of banks
NF = number of firms
NH = number of households

Expenditure Side

(1) Consumption (real) = $\sum_{i=1}^{NH} XH_{it}$

(2) Consumption (money) = $\sum_{i=1}^{NH} PH_{it}\, XH_{it}$

(3) Fixed Investment (real) = $\sum_{i=1}^{NF} INV_{it}$

(4) Fixed Investment (money) = $\sum_{i=1}^{NF} PFF_{it}\, INV_{it}$

(5) Government Expenditures on Goods (real) = XG_t

(6) Government Expenditures on Goods (money) = $PG_t\, XG_t$

(7) Government Expenditures on Labor (real) = HPG_t

(8) Government Expenditures on Labor (money) = $WG_t\, HPG_t$

(9) Inventory Investment (real) = $\sum_{i=1}^{NF} (V_{it} - V_{it-1})$

(10) Inventory Investment (money) = $\sum_{i=1}^{NF} PF_{it}\, (V_{it} - V_{it-1})$

Gross National Product (real) = (1) + (3) + (5) + (7) + (9)
Gross National Product (money) = (2) + (4) + (6) + (8) + (10)

Income Side

(1) Wages = $\sum_{i=1}^{NH} WH_{it}\, HPH_{it}$

(2) Before-Tax Profits Net of Capital Gains and Losses =

$$\sum_{i=1}^{NB} [\Pi B_{it} - (\frac{BONDB_{it}}{R_{t+1}} - \frac{BONDB_{it}}{R_t})] + \sum_{i=1}^{NF} \Pi F_{it} + [\Pi D_t - (\frac{BONDD_t}{R_{t+1}} - \frac{BONDD_t}{R_t})]$$

(3) Inventory Valuation Adjustment = $- \sum_{i=1}^{NF} [(PF_{it} - PF_{it-1})\, V_{it-1}]$

Table A-4. (continued)

(4) Profits and Inventory Valuation Adjustment = (2) + (3)

(5) Capital Consumption Allowances = $\sum_{i=1}^{NF} DEP_{it}$

(6) Net Interest = $\sum_{i=1}^{NH} r_t SDH_{it} - \sum_{i=1}^{NH} RH_{it} LH_{it} - BONDG_t - r_t VBILLG_t$

Gross National Product (money) = (1) + (4) + (5) + (6)

Production Side

(1) Production of Goods (real) = $\sum_{i=1}^{NF} (Y_{1it} + Y_{2it})$

(2) Production of Goods (money) = $\sum_{i=1}^{NF} PF_{it} (Y_{1it} + Y_{2it})$

(3) Government Expenditures on Labor (real) = HPG_t

(4) Government Expenditures on Labor (money) = $WG_t HPG_t$
Gross National Product (real) = (1) + (3)
Gross National Product (money) = (2) + (4)

Consider next Equations (3.26) and (3.33) for firms:

$$X_t^e = X_{t-1} \left(\frac{\overline{PF}_t^e}{\overline{PF}_{t-1}} \right)^{\beta_8}, \beta_8 < 0, \tag{3.26}$$

$$HPUN_t^e = HPUN_{t-1} \left(\frac{\overline{WF}_t^e}{\overline{WF}_{t-1}} \right)^{\beta_{11}} \left(\frac{\overline{PF}_t^e}{\overline{PF}_{t-1}} \right)^{\beta_{12}}, \beta_{11} > 0, \beta_{12} < 0. \tag{3.33}$$

In the programming of the non-condensed model, each firm was assumed to estimate β_8 in the same way that the banks were assumed to estimate α_3. For Equation (3.33) the constraint that β_{11} be equal to β_{12} in absolute value was imposed, and each firm was assumed to estimate the absolute value in the same way that the banks were assumed to estimate α_3.

Consider finally Equation (5.8) for the bond dealer:

$$\frac{r_t - r_{t-1}}{r_{t-1}} = \lambda \left[\frac{(VBILLG_{t-1} + \frac{BONDG_{t-1}}{R_{t-1}} - (\sum_{i=1}^{NB} VBB_{it-1} + VBD^*)}{\sum_{i=1}^{NB} VBB_{it-1} + VBD^*} \right], \lambda > 0. \tag{5.8}$$

In the programming of the non-condensed model, the bond dealer was assumed to estimate λ in a similar way that banks were assumed to estimate α_3, by observing the past correlation between percentage changes in the bill rate and percentage changes in the demand for bills and bonds from banks. In period $t-1$, for example, the bond dealer can compute

$$\frac{\sum_{i=1}^{NB} VBB_{it-1} - \sum_{i=1}^{NB} VBB_{it-2}}{\sum_{i=1}^{NB} VBB_{it-2}} \Bigg/ \frac{r_{t-1} - r_{t-2}}{r_{t-2}},$$

which is an estimate of the elasticity of the demand for bills and bonds with respect to the bill rate. The bond dealer was assumed to compute this estimate for each of the previous five periods, with, however, prior bounds on each of the estimates. The five estimates were then averaged, and the value of λ used in determining r_t was taken to be the inverse of this average.

