

## 1 Technical Appendix 1: elements of (25 x 25) transition matrix $P$

Recall:

$$\beta_{m0} = (w_H + w_L) - c \quad (1)$$

$$\beta_{me} = (w_H + w_L) - c - e \quad (2)$$

$$\beta_{h0} = (2w_H) - c \quad (3)$$

$$\beta_{he} = (2w_H) - c - e \quad (4)$$

Let  $p_{i,j}$  be the  $(i, j)$ th element of the transition matrix  $P$ .

Column 1

$$p_{1,1} = q_L[\{1 - p_1\}\{1 - \Phi(0)\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(0)\}] \quad (5)$$

$$p_{2,1} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{m0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{m0})\}] \quad (6)$$

$$p_{3,1} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{me})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{me})\}] \quad (7)$$

$$p_{4,1} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{h0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{h0})\}] \quad (8)$$

$$p_{5,1} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{he})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{he})\}] \quad (9)$$

$$p_{i,j} = 0 \quad \forall \text{ other } i, j = 1 \quad (10)$$

Column 2

$$p_{6,2} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{m0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{m0})\}] \quad (11)$$

$$p_{7,2} = q_L[\{1 - p_1\}\{1 - \Phi(2\beta_{m0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(2\beta_{m0})\}] \quad (12)$$

$$p_{8,2} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{m0} + \beta_{me})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{m0} + \beta_{me})\}] \quad (13)$$

$$p_{9,2} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{m0} + \beta_{h0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{m0} + \beta_{h0})\}] \quad (14)$$

$$p_{10,2} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{m0} + \beta_{he})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{m0} + \beta_{he})\}] \quad (15)$$

$$p_{i,j} = 0 \quad \forall \text{ other } i, j = 2 \quad (16)$$

## Column 3

$$p_{11,3} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{me})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{me})\}] \quad (17)$$

$$p_{12,3} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{me} + \beta_{m0})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{me} + \beta_{m0})\}] \quad (18)$$

$$p_{13,3} = q_L[\{1 - p_3\}\{1 - \Phi(2\beta_{me})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(2\beta_{me})\}] \quad (19)$$

$$p_{14,3} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{me} + \beta_{h0})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{me} + \beta_{h0})\}] \quad (20)$$

$$p_{15,3} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{me} + \beta_{he})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{me} + \beta_{he})\}] \quad (21)$$

$$p_{i,j} = 0 \quad \forall \text{ other } i, j = 3 \quad (22)$$

## Column 4

$$p_{16,4} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{h0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{h0})\}] \quad (23)$$

$$p_{17,4} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{h0} + \beta_{m0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{h0} + \beta_{m0})\}] \quad (24)$$

$$p_{18,4} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{h0} + \beta_{me})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{h0} + \beta_{me})\}] \quad (25)$$

$$p_{19,4} = q_L[\{1 - p_1\}\{1 - \Phi(2\beta_{h0})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(2\beta_{h0})\}] \quad (26)$$

$$p_{20,4} = q_L[\{1 - p_1\}\{1 - \Phi(\beta_{h0} + \beta_{he})\}] + (1 - q_L)[\{1 - p_2\}\{1 - \Phi(\beta_{h0} + \beta_{he})\}] \quad (27)$$

$$p_{i,j} = 0 \quad \forall \text{ other } i, j = 4 \quad (28)$$

## Column 5

$$p_{21,5} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{he})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{he})\}] \quad (29)$$

$$p_{22,5} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{he} + \beta_{m0})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{he} + \beta_{m0})\}] \quad (30)$$

$$p_{23,5} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{he} + \beta_{me})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{he} + \beta_{me})\}] \quad (31)$$

$$p_{24,5} = q_L[\{1 - p_3\}\{1 - \Phi(\beta_{he} + \beta_{h0})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(\beta_{he} + \beta_{h0})\}] \quad (32)$$

$$p_{25,5} = q_L[\{1 - p_3\}\{1 - \Phi(2\beta_{he})\}] + (1 - q_L)[\{1 - p_4\}\{1 - \Phi(2\beta_{he})\}] \quad (33)$$