The parameter values, initial conditions, and government values that were used for the base run are presented in Table A-5. The values for the government and the bond dealer are the same as for the base run for the condensed model in Chapter Six. The values for the banks, firms, and households are the same as those used for the base run solutions of the optimal control problems in Chapters Two, Three, and Four, with one minor exception for the firms. In Table 3-2 the lagged values of the aggregate unconstrained and constrained supplies of labor were taken to be 637.3, whereas here they are taken to be 758.0. This difference of 120.7 is the number of worker hours paid for by the government. The values referred to in Table A-5 were chosen so that the base run for the non-condensed model would be a self-repeating run. The choice of the initial values must, of course, meet certain consistency re-

Table A-5. Parameter Values, Initial Conditions, and Government Values for the Base Run in Table A-6

The Government

Same as in Table 6-5 for the Condensed Model.

The Bond Dealer

Same as in Table 6-5 for the Condensed Model.

The Banks

Same as in Table 2-2. Values are relevant for both banks.

The Firms

Same as in Table 3-2 except:

$HP_{t-1} = 758.0,$

$HPUN_{t-1} = 758.0.$

Values in Table 3-2 are relevant for both firms.

The Households

Same as in Table 4-2.

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quirements, since there are important links among all the sectors, and all these requirements have been met for the values referred to in Table A-5.

It should be remembered that the values of α_3, β_8, β_{11}, β_{12}, and λ change over time as the banks, firms, and bond dealer re-estimate the values each period. The values referred to in Table A-5 are the values used for the first period (period t) of the run. Values of the estimates of each of these parameters for periods $t-3$, $t-2$, and $t-1$ are also needed to compute the estimates of the parameters for period $t+1$, and in each case these lagged values were taken to be the same as the value for period t.

It should also be noted that when the non-condensed model was solved for successive periods, the length of the decision horizon of banks and firms, $T+1$, was always taken to be 30. In other words, when the model was solved for period t, banks and firms were assumed to look ahead to period $t+30$, whereas when the model was solved for period $t+1$, banks and firms were assumed to look ahead to period $t+31$. The length of the expected remaining lifetime of households, $N+1$, was also always taken to be 30 for the runs. Without these assumptions, it would not be possible to concoct a self-repeating run, which would make it somewhat more difficult to compare the experimental runs to the base run.

It should finally be noted that when Y_{it} had to be computed in Equation (29) in Table A-2, the inventory cost parameter β_2 was taken to be 0.010 rather than 0.075. In the discussion of Equation (29) for the condensed model in Chapter Six, it was mentioned that computing the level of output in Equation (29) requires solving a quadratic equation in output. The quadratic equation for the condensed model is presented in footnote [a] in Chapter Six, and the quadratic equation for the non-condensed model is the same with the appropriate change of notation. The parameter β_2 is part of this equation. The higher is β_2, the more does output have to be lowered when worker hour requirements exceed the number of worker hours allocated to the firm. The value of β_2 was lowered for the computations in Equation (29) to make the decrease in output less for a given difference between worker hour requirements and worker hours on hand.

The value of β_2 used for the condensed model was 0.001, and so the 0.010 value used here is more in line with the value used for the condensed model. The value of 0.075 was, however, still used in the solution of the optimal control problem of the firms, since this was the value used for the results in Chapter Four. This procedure means that it had to be assumed that the firms *expect* that the value of β_2 is 0.075 when solving their control problems, while in fact the actual value is only 0.010. This assumption is not, however, a very important assumption of the model, and it was made so that the results between the condensed and non-condensed models would be somewhat more comparable.

The results for the base run are presented in Table A-6 for periods *t*, *t+1*, and *t+2*. The same variables are presented in Table A-6 as were presented in Table 6-6, and the discussion of the variables in Table 6-6 in Chapter Six is relevant here also. Since there are two identical banks and two identical firms, the optimal control problem of each bank and firm only had to be solved once each period. The appropriate bank and firm variables have been multiplied by 2 in Table A-6 to put them on an aggregative basis and to make them directly comparable to the variables in Table 6-6. The variables in Table 6-6 that have "*UN*" for the last two letters are unconstrained quantities. The unconstrained quantities for the firms are the quantities that result from solving the optimal control problems of the firms under the assumption of no loan constraints. Similarly, the unconstrained quantities for the households are the quantities that result from solving the optimal control problems of the households under the assumption of no loan, hours, and goods constraints. The results for the base run in Table A-6 are identical to the results for the base run in Table 6-6 except, in a few cases, for the last digit of the number. In these few cases the last digits differ by 1.