## Column 6

$$\begin{aligned}
 p_{1,6} &= t_1[q_L\{(1-p_1)\Phi(0)+p_1((1-\Phi(0)))\}+(1-q_L)\{(1-p_2)\Phi(0)+p_2(1-\Phi(0))\}] \\
 &\hspace{15em} (1) \\
 p_{2,6} &= t_1[q_L\{(1-p_1)\Phi(\beta_{m0})+p_1((1-\Phi(\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0})+p_2(1-\Phi(\beta_{m0}))\}] \\
 &\hspace{15em} (2) \\
 p_{3,6} &= t_1[q_L\{(1-p_1)\Phi(\beta_{me})+p_1((1-\Phi(\beta_{me})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{me})+p_2(1-\Phi(\beta_{me}))\}] \\
 &\hspace{15em} (3) \\
 p_{4,6} &= t_1[q_L\{(1-p_1)\Phi(\beta_{h0})+p_1((1-\Phi(\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0})+p_2(1-\Phi(\beta_{h0}))\}] \\
 &\hspace{15em} (4) \\
 p_{5,6} &= t_1[q_L\{(1-p_1)\Phi(\beta_{he})+p_1((1-\Phi(\beta_{he})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{he})+p_2(1-\Phi(\beta_{he}))\}] \\
 &\hspace{15em} (5) \\
 p_{i,6} &= 0 \quad \forall \text{ other } i \hspace{15em} (6)
 \end{aligned}$$

## Column 7

$$\begin{aligned}
 p_{6,7} &= t_3[q_L\{(1-p_1)\Phi(\beta_{m0})+p_1((1-\Phi(\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0})+p_2(1-\Phi(\beta_{m0}))\}] \\
 &\hspace{15em} (7) \\
 p_{7,7} &= t_3[q_L\{(1-p_1)\Phi(2\beta_{m0})+p_1((1-\Phi(2\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(2\beta_{m0})+p_2(1-\Phi(2\beta_{m0}))\}] \\
 &\hspace{15em} (8) \\
 p_{8,7} &= t_3[q_L\{(1-p_1)\Phi(\beta_{m0}+\beta_{me})+p_1((1-\Phi(\beta_{m0}+\beta_{me})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0}+\beta_{me})+p_2(1-\Phi(\beta_{m0}+\beta_{me}))\}] \\
 &\hspace{15em} (9) \\
 p_{9,7} &= t_3[q_L\{(1-p_1)\Phi(\beta_{m0}+\beta_{h0})+p_1((1-\Phi(\beta_{m0}+\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0}+\beta_{h0})+p_2(1-\Phi(\beta_{m0}+\beta_{h0}))\}] \\
 &\hspace{15em} (10) \\
 p_{10,7} &= t_3[q_L\{(1-p_1)\Phi(\beta_{m0}+\beta_{he})+p_1((1-\Phi(\beta_{m0}+\beta_{he})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0}+\beta_{he})+p_2(1-\Phi(\beta_{m0}+\beta_{he}))\}] \\
 &\hspace{15em} (11) \\
 p_{i,7} &= 0 \quad \forall \text{ other } i \hspace{15em} (12)
 \end{aligned}$$

## Column 8

$$\begin{aligned}
 p_{11,8} &= t_2[q_L\{(1-p_3)\Phi(\beta_{me})+p_3((1-\Phi(\beta_{me})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me})+p_4(1-\Phi(\beta_{me}))\}] \\
 &\hspace{15em} (13) \\
 p_{12,8} &= t_2[q_L\{(1-p_3)\Phi(\beta_{me}+\beta_{m0})+p_3((1-\Phi(\beta_{me}+\beta_{m0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me}+\beta_{m0})+p_4(1-\Phi(\beta_{me}+\beta_{m0}))\}] \\
 &\hspace{15em} (14) \\
 p_{13,8} &= t_2[q_L\{(1-p_3)\Phi(2\beta_{me})+p_3((1-\Phi(2\beta_{me})))\}+(1-q_L)\{(1-p_4)\Phi(2\beta_{me})+p_4(1-\Phi(2\beta_{me}))\}] \\
 &\hspace{15em} (15) \\
 p_{14,8} &= t_2[q_L\{(1-p_3)\Phi(\beta_{me}+\beta_{h0})+p_3((1-\Phi(\beta_{me}+\beta_{h0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me}+\beta_{h0})+p_4(1-\Phi(\beta_{me}+\beta_{h0}))\}] \\
 &\hspace{15em} (16) \\
 p_{15,8} &= t_2[q_L\{(1-p_3)\Phi(\beta_{me}+\beta_{he})+p_3((1-\Phi(\beta_{me}+\beta_{he})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me}+\beta_{he})+p_4(1-\Phi(\beta_{me}+\beta_{he}))\}] \\
 &\hspace{15em} (17) \\
 p_{i,8} &= 0 \quad \forall \text{ other } i \hspace{15em} (18)
 \end{aligned}$$