The first four experiments that were carried out in Chapter Six for the condensed model were also carried out for the non-condensed model: a decrease in XG_t of 5.0, an increase in $VBILLG_t$ of 5.0, an increase in XG_t of 5.0, and a decrease in $VBILLG_t$ of 5.0. The results for these four experiments are presented in Table A-6. The results for these four experiments in Table A-6 are so similar to the results in Table 6-6 that they require little further discussion here.

Table A-6. Results of Solving the Non-Condensed Model

	Base Run t	$t+1$	$t+2$		t	$t+1$	$t+2$
Real GNP	962.7	962.7	962.7	XUN	842.0	842.0	842.0
UR	0.0000	0.0000	0.0000	X	842.0	842.0	842.0
Surplus (+) or Deficit (−)	0.0	0.0	0.0	LUN	810.2	810.2	810.2
				L	810.2	810.2	810.2
r	0.06500	0.06500	0.06500	$HPUN$	758.0	758.0	758.0
PS	1146.4	1146.4	1146.4	HP	758.0	758.0	758.0
$2{\cdot}FUNDS_i^e$	1150.2	1150.2	1150.2	$2{\cdot}HPF_i$	637.3	637.3	637.3
RB_i	0.07500	0.07500	0.07500	$2{\cdot}MH_{4i}$	0.0	0.0	0.0
$2{\cdot}VBB_i$	340.0	340.0	340.0	$2{\cdot}Y_i$	842.0	842.0	842.0
$2{\cdot}LBMAX_i$	810.2	810.2	810.2	$2{\cdot}V_i$	105.3	105.3	105.3
$LHMAX_2$	482.1	482.1	482.1	$2{\cdot}\Pi F_i$	130.1	130.1	130.1
$2{\cdot}LFMAX_i$	328.1	328.1	328.1	$2{\cdot}TAXF_i$	65.0	65.0	65.0
$2{\cdot}LFUN_i$	328.1	328.1	328.1	$2{\cdot}\overline{CF}_i$	0.0	0.0	0.0
$PFUN_i$	1.0000	1.0000	1.0000	$2{\cdot}DDF_i$	50.3	50.3	50.3
$2{\cdot}INVUN_i$	50.0	50.0	50.0	$2{\cdot}VBILLB_i$	185.0	185.0	185.0
$2{\cdot}Y^PUN_i$	842.0	842.0	842.0	$2{\cdot}BONDB_i$	10.08	10.08	10.07
$WFUN_i$	1.0000	1.0000	1.0000	$BONDD$	1.95	1.95	1.95
$2{\cdot}HPFMAXUN_i$	637.3	637.3	637.3	ΠD	1.95	1.95	1.95
$2{\cdot}LF_i$	328.1	328.1	328.1	$TAXD$	0.97	0.97	0.97
PF_i	1.0000	1.0000	1.0000	CGD	0.00	0.00	0.00
$2{\cdot}INV_i$	50.0	50.0	50.0	DDD	30.0	30.0	30.0
$2{\cdot}Y_i^P$	842.0	842.0	842.0	DDH_1	60.1	60.1	60.1
$2{\cdot}X_i^e$	842.0	842.0	842.0	DDH_2	51.8	51.8	51.8
$2{\cdot}V_i^P$	105.3	105.2	105.2	$2{\cdot}DDB_i$	192.2	192.2	192.1
WF_i	1.0000	1.0000	1.0000	YH_2	435.0	435.0	435.0
$2{\cdot}HPFMAX_i$	637.3	637.3	637.3	$TAXH_2$	77.1	77.1	77.1
a	1.000	1.000	1.000	SAV_2	0.0	0.0	0.0
$HPFMAX_i/MH_i^P$	1.000	1.000	1.000	CG_1	0.0	0.0	0.0
$2{\cdot}MH_{4i}^P$	0.0	0.0	0.0	YH_1	463.4	463.4	463.4
$HPHUN_1$	323.0	323.0	323.0	$TAXH_1$	89.6	89.6	89.6
$XHUN_1$	373.8	373.8	373.8	SAV_1	0.0	0.0	0.0
$HPHUN_2$	435.0	435.0	435.0	SDH_1	1013.4	1013.4	1013.4
$XHUN_2$	321.7	321.7	321.7	$2{\cdot}CGB_i$	0.0	0.0	0.0
$LHUN_2$	482.1	482.1	482.1	$2{\cdot}\Pi B_i$	17.0	17.0	17.0
$HPHMAX_1$	323.0	323.0	323.0	$2{\cdot}TAXB_i$	8.5	8.5	8.5
$HPHMAX_2$	435.0	435.0	435.0	$2{\cdot}DIVB_i$	8.5	8.5	8.5
HPH_1	323.0	323.0	323.0	DIV	74.5	74.5	74.5
XH_1	373.8	373.8	373.8	TAX	241.3	241.3	241.3
SDH_1^P	1013.4	1013.4	1013.4	$2{\cdot}BR_i$	55.4	55.4	55.4
HPH_2	435.0	435.0	435.0	$2{\cdot}BR_i^{**}$	55.4	55.4	55.4
XH_2	321.7	321.7	321.7	$V_i/(\beta_1 XF_i)$	1.000	1.000	1.000
LH_2	482.1	482.1	482.1	HPF_i/MH_i	1.000	1.000	1.000
				$(K_{1i}^a+K_{2i}^a)/$	1.000	1.000	1.000
				$(KMIN_{1i}+KMIN_{2i})$	1.000	1.000	1.000
				$EXBB$	0.0	0.0	0.0