Column 9

$$p_{16,9} = t_5[q_L\{(1-p_1)\Phi(\beta_{h0})+p_1((1-\Phi(\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0})+p_2(1-\Phi(\beta_{h0}))\}] \quad (19)$$

$$p_{17,9} = t_5[q_L\{(1-p_1)\Phi(\beta_{h0}+\beta_{m0})+p_1((1-\Phi(\beta_{h0}+\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0}+\beta_{m0})+p_2(1-\Phi(\beta_{h0}+\beta_{m0}))\}] \quad (20)$$

$$p_{18,9} = t_5[q_L\{(1-p_1)\Phi(\beta_{h0}+\beta_{me})+p_1((1-\Phi(\beta_{h0}+\beta_{me})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0}+\beta_{me})+p_2(1-\Phi(\beta_{h0}+\beta_{me}))\}] \quad (21)$$

$$p_{19,9} = t_5[q_L\{(1-p_1)\Phi(2\beta_{h0})+p_1((1-\Phi(2\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(2\beta_{h0})+p_2(1-\Phi(2\beta_{h0}))\}] \quad (22)$$

$$p_{20,9} = t_5[q_L\{(1-p_1)\Phi(\beta_{h0}+\beta_{he})+p_1((1-\Phi(\beta_{h0}+\beta_{he})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0}+\beta_{he})+p_2(1-\Phi(\beta_{h0}+\beta_{he}))\}] \quad (23)$$

$$p_{i,9} = 0 \quad \forall \text{ other } i \quad (24)$$

Column 10

$$p_{21,10} = t_4[q_L\{(1-p_3)\Phi(\beta_{he})+p_3((1-\Phi(\beta_{he})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he})+p_4(1-\Phi(\beta_{he}))\}] \quad (25)$$

$$p_{22,10} = t_4[q_L\{(1-p_3)\Phi(\beta_{he}+\beta_{m0})+p_3((1-\Phi(\beta_{he}+\beta_{m0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he}+\beta_{m0})+p_4(1-\Phi(\beta_{he}+\beta_{m0}))\}] \quad (26)$$

$$p_{23,10} = t_4[q_L\{(1-p_3)\Phi(\beta_{he}+\beta_{me})+p_3((1-\Phi(\beta_{he}+\beta_{me})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he}+\beta_{me})+p_4(1-\Phi(\beta_{he}+\beta_{me}))\}] \quad (27)$$

$$p_{24,10} = t_4[q_L\{(1-p_3)\Phi(\beta_{he}+\beta_{h0})+p_3((1-\Phi(\beta_{he}+\beta_{h0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he}+\beta_{h0})+p_4(1-\Phi(\beta_{he}+\beta_{h0}))\}] \quad (28)$$

$$p_{25,10} = t_4[q_L\{(1-p_3)\Phi(2\beta_{he})+p_3((1-\Phi(2\beta_{he})))\}+(1-q_L)\{(1-p_4)\Phi(2\beta_{he})+p_4(1-\Phi(2\beta_{he}))\}] \quad (29)$$

$$p_{i,10} = 0 \quad \forall \text{ other } i \quad (30)$$

Column 11: **Let**  $\iota = (1 - \mathbf{t}_1)$  **in column 11**

$$p_{1,11} = \iota[q_L\{(1-p_1)\Phi(0)+p_1((1-\Phi(0)))\}+(1-q_L)\{(1-p_2)\Phi(0)+p_2(1-\Phi(0))\}] \quad (31)$$

$$p_{2,11} = \iota[q_L\{(1-p_1)\Phi(\beta_{m0})+p_1((1-\Phi(\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0})+p_2(1-\Phi(\beta_{m0}))\}] \quad (32)$$

$$p_{3,11} = \iota[q_L\{(1-p_1)\Phi(\beta_{me})+p_1((1-\Phi(\beta_{me})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{me})+p_2(1-\Phi(\beta_{me}))\}] \quad (33)$$

$$p_{4,11} = \iota[q_L\{(1-p_1)\Phi(\beta_{h0})+p_1((1-\Phi(\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0})+p_2(1-\Phi(\beta_{h0}))\}] \quad (34)$$

$$p_{5,11} = \iota[q_L\{(1-p_1)\Phi(\beta_{he})+p_1((1-\Phi(\beta_{he})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{he})+p_2(1-\Phi(\beta_{he}))\}] \quad (35)$$

$$p_{i,11} = 0 \quad \forall \text{ other } i \quad (36)$$

Column 12: **Let**  $\iota = (1 - \mathbf{t}_3)$  **in column 12**

$$p_{6,12} = \iota[q_L\{(1-p_1)\Phi(\beta_{m0})+p_1((1-\Phi(\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0})+p_2(1-\Phi(\beta_{m0}))\}] \quad (37)$$

$$p_{7,12} = \iota[q_L\{(1-p_1)\Phi(2\beta_{m0})+p_1((1-\Phi(2\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(2\beta_{m0})+p_2(1-\Phi(2\beta_{m0}))\}] \quad (38)$$

$$p_{8,12} = \iota[q_L\{(1-p_1)\Phi(\beta_{m0}+\beta_{me})+p_1((1-\Phi(\beta_{m0}+\beta_{me})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0}+\beta_{me})+p_2(1-\Phi(\beta_{m0}+\beta_{me}))\}] \quad (39)$$

$$p_{9,12} = \iota[q_L\{(1-p_1)\Phi(\beta_{m0}+\beta_{h0})+p_1((1-\Phi(\beta_{m0}+\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0}+\beta_{h0})+p_2(1-\Phi(\beta_{m0}+\beta_{h0}))\}] \quad (40)$$

$$p_{10,12} = \iota[q_L\{(1-p_1)\Phi(\beta_{m0}+\beta_{he})+p_1((1-\Phi(\beta_{m0}+\beta_{he})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{m0}+\beta_{he})+p_2(1-\Phi(\beta_{m0}+\beta_{he}))\}] \quad (41)$$

$$p_{i,12} = 0 \quad \forall \text{ other } i \quad (42)$$

Column 13: **Let**  $\iota = (1 - \mathbf{t}_2)$  **in column 13**

$$p_{11,13} = \iota[q_L\{(1-p_3)\Phi(\beta_{me})+p_3((1-\Phi(\beta_{me})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me})+p_4(1-\Phi(\beta_{me}))\}] \quad (43)$$

$$p_{12,13} = \iota[q_L\{(1-p_3)\Phi(\beta_{me}+\beta_{m0})+p_3((1-\Phi(\beta_{me}+\beta_{m0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me}+\beta_{m0})+p_4(1-\Phi(\beta_{me}+\beta_{m0}))\}] \quad (44)$$

$$p_{13,13} = \iota[q_L\{(1-p_3)\Phi(2\beta_{me})+p_3((1-\Phi(2\beta_{me})))\}+(1-q_L)\{(1-p_4)\Phi(2\beta_{me})+p_4(1-\Phi(2\beta_{me}))\}] \quad (45)$$

$$p_{14,13} = \iota[q_L\{(1-p_3)\Phi(\beta_{me}+\beta_{h0})+p_3((1-\Phi(\beta_{me}+\beta_{h0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me}+\beta_{h0})+p_4(1-\Phi(\beta_{me}+\beta_{h0}))\}] \quad (46)$$

$$p_{15,13} = \iota[q_L\{(1-p_3)\Phi(\beta_{me}+\beta_{he})+p_3((1-\Phi(\beta_{me}+\beta_{he})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{me}+\beta_{he})+p_4(1-\Phi(\beta_{me}+\beta_{he}))\}] \quad (47)$$

$$p_{i,13} = 0 \quad \forall \text{ other } i \quad (48)$$

Column 14: **Let**  $\iota = (1 - \mathbf{t}_5)$  **in column 14**

$$p_{16,14} = \iota[q_L\{(1-p_1)\Phi(\beta_{h0})+p_1((1-\Phi(\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0})+p_2(1-\Phi(\beta_{h0}))\}] \quad (49)$$