[a] $(K_{1i}^a+K_{2i}^a)/(KMIN_{1i}^P+KMIN_{2i}^P)$

Table A–6. (continued)

	Experiment 1 (XG_t:−5.0)						
	t	*t+1*	*t+2*		*t*	*t+1*	*t+2*
Real GNP	960.6	954.3	948.1	XUN	837.0	839.8	833.9
UR	0.0000	0.0082	0.0097	X	837.0	835.6	830.8
Surplus (+)	3.1	−1.6	−3.0	LUN	810.2	808.6	804.8
or Deficit (−)				L	810.2	807.5	804.8
r	0.06500	0.06500	0.06503	$HPUN$	758.0	758.0	756.8
PS	1146.4	1143.1	1142.0	HP	758.0	751.8	749.4
$2 \cdot FUNDS_i^e$	1150.2	1147.6	1145.8	$2 \cdot HPF_i$	637.3	631.1	628.7
RB_i	0.07500	0.07505	0.07509	$2 \cdot MH_{4i}$	1.6	0.1	1.4
$2 \cdot VBB_i$	340.0	339.2	338.7	$2 \cdot Y_i$	839.8	833.6	827.4
$2 \cdot LBMAX_i$	810.2	808.4	807.1	$2 \cdot V_i$	108.1	106.1	102.6
$LHMAX_2$	482.1	481.0	481.2	$2 \cdot \Pi F_i$	127.9	129.9	129.4
$2 \cdot LFMAX_i$	328.1	327.4	325.9	$2 \cdot TAXF_i$	64.0	65.0	64.7
$2 \cdot LFUN_i$	328.1	326.5	323.7	$2 \cdot \overline{CF}_i$	−2.9	2.4	4.3
$PFUN_i$	1.0000	0.9990	0.9995	$2 \cdot DDF_i$	47.4	48.2	49.7
$2 \cdot INVUN_i$	50.0	49.7	49.1	$2 \cdot VBILLB_i$	185.0	185.0	185.0
$2 \cdot Y^P UN_i$	842.0	833.8	830.0	$2 \cdot BONDB_i$	10.08	10.02	10.00
$WFUN_i$	1.0000	0.9956	0.9917	$BONDD$	1.95	2.00	2.03
$2 \cdot HPFMAXUN_i$	637.3	631.1	629.7	πD	1.95	1.99	2.01
$2 \cdot LF_i$	328.1	326.5	323.7	$TAXD$	0.97	0.99	1.00
PF_i	1.0000	0.9990	0.9995	CGD	0.00	−0.01	−0.02
$2 \cdot INV_i$	50.0	49.7	49.1	DDD	30.0	29.2	28.8
$2 \cdot Y_i^P$	842.0	833.8	830.0	DDH_1	60.1	59.8	59.4
$2 \cdot X_i^e$	842.0	837.2	833.1	DDH_2	51.8	51.0	50.8
$2 \cdot V_i^P$	105.3	104.7	103.0	$2 \cdot DDB_i$	189.3	188.3	188.8
WF_i	1.0000	0.9956	0.9917	YH_2	435.0	429.5	427.2
$2 \cdot HPFMAX_i$	637.3	631.1	629.7	$TAXH_2$	77.1	76.1	75.6
a	1.000	1.009	1.012	SAV_2	0.0	0.3	−0.2
$HPFMAX_i/MH_i^P$	1.000	1.000	1.000	CG_1	−3.3	−1.1	−2.5
$2 \cdot MH_{4i}^P$	0.0	0.0	0.4	YH_1	462.3	459.1	455.7
$HPHUN_1$	323.0	323.0	322.4	$TAXH_1$	88.8	88.6	87.7
$XHUN_1$	373.8	372.9	370.0	SAV_1	−0.2	−1.2	−1.2
$HPHUN_2$	435.0	435.0	434.4	SDH_1	1013.2	1012.3	1011.5
$XHUN_2$	321.7	320.7	318.4	$2 \cdot CGB_i$	0.0	−0.1	−0.1
$LHUN_2$	482.1	482.1	481.0	$2 \cdot \Pi B_i$	17.0	16.8	16.6
$HPHMAX_1$	323.0	320.4	319.6	$2 \cdot TAXB_i$	8.5	8.4	8.3
$HPHMAX_2$	435.0	431.4	430.8	$2 \cdot DIVB_i$	8.5	8.4	8.3
HPH_1	323.0	320.4	318.6	DIV	73.4	74.3	74.0
XH_1	373.8	372.1	369.4	TAX	239.4	239.0	237.3
SDH_1^P	1013.4	1012.1	1011.3	$2 \cdot BR_i$	52.3	53.9	56.9
HPH_2	435.0	431.4	430.8	$2 \cdot BR_i^{**}$	54.9	54.7	54.8
XH_2	321.7	317.3	315.8	$V_i/(\beta_1 XF_i)$	1.033	1.016	0.988
LH_2	482.1	481.0	481.0	HPF_i/MH_i	1.000	1.000	1.000
$^a(K_{1t}^a+K_{2i}^a)/(KMIN_{1i}^P+KMIN_{2i}^P)$				$(K_{1i}^a+K_{2i}^a)/(KMIN_{1i}+KMIN_{2i})$	1.003	1.009	1.015
				$EXBB$	0.0	0.8	1.2