$$p_{17,14} = \iota[q_L\{(1-p_1)\Phi(\beta_{h0}+\beta_{m0})+p_1((1-\Phi(\beta_{h0}+\beta_{m0})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0}+\beta_{m0})+p_2(1-\Phi(\beta_{h0}+\beta_{m0}))\}] \quad (50)$$

$$p_{18,14} = \iota[q_L\{(1-p_1)\Phi(\beta_{h0}+\beta_{me})+p_1((1-\Phi(\beta_{h0}+\beta_{me})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0}+\beta_{me})+p_2(1-\Phi(\beta_{h0}+\beta_{me}))\}] \quad (51)$$

$$p_{19,14} = \iota[q_L\{(1-p_1)\Phi(2\beta_{h0})+p_1((1-\Phi(2\beta_{h0})))\}+(1-q_L)\{(1-p_2)\Phi(2\beta_{h0})+p_2(1-\Phi(2\beta_{h0}))\}] \quad (52)$$

$$p_{20,14} = \iota[q_L\{(1-p_1)\Phi(\beta_{h0}+\beta_{he})+p_1((1-\Phi(\beta_{h0}+\beta_{he})))\}+(1-q_L)\{(1-p_2)\Phi(\beta_{h0}+\beta_{he})+p_2(1-\Phi(\beta_{h0}+\beta_{he}))\}] \quad (53)$$

$$p_{i,14} = 0 \quad \forall \text{ other } i \quad (54)$$

Column 15: **Let**  $\iota = (1 - \mathbf{t}_4)$  **in column 15**

$$p_{21,15} = \iota[q_L\{(1-p_3)\Phi(\beta_{he})+p_3((1-\Phi(\beta_{he})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he})+p_4(1-\Phi(\beta_{he}))\}] \quad (55)$$

$$p_{22,15} = \iota[q_L\{(1-p_3)\Phi(\beta_{he}+\beta_{m0})+p_3((1-\Phi(\beta_{he}+\beta_{m0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he}+\beta_{m0})+p_4(1-\Phi(\beta_{he}+\beta_{m0}))\}] \quad (56)$$

$$p_{23,15} = \iota[q_L\{(1-p_3)\Phi(\beta_{he}+\beta_{me})+p_3((1-\Phi(\beta_{he}+\beta_{me})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he}+\beta_{me})+p_4(1-\Phi(\beta_{he}+\beta_{me}))\}] \quad (57)$$

$$p_{24,15} = \iota[q_L\{(1-p_3)\Phi(\beta_{he}+\beta_{h0})+p_3((1-\Phi(\beta_{he}+\beta_{h0})))\}+(1-q_L)\{(1-p_4)\Phi(\beta_{he}+\beta_{h0})+p_4(1-\Phi(\beta_{he}+\beta_{h0}))\}] \quad (58)$$

$$p_{25,15} = \iota[q_L\{(1-p_3)\Phi(2\beta_{he})+p_3((1-\Phi(2\beta_{he})))\}+(1-q_L)\{(1-p_4)\Phi(2\beta_{he})+p_4(1-\Phi(2\beta_{he}))\}] \quad (59)$$

$$p_{i,15} = 0 \quad \forall \text{ other } i \quad (60)$$

Column 16:

$$p_{1,16} = t_3[q_L p_1 \Phi(0) + (1 - q_L) p_2 \Phi(0)] \quad (1)$$

$$p_{2,16} = t_3[q_L p_1 \Phi(\beta_{m0}) + (1 - q_L) p_2 \Phi(\beta_{m0})] \quad (2)$$

$$p_{3,16} = t_3[q_L p_1 \Phi(\beta_{me}) + (1 - q_L) p_2 \Phi(\beta_{me})] \quad (3)$$

$$p_{4,16} = t_3[q_L p_1 \Phi(\beta_{h0}) + (1 - q_L) p_2 \Phi(\beta_{h0})] \quad (4)$$

$$p_{5,16} = t_3[q_L p_1 \Phi(\beta_{he}) + (1 - q_L) p_2 \Phi(\beta_{he})] \quad (5)$$

$$p_{i,16} = 0 \quad \forall \text{ other } i \quad (6)$$

Column 17:

$$p_{6,17} = t_5[q_L p_1 \Phi(\beta_{m0}) + (1 - q_L) p_2 \Phi(\beta_{m0})] \quad (7)$$

$$p_{7,17} = t_5[q_L p_1 \Phi(2\beta_{m0}) + (1 - q_L) p_2 \Phi(2\beta_{m0})] \quad (8)$$