Table A-6. (continued)

	Experiment 2 ($VBILLG_t$:+5.0) t	$t+1$	$t+2$		t	$t+1$	$t+2$
Real GNP	962.7	961.2	950.0	XUN	842.0	841.2	835.7
UR	0.0000	0.0033	0.0098	X	842.0	838.9	832.5
Surplus (+)	−1.3	−1.1	−2.9	LUN	810.2	809.0	803.9
or Deficit (-)				L	810.2	807.6	805.1
r	0.06500	0.06521	0.06523	$HPUN$	758.0	760.0	758.5
PS	1146.4	1142.2	1140.2	HP	758.0	757.5	751.0
$2 \cdot FUNDS_i^e$	1150.2	1146.9	1149.6	$2 \cdot HPF_i$	637.3	636.8	630.3
RB_i	0.07500	0.07515	0.07514	$2 \cdot MH_{4t}$	0.0	0.6	2.5
$2 \cdot VBB_i$	340.0	339.0	339.8	$2 \cdot Y_i$	842.0	840.5	829.3
$2 \cdot LBMAX_i$	810.2	807.8	809.8	$2 \cdot V_i$	105.3	106.8	103.6
$LHMAX_2$	482.1	480.7	481.4	$2 \cdot \Pi F_i$	130.1	129.4	129.0
$2 \cdot LFMAX_i$	328.1	327.1	328.4	$2 \cdot TAXF_i$	65.0	64.7	64.5
$2 \cdot LFUN_i$	328.1	328.1	324.4	$2 \cdot \overline{CF}_i$	0.0	−1.2	3.9
$PFUN_i$	1.0000	1.0000	1.0004	$2 \cdot DDF_i$	50.3	47.9	49.2
$2 \cdot INVUN_i$	50.0	50.0	49.2	$2 \cdot VBILLB_i$	190.0	185.0	185.0
$2 \cdot Y^P UN_i$	842.0	842.0	831.0	$2 \cdot BONDB_i$	9.75	10.04	10.10
$WFUN_i$	1.0000	1.0000	0.9938	$BONDD$	2.27	1.98	1.93
$2 \cdot HPFMAXUN_i$	637.3	637.3	630.3	ΠD	2.16	1.97	1.93
$2 \cdot LF_i$	328.1	326.9	324.4	$TAXD$	1.08	0.99	0.97
PF_i	1.0000	1.0000	1.0004	CGD	−0.11	−0.01	0.01
$2 \cdot INV_i$	50.0	49.6	49.2	DDD	25.1	29.6	30.5
$2 \cdot Y_i^P$	842.0	841.3	831.0	DDH_1	60.1	60.0	59.5
$2 \cdot X_i^e$	842.0	842.0	834.5	DDH_2	51.8	51.5	51.0
$2 \cdot V_i^P$	105.3	104.5	103.3	$2 \cdot DDB_i$	187.3	189.0	190.3
WF_i	1.0000	0.9997	0.9938	YH_2	435.0	434.4	428.6
$2 \cdot HPFMAX_i$	637.3	636.8	630.3	$TAXH_2$	77.1	77.0	75.9
a	1.000	1.000	1.011	SAV_2	0.0	1.1	−0.5
$HPFMAX_i/MH_i^P$	1.000	1.000	1.000	CG_1	−4.2	−2.0	−2.2
$2 \cdot MH_{4i}^P$	0.0	0.0	1.2	YH_1	463.3	463.0	457.7
$HPHUN_1$	323.0	324.0	322.9	$TAXH_1$	88.8	89.2	88.1
$XHUN_1$	373.8	373.5	371.1	SAV_1	0.7	1.1	−0.4
$HPHUN_2$	435.0	436.0	435.6	SDH_1	1014.1	1015.4	1015.4
$XHUN_2$	321.7	321.3	318.9	$2 \cdot CGB_i$	−0.5	0.0	0.0
$LHUN_2$	482.1	480.9	479.5	$2 \cdot \Pi B_i$	16.5	16.5	16.5
$HPHMAX_1$	323.0	322.9	319.8	$2 \cdot TAXB_i$	8.2	8.3	8.2
$HPHMAX_2$	435.0	434.6	431.3	$2 \cdot DIVB_i$	8.2	8.3	8.2
HPH_1	323.0	322.9	319.8	DIV	74.4	73.9	73.7
XH_1	373.8	372.7	369.9	TAX	240.3	240.1	237.7
SDH_1^P	1013.4	1015.5	1015.6	$2 \cdot BR_i$	51.7	57.8	60.7
HPH_2	435.0	434.6	431.3	$2 \cdot BR_i^{**}$	54.6	54.9	55.1
XH_2	321.7	320.1	317.0	$V_i/(\beta_1 XF_i)$	1.000	1.019	0.996
LH_2	482.1	480.7	480.7	HPF_i/MH_i	1.000	1.000	1.000
[a] $(K_{1i}^a+K_{2i}^a)/(KMIN_{1i}^P+KMIN_{2i}^P)$				$(K_{1i}^a+K_{2i}^a)/(KMIN_{1i}+KMIN_{2i})$	1.000	1.001	1.013
				$EXBB$	5.0	0.4	−0.5

Table A-6. (continued)

	Experiment 3 (XG_t:+5.0)						
	t	*t+1*	*t+2*		*t*	*t+1*	*t+2*
Real GNP	960.2	960.7	956.8	XUN	847.0	843.4	847.5
UR	0.0000	0.0000	0.0000	X	847.0	843.4	847.5
Surplus (+)	−7.2	−1.2	−5.0	LUN	810.2	809.6	813.6
or Deficit (−)				L	810.2	809.6	813.6
r	0.06500	0.06500	0.06493	$HPUN$	758.0	758.0	758.0
PS	1146.4	1142.6	1141.8	HP	758.0	758.0	758.0
$2{\cdot}FUNDS_i^e$	1150.2	1156.2	1158.2	$2{\cdot}HPF_i$	637.3	637.3	637.3
RB_i	0.07500	0.07489	0.07471	$2{\cdot}MH_{4i}$	1.6	0.8	1.0
$2{\cdot}VBB_i$	340.0	341.8	342.4	$2{\cdot}Y_i$	839.5	840.0	836.1
$2{\cdot}LBMAX_i$	810.2	814.4	815.9	$2{\cdot}V_i$	97.8	94.4	83.0
$LHMAX_2$	482.1	484.6	487.1	$2{\cdot}\Pi F_i$	127.6	128.7	124.2
$2{\cdot}LFMAX_i$	328.1	329.8	328.8	$2{\cdot}TAXF_i$	63.8	64.3	62.1
$2{\cdot}LFUN_i$	328.1	326.2	327.8	$2{\cdot}\overline{CF}_i$	7.5	2.2	8.6
$PFUN_i$	1.0000	1.0034	1.0067	$2{\cdot}DDF_i$	57.8	58.1	68.3
$2{\cdot}INVUN_i$	50.0	50.8	52.6	$2{\cdot}VBILLB_i$	185.0	185.0	185.0
$2{\cdot}Y^PUN_i$	842.0	843.4	847.7	$2{\cdot}BONDB_i$	10.08	10.19	10.22
$WFUN_i$	1.0000	1.0043	1.0089	$BONDD$	1.95	1.84	1.81
$2{\cdot}HPFMAXUN_i$	637.3	642.3	643.6	ΠD	1.95	1.87	1.84
$2{\cdot}LF_i$	328.1	326.2	327.8	$TAXD$	0.97	0.93	0.92
PF_i	1.0000	1.0034	1.0067	CGD	0.00	0.03	0.04
$2{\cdot}INV_i$	50.0	50.8	52.6	DDD	30.0	31.7	32.1
$2{\cdot}Y_i^P$	842.0	843.4	847.7	DDH_1	60.1	60.4	60.7
$2{\cdot}X_i^e$	842.0	839.5	842.1	DDH_2	51.8	52.0	52.4
$2{\cdot}V_i^P$	105.3	101.6	100.0	$2{\cdot}DDB_i$	199.7	202.2	213.5
WF_i	1.0000	1.0043	1.0089	YH_2	435.0	435.8	437.8
$HPFMAX$	637.3	642.3	643.6	$TAXH_2$	77.1	77.3	77.7
a	1.000	1.000	1.000	SAV_2	0.0	−1.0	−2.0
$2{\cdot}HPFMAX_i$	1.000	1.000	1.000	CG_1	−3.8	−0.8	−6.9
$2{\cdot}MH_{4i}^P$	0.0	3.5	0.1	YH_1	462.1	465.1	464.3
$HPHUN_1$	323.0	324.0	324.0	$TAXH_1$	88.6	89.8	88.5
$XHUN_1$	373.8	373.9	374.7	SAV_1	−0.3	0.2	−1.3
$HPHUN_2$	435.0	434.0	434.0	SDH_1	1013.1	1013.1	1011.4
$XHUN_2$	321.7	322.2	323.7	$2{\cdot}CGB_i$	0.0	0.2	0.2
$LHUN_2$	482.1	483.3	485.8	$2{\cdot}\Pi B_i$	17.0	17.2	17.5
$HPHMAX_1$	323.0	326.1	326.7	$2{\cdot}TAXB_i$	8.5	8.6	8.8
$HPHMAX_2$	435.0	436.9	437.6	$2{\cdot}DIVB_i$	8.5	8.6	8.8
HPH_1	323.0	324.0	324.0	DIV	73.3	73.9	71.8
XH_1	373.8	373.9	374.7	TAX	239.1	240.9	237.9
SDH_1^P	1013.4	1013.3	1012.0	$2{\cdot}BR_i$	62.6	63.8	68.8
HPH_2	435.0	434.0	434.0	$2{\cdot}BR_i^{**}$	56.6	57.1	58.9
XH_2	321.7	322.2	323.7	$V_i/(\beta_1 XF_i)$	0.923	0.895	0.783
LH_2	482.1	483.3	485.8	HPF_i/MH_i	1.000	1.000	1.000
$a(K_{1i}^a+K_{2i}^a)/$				$(K_{1i}^a+K_{2i}^a)/$			
$(KMIN_{1i}^P+KMIN_{2i}^P)$				$(KMIN_{1i}+KMIN_{2i})$	1.003	1.004	1.014
				$EXBB$	0.0	−1.8	−2.2