$$p_{8,17} = t_5[q_L p_1 \Phi(\beta_{m0} + \beta_{me}) + (1 - q_L) p_2 \Phi(\beta_{m0} + \beta_{me})] \quad (9)$$

$$p_{9,17} = t_5[q_L p_1 \Phi(\beta_{m0} + \beta_{h0}) + (1 - q_L) p_2 \Phi(\beta_{m0} + \beta_{h0})] \quad (10)$$

$$p_{10,17} = t_5[q_L p_1 \Phi(\beta_{m0} + \beta_{he}) + (1 - q_L) p_2 \Phi(\beta_{m0} + \beta_{he})] \quad (11)$$

$$p_{i,17} = 0 \quad \forall \text{ other } i \quad (12)$$

Column 18:

$$p_{11,18} = t_4[q_L p_3 \Phi(\beta_{me}) + (1 - q_L) p_4 \Phi(\beta_{me})] \quad (13)$$

$$p_{12,18} = t_4[q_L p_3 \Phi(\beta_{me} + \beta_{m0}) + (1 - q_L) p_4 \Phi(\beta_{me} + \beta_{m0})] \quad (14)$$

$$p_{13,18} = t_4[q_L p_3 \Phi(2\beta_{me}) + (1 - q_L) p_4 \Phi(2\beta_{me})] \quad (15)$$

$$p_{14,18} = t_4[q_L p_3 \Phi(\beta_{me} + \beta_{h0}) + (1 - q_L) p_4 \Phi(\beta_{me} + \beta_{h0})] \quad (16)$$

$$p_{15,18} = t_4[q_L p_3 \Phi(\beta_{me} + \beta_{he}) + (1 - q_L) p_4 \Phi(\beta_{me} + \beta_{he})] \quad (17)$$

$$p_{i,18} = 0 \quad \forall \text{ other } i \quad (18)$$

Column 19:

$$p_{16,19} = t_7[q_L p_1 \Phi(\beta_{h0}) + (1 - q_L) p_2 \Phi(\beta_{h0})] \quad (19)$$

$$p_{17,19} = t_7[q_L p_1 \Phi(\beta_{h0} + \beta_{m0}) + (1 - q_L) p_2 \Phi(\beta_{h0} + \beta_{m0})] \quad (20)$$

$$p_{18,19} = t_7[q_L p_1 \Phi(\beta_{h0} + \beta_{me}) + (1 - q_L) p_2 \Phi(\beta_{h0} + \beta_{me})] \quad (21)$$

$$p_{19,19} = t_7[q_L p_1 \Phi(2\beta_{h0}) + (1 - q_L) p_2 \Phi(2\beta_{h0})] \quad (22)$$

$$p_{20,19} = t_7[q_L p_1 \Phi(\beta_{h0} + \beta_{he}) + (1 - q_L) p_2 \Phi(\beta_{h0} + \beta_{he})] \quad (23)$$

$$p_{i,19} = 0 \quad \forall \text{ other } i \quad (24)$$

Column 20:

$$p_{21,20} = t_6[q_L p_3 \Phi(\beta_{he}) + (1 - q_L)p_4 \Phi(\beta_{he})] \quad (25)$$

$$p_{22,20} = t_6[q_L p_3 \Phi(\beta_{he} + \beta_{m0}) + (1 - q_L)p_4 \Phi(\beta_{he} + \beta_{m0})] \quad (26)$$

$$p_{23,20} = t_6[q_L p_3 \Phi(\beta_{he} + \beta_{me}) + (1 - q_L)p_4 \Phi(\beta_{he} + \beta_{me})] \quad (27)$$

$$p_{24,20} = t_6[q_L p_3 \Phi(\beta_{he} + \beta_{h0}) + (1 - q_L)p_4 \Phi(\beta_{he} + \beta_{h0})] \quad (28)$$

$$p_{25,20} = t_6[q_L p_3 \Phi(2\beta_{he}) + (1 - q_L)p_4 \Phi(2\beta_{he})] \quad (29)$$

$$p_{i,20} = 0 \quad \forall \text{ other } i \quad (30)$$

Column 21: **Let  $\iota = (1 - t_3)$  in column 21**

$$p_{1,21} = \iota[q_L p_1 \Phi(0) + (1 - q_L)p_2 \Phi(0)] \quad (31)$$

$$p_{2,21} = \iota[q_L p_1 \Phi(\beta_{m0}) + (1 - q_L)p_2 \Phi(\beta_{m0})] \quad (32)$$