Table A-6. (continued)

	Experiment 4 ($VBILLG_t$:-5.0)						
	t	$t+1$	$t+2$		t	$t+1$	$t+2$
Real GNP	962.7	961.2	961.0	XUN	842.0	843.3	844.1
UR	0.0000	0.0000	0.0000	X	842.0	843.3	843.7
Surplus (+)	1.3	−0.3	−0.8	LUN	810.2	811.4	809.5
or Deficit (−)				L	810.2	811.4	809.1
r	0.06500	0.06479	0.06477	$HPUN$	758.0	757.0	757.0
PS	1146.4	1150.7	1150.7	HP	758.0	757.0	757.0
$2 \cdot FUNDS_i^e$	1150.2	1153.6	1150.9	$2 \cdot HPF_i$	637.3	636.3	636.3
RB_i	0.07500	0.07485	0.07486	$2 \cdot MH_{4i}$	0.0	0.1	0.0
$2 \cdot VBB_i$	340.0	341.0	340.2	$2 \cdot Y_i$	842.0	840.5	840.3
$2 \cdot LBMAX_i$	810.2	812.6	810.7	$2 \cdot V_i$	105.3	102.5	99.1
$LHMAX_2$	482.1	483.5	482.9	$2 \cdot \Pi F_i$	130.1	129.6	129.3
$2 \cdot LFMAX_i$	328.1	329.1	327.8	$2 \cdot TAXF_i$	65.0	64.8	64.6
$2 \cdot LFUN_i$	328.1	328.1	326.2	$2 \cdot \overline{CF}_i$	0.0	2.8	2.8
$PFUN_i$	1.0000	1.0000	1.0008	$2 \cdot DDF_i$	50.3	53.1	54.0
$2 \cdot INVUN_i$	50.0	50.0	50.5	$2 \cdot VBILLB_i$	180.0	185.0	185.0
$2 \cdot Y^P UN_i$	842.0	842.0	842.9	$2 \cdot BONDB_i$	10.40	10.11	10.05
$WFUN_i$	1.0000	1.0000	1.0016	$BONDD$	1.62	1.92	1.97
$2 \cdot HPFMAXUN_i$	637.3	637.3	638.4	ΠD	1.71	1.93	1.96
$2 \cdot LF_i$	328.1	328.1	326.2	$TAXD$	0.85	0.96	0.98
PF_i	1.0000	1.0000	1.0008	CGD	0.08	0.01	−0.01
$2 \cdot INV_i$	50.0	50.0	50.5	DDD	34.9	30.4	29.6
$2 \cdot Y_i^P$	842.0	842.0	842.9	DDH_1	60.1	60.3	60.4
$2 \cdot X_i^e$	842.0	842.0	842.8	DDH_2	51.8	51.8	51.8
$2 \cdot V_i^P$	105.3	105.2	102.6	$2 \cdot DDB_i$	197.1	195.6	195.7
WF_i	1.0000	1.0000	1.0016	YH_2	435.0	434.0	435.7
$2 \cdot HPFMAX_i$	637.3	637.3	638.4	$TAXH_2$	77.1	76.9	77.3
a	1.000	1.000	1.000	SAV_2	0.0	−1.2	0.4
$HPFMAX_i/MH_i^P$	1.000	1.000	1.000	CG_1	4.2	0.1	−1.2
$2 \cdot MH_{4i}^P$	0.0	0.0	0.0	YH_1	463.5	463.0	462.1
$HPHUN_1$	323.0	323.0	322.0	$TAXH_1$	90.5	89.6	89.1
$XHUN_1$	373.8	374.7	375.1	SAV_1	−0.7	−1.3	−2.4
$HPHUN_2$	435.0	434.0	435.0	SDH_1	1012.7	1011.2	1008.7
$XHUN_2$	321.7	322.1	321.9	$2 \cdot CGB_i$	0.5	0.0	0.0
$LHUN_2$	482.1	483.3	483.3	$2 \cdot \Pi B_i$	17.6	17.3	17.2
$HPHMAX_1$	323.0	323.4	322.9	$2 \cdot TAXB_i$	8.8	8.7	8.6
$HPHMAX_2$	435.0	434.6	436.2	$2 \cdot DIVB_i$	8.8	8.7	8.6
HPH_1	323.0	323.0	322.0	DIV	74.7	74.5	74.2
XH_1	373.8	374.7	375.1	TAX	242.3	240.9	240.7
SDH_1^P	1013.4	1011.3	1008.7	$2 \cdot BR_i$	59.1	54.3	55.2
HPH_2	435.0	434.0	435.0	$2 \cdot BR_i^{**}$	56.2	55.9	56.0
XH_2	321.7	322.1	321.6	$V_i/(\beta_1 XF_i)$	1.000	0.972	0.939
LH_2	482.1	483.3	482.9	HPF_i/MH_i	1.000	1.000	1.000
$a(K_{1i}^a+K_{2i}^a)/(KMIN_{1i}^P+KMIN_{2i}^P)$				$(K_{1i}^a+K_{2i}^a)/(KMIN_{1i}+KMIN_{2i})$	1.000	1.002	1.003
				$EXBB$	−5.0	−0.4	0.5

Quantitatively, the most important difference between the two models is probably the solution of the quadratic equation in Equation (29) in Tables 6-2 and A-2. Even given the adjustment in β_2, the cost parameters are still larger for the non-condensed model, and so the decrease in output due to adjustment costs is greater. In experiment 1, for example, the change in sales in period t caused worker hour requirements in period t to increase by 1.6 for the non-condensed model ($2 \cdot MH_{4it} = 1.6$ in Table A-6), but by only 0.4 for the condensed model ($MH_{4t} = 0.4$ in Table 6-6). For the non-condensed model, aggregate output in period t was forced to decrease from its planned level of 842.0 to 839.8, whereas for the condensed model, aggregate output in period t was only forced to decrease from its planned level of 842.0 to 841.5. This basic quantitative difference between the two models is, however, not very important and has virtually no effect on the qualitative similarities of the two models.

This quantitative difference between the two models does point out a characteristic of the optimal control problem of the firm that the author is not too satisfied with. As mentioned in Chapter Three, the firm had a proclivity, given the parameter values tried, to want to raise its price and thus lower expected sales and planned production. In order to get the optimal path of the price of the firm and the optimal paths of the other decision variables to be flat, the adjustment cost parameters had to be set fairly high, higher than one might want them to be for purposes of solving the overall model as in Table A-6. In future work it would be of interest to do more experimentation on solving the control problem of the firm both under different assumptions about the parameter values and under different specifications of some of the equations.

One other difference between the results in Table A-6 and the results in Table 6-6 that should be pointed out is the following. In experiment 2 in Table 6-6 the higher loan rate and more restrictive loan constraint in period $t+1$ caused the firm sector to raise its price in period $t+1$, whereas in Table A-6 the firms did not change their prices in period $t+1$. The higher loan rate and more restrictive loan constraint were not large enough in Table A-6 to lead the firms to raise their prices. Likewise, the lower loan rate in period $t+1$ in experiment 4 did not lead the firms to lower their prices in period $t+1$ in Table A-6, although the lower loan rate did lead the firm sector to lower its price in period $t+1$ in Table 6-6.

Other results of solving the non-condensed model could be presented, but since the results for the non-condensed and condensed models are so close, there is little point in doing so. The main purpose of this Appendix has been to show how the non-condensed model is solved (Table A-2) and to show that the results are similar to the results for the condensed model in Chapter Six (Table A-6). The non-condensed model is also not stable in the sense that the model did not give any indication of returning to the self-repeating run after having a one-period shock inflicted on it. As mentioned in Chapter Six, this lack of stability is not surprising, given the structure of the model.