$$p_{3,21} = \iota[q_L p_1 \Phi(\beta_{me}) + (1 - q_L)p_2 \Phi(\beta_{me})] \quad (33)$$

$$p_{4,21} = \iota[q_L p_1 \Phi(\beta_{h0}) + (1 - q_L)p_2 \Phi(\beta_{h0})] \quad (34)$$

$$p_{5,21} = \iota[q_L p_1 \Phi(\beta_{he}) + (1 - q_L)p_2 \Phi(\beta_{he})] \quad (35)$$

$$p_{i,21} = 0 \quad \forall \text{ other } i \quad (36)$$

Column 22: **Let  $\iota = (1 - t_5)$  in column 22**

$$p_{6,22} = \iota[q_L p_1 \Phi(\beta_{m0}) + (1 - q_L)p_2 \Phi(\beta_{m0})] \quad (37)$$

$$p_{7,22} = \iota[q_L p_1 \Phi(2\beta_{m0}) + (1 - q_L)p_2 \Phi(2\beta_{m0})] \quad (38)$$

$$p_{8,22} = \iota[q_L p_1 \Phi(\beta_{m0} + \beta_{me}) + (1 - q_L)p_2 \Phi(\beta_{m0} + \beta_{me})] \quad (39)$$

$$p_{9,22} = \iota[q_L p_1 \Phi(\beta_{m0} + \beta_{h0}) + (1 - q_L)p_2 \Phi(\beta_{m0} + \beta_{h0})] \quad (40)$$

$$p_{10,22} = \iota[q_L p_1 \Phi(\beta_{m0} + \beta_{he}) + (1 - q_L)p_2 \Phi(\beta_{m0} + \beta_{he})] \quad (41)$$

$$p_{i,22} = 0 \quad \forall \text{ other } i \quad (42)$$

Column 23: **Let  $\iota = (1 - t_4)$  in column 23**

$$p_{11,23} = \iota[q_L p_3 \Phi(\beta_{me}) + (1 - q_L)p_4 \Phi(\beta_{me})] \quad (43)$$

$$p_{12,23} = \iota[q_L p_3 \Phi(\beta_{me} + \beta_{m0}) + (1 - q_L)p_4 \Phi(\beta_{me} + \beta_{m0})] \quad (44)$$

$$p_{13,23} = \iota[q_L p_3 \Phi(2\beta_{me}) + (1 - q_L)p_4 \Phi(2\beta_{me})] \quad (45)$$

$$p_{14,23} = \iota[q_L p_3 \Phi(\beta_{me} + \beta_{h0}) + (1 - q_L)p_4 \Phi(\beta_{me} + \beta_{h0})] \quad (46)$$

$$p_{15,23} = \iota[q_L p_3 \Phi(\beta_{me} + \beta_{he}) + (1 - q_L)p_4 \Phi(\beta_{me} + \beta_{he})] \quad (47)$$

$$p_{i,23} = 0 \quad \forall \text{ other } i \quad (48)$$



Column 24: **Let**  $\iota = (1 - \mathbf{t}_7)$  **in column 24**

$$p_{16,24} = \iota[q_L p_1 \Phi(\beta_{h0}) + (1 - q_L) p_2 \Phi(\beta_{h0})] \quad (49)$$

$$p_{17,24} = \iota[q_L p_1 \Phi(\beta_{h0} + \beta_{m0}) + (1 - q_L) p_2 \Phi(\beta_{h0} + \beta_{m0})] \quad (50)$$

$$p_{18,24} = \iota[q_L p_1 \Phi(\beta_{h0} + \beta_{me}) + (1 - q_L) p_2 \Phi(\beta_{h0} + \beta_{me})] \quad (51)$$

$$p_{19,24} = \iota[q_L p_1 \Phi(2\beta_{h0}) + (1 - q_L) p_2 \Phi(2\beta_{h0})] \quad (52)$$

$$p_{20,24} = \iota[q_L p_1 \Phi(\beta_{h0} + \beta_{he}) + (1 - q_L) p_2 \Phi(\beta_{h0} + \beta_{he})] \quad (53)$$

$$p_{i,24} = 0 \quad \forall \text{ other } i \quad (54)$$

Column 25: **Let**  $\iota = (1 - \mathbf{t}_6)$  **in column 25**

$$p_{21,25} = \iota[q_L p_3 \Phi(\beta_{he}) + (1 - q_L) p_4 \Phi(\beta_{he})] \quad (55)$$

$$p_{22,25} = \iota[q_L p_3 \Phi(\beta_{he} + \beta_{m0}) + (1 - q_L) p_4 \Phi(\beta_{he} + \beta_{m0})] \quad (56)$$

$$p_{23,25} = \iota[q_L p_3 \Phi(\beta_{he} + \beta_{me}) + (1 - q_L) p_4 \Phi(\beta_{he} + \beta_{me})] \quad (57)$$

$$p_{24,25} = \iota[q_L p_3 \Phi(\beta_{he} + \beta_{h0}) + (1 - q_L) p_4 \Phi(\beta_{he} + \beta_{h0})] \quad (58)$$

$$p_{25,25} = \iota[q_L p_3 \Phi(2\beta_{he}) + (1 - q_L) p_4 \Phi(2\beta_{he})] \quad (59)$$

$$p_{i,25} = 0 \quad \forall \text{ other } i \quad (60)$$

## Technical Appendix 2: Unique values of total durables corresponding to 25 states

Recall that:

$$\beta_{m0} = w_H + w_L - c \quad (1)$$

$$\beta_{me} = w_H + w_L - c - e \quad (2)$$

$$\beta_{h0} = 2w_H - c \quad (3)$$

$$\beta_{he} = 2w_H - c - e \quad (4)$$

In the table below, we list the 25 different states that are possible in our model and the total household durables corresponding to each state (sum of elements of the state). Only unique values of total household durables are listed (recall that state  $(a, b)$  has the same total durables as state  $(b, a)$ ).

Serial No.	State $(\beta_{t-1}, \beta_t)$	Unique values of household durables in time t
1	$(0, 0)$	0
2	$(0, \beta_{m0})$	$\beta_{m0}$
3	$(0, \beta_{me})$	$\beta_{me}$
4	$(0, \beta_{h0})$	$\beta_{h0}$
5	$(0, \beta_{he})$	$\beta_{he}$
6	$(\beta_{m0}, 0)$	$\beta_{m0}$
7	$(\beta_{m0}, \beta_{m0})$	$2\beta_{m0}$
8	$(\beta_{m0}, \beta_{me})$	$\beta_{m0} + \beta_{me}$
9	$(\beta_{m0}, \beta_{h0})$	$\beta_{m0} + \beta_{h0}$
10	$(\beta_{m0}, \beta_{he})$	$\beta_{m0} + \beta_{he}$
11	$(\beta_{me}, 0)$	—
12	$(\beta_{me}, \beta_{m0})$	—
13	$(\beta_{me}, \beta_{me})$	$2\beta_{me}$
14	$(\beta_{me}, \beta_{h0})$	$\beta_{me} + \beta_{h0}$
15	$(\beta_{me}, \beta_{he})$	$\beta_{me} + \beta_{he}$
16	$(\beta_{h0}, 0)$	—
17	$(\beta_{h0}, \beta_{m0})$	—
18	$(\beta_{h0}, \beta_{me})$	—
19	$(\beta_{h0}, \beta_{h0})$	$2\beta_{h0}$
20	$(\beta_{h0}, \beta_{he})$	$\beta_{h0} + \beta_{he}$
21	$(\beta_{he}, 0)$	—
22	$(\beta_{he}, \beta_{m0})$	—
23	$(\beta_{he}, \beta_{me})$	—
24	$(\beta_{he}, \beta_{h0})$	—
25	$(\beta_{he}, \beta_{he})$	$2\beta_{he}$

The table above shows that there are 15 unique values of household durables that can possibly exist at any time.

Now, note that under the assumption  $c = 2w_L$ , the following conditions are also true:

$$\beta_{h0} = 2\beta_{m0} \tag{5}$$

$$\beta_{he} = \beta_{m0} + \beta_{me} \tag{6}$$

$$\beta_{m0} + \beta_{he} = \beta_{me} + \beta_{h0} \tag{7}$$

This reduces the number of unique values of total durables by 3. Hence there are 12 unique values of total durables that are possible in our model.