Table S5: R code for household cooking demand model and analysis

|  |
| --- |
| *#To use the model, modify appropriately for user directory and input data.*  *#Key input data files to run this code for Guatemala have been included at the end of the code*  *#For a public version of the model with input data files for another region visit -*  *#*[*http://data.ene.iiasa.ac.at/MESSAGE-Access/*](http://data.ene.iiasa.ac.at/MESSAGE-Access/)  #############################################################################  *############################ Sets working folder and load data ############################*  # Set the filepath to the appropriate local directory containing program files  setwd(' ')  # Load Survey Data and Parameters  filepath <- ('P:/ene.model/Access\_ Guatemala/')  load(paste(filepath,'lam/data/upds/R/Guatemala\_Survey2.RData',sep=''))  ############################################################################  *############################## Define scenario* #############################  dem <- 'geam\_base'  scen <- 'geam'  id <- 'nnp\_0'  coreid <- 'nnp'  itr <- 0  ps <- 0  ca <- 0  cainbms<-30  cagasst<-30  ss<-0.5  pslpgg <- 0  pselec <- 0  pslpggpcts <- ('0')  pslpgggrps <- ('R1,R2,R3,U1,U2,U3')  pslpggpcts <- ('90,90,90,90,90,90')  ##############################################################################  *########################## Define parameters*# ############################  MERtoPPP<-7.63394417/3.05  years<-as.character(c(seq(1990,2005,5),seq(2010,2110,10)))  new\_demand\_var <- c('a-c','b-c','c-c','d-c','A-c','B-c','C-c','D-c')  new\_dmd\_array <- array(NA, dim=c(length(new\_demand\_var),length(years)),  dimnames=list('variables'=new\_demand\_var,'years'=years))  ###############################################################################  *################## Get fuel price data from file* ####################  ### function to adjust data into an usable format##############  adj\_df <- function(df\_data)  { rownames(df\_data) <- df\_data[,1]  { if (ncol(df\_data)==2) { df\_data <- data.frame(df\_data[,-1,drop=FALSE]) }  else { df\_data <- data.frame(df\_data[,-1]) } }  colnames(df\_data) <- gsub('X','',colnames(df\_data))  df\_data }  ### function to read in fuel prices from tab files  message\_fuel\_prices <- function(scenario, coreident, iteration)  { if (iteration>=0) { filename <- paste(filepath,'glb/res/regres/fuel\_prices.tab',sep='') }  if (iteration< 0) { filename <- paste(filepath,'glb/res/regres/fuel\_prices.tab',sep='') }  skip <- 6 # this number determines what row of the cin file output R starts reading - must adjust if number of fuels is changed  nrows <- 6 # this number determines how many lines are read after the starting point defined above - must adjust the number of fuels is changed  result <- read.csv(filename, header=TRUE, sep='', skip=skip, nrows=nrows)  result <- adj\_df(result)  result }  ### define years  access\_years <- as.character(c(2005,seq(2010,2100,10)))  new\_years <- as.character(seq(2010,2100,10))  policy\_years <- as.character(seq(2020,2100,10))  avg\_years <- as.character(seq(2030,2090,10))  ############################ Guatemala Prices ###############################  prices\_2005 <- adj\_df(read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/fuel\_price\_2005.txt',sep=''), header=TRUE, sep='\t'))  itr\_0\_prices <- message\_fuel\_prices(scen,coreid,0)  itr\_0\_prices <- itr\_0\_prices\*MERtoPPP  adj\_2010 <- prices\_2005[,'fuel\_price']-itr\_0\_prices[,'2020']  MSG\_prices <- itr\_0\_prices+adj\_2010  MSG\_prices[MSG\_prices<0] <- 0  MSG\_prices[,'2005'] <- prices\_2005[,'fuel\_price']  MSG\_prices[,'2010'] <- prices\_2005[,'fuel\_price']  #############################################################################  ######## *Create an array with fields and variables needed to calculate demands #############*  exp\_grp <- c('R1','R2','R3','U1','U2')  stoves <- c('frwd\_three','frwd\_inbms','lpgg\_gasst','elec\_elest')  adv\_stv <- c('frwd\_inbms','lpgg\_gasst','elec\_elest')  thr\_stv <- c('frwd\_three')  all\_stv <- c('frwd\_three','frwd\_inbms','lpgg\_gasst')  stv\_eff <- c('frwd\_three'=0.15,'frwd\_inbms'=0.24,'lpgg\_gasst'=0.60,'elec\_elest'=0.75)  variables <- c('exp\_ppp\_pc','exp\_ppp\_hh','disc\_rate','hh\_size','ck\_dmd','frwd\_three','population','hh\_num','cook\_ratio','cook\_exp')  stv\_var <- c('lfyr','an\_stv','fuel\_price','cook\_price')  pp\_var <- c('pp\_diff','pp\_ratio')  dmd\_var <- c('orig\_dmd','demand\_UE')  fuels <- c('frwd','lpgg','elec')  years <- as.character(c(2005,seq(2010,2100,10)))  coeff <- c('a','b')  units <- c('GJ','GJ/cap','GWyr','GWyr\_FE')  tier1 <- c('lpgg\_gasst','elec\_elest')  tier2 <- c('frwd\_inbms')  ### dynamic groups ###  dyn\_grp <- c('R3'='exp\_grpR20','U2'='exp\_grpU20')  grp\_array <- array(NA, dim=c(length(exp\_grp),length(variables),length(years)),dimnames=list('exp\_grp'=exp\_grp,'variables'=variables,'years'=years))  stv\_array <- array(NA, dim=c(length(exp\_grp),length(stoves),length(stv\_var),length(years)),dimnames=list('exp\_grp'=exp\_grp,'stoves'=stoves,'variables'=stv\_var,'years'=years))  fuel\_adj\_array <- array(NA, dim=c(length(exp\_grp),length(fuels)),dimnames=list('exp\_grp'=exp\_grp,'fuels'=fuels))  stv\_coeff\_array <- array(NA, dim=c(length(exp\_grp),length(adv\_stv),length(coeff),length(years)),dimnames=list('exp\_grp'=exp\_grp,'stoves'=adv\_stv,'coeff'=coeff,'years'=years))  demand\_array <- array(NA, dim=c(length(exp\_grp),length(stoves),length(dmd\_var),length(years)),dimnames=list('exp\_grp'=exp\_grp,'stoves'=stoves,'variables'=dmd\_var,'years'=years))  MESSAGE\_demand <- array(NA, dim=c(length(exp\_grp),length(stoves),length(years),length(units)),dimnames=list('exp\_grp'=exp\_grp,'stoves'=stoves,'years'=years,'units'=units))  constraint\_array<- array(NA, dim=c(length(exp\_grp),length(adv\_stv),length(years)),dimnames=list('exp\_grp'=exp\_grp,'stoves'=adv\_stv,'years'=years))  ###############################################################################  ############### *Creates variables with current data* *and future projections* ################  ### expenditure per capita in ppp  v <- 'exp\_ppp\_pc'  exp\_ppp\_pc\_RU <- adj\_df(read.table(paste(filepath,'lam/data/upds/exp\_ppp\_pc\_',scen,'.txt',sep=''), header=TRUE, sep='\t'))  grp\_array[,v,] <- as.matrix(exp\_ppp\_pc\_RU)  ### hh size  v <- 'hh\_size'  hh\_size\_2005 <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/hh\_size\_2005.txt',sep=''), header=TRUE, sep='\t')  grp\_array[,v,] <- hh\_size\_2005[,v]  reg\_hh\_size <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/regress/regress\_hh\_size.txt',sep=''), header=TRUE, sep='\t')  y <- new\_years  for (d in names(dyn\_grp)) {  grp\_array[d,v,y] <- reg\_hh\_size[match(dyn\_grp[[d]],reg\_hh\_size[,'rururb']),'b']\*log(grp\_array[d,'exp\_ppp\_pc',y])+  reg\_hh\_size[match(dyn\_grp[[d]],reg\_hh\_size[,'rururb']),'a']  }  ### if the new household size is bigger than 2, it's adjusted to 2  grp\_array[,v,][grp\_array[,v,]<2] <- 2  ### hh expenditure ###  grp\_array[,'exp\_ppp\_hh',] <- grp\_array[,'exp\_ppp\_pc',]\*grp\_array[,'hh\_size',]  ### discount rate ###  v <- 'disc\_rate'  disc\_rate\_2005 <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/disc\_rate\_2005.txt',sep=''), header=TRUE, sep='\t')  grp\_array[,v,] <- disc\_rate\_2005[,v]  d <- names(dyn\_grp)  grp\_array[d,v,new\_years] <- -0.162\*log(grp\_array[d,'exp\_ppp\_hh',new\_years])+1.9558  ### cook ratio ###  v <- 'cook\_ratio'  cook\_ratio\_2005 <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/cook\_ratio\_2005.txt',sep=''), header=TRUE, sep='\t')  grp\_array[,v,] <- cook\_ratio\_2005[,v]  reg\_cook\_ratio <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/regress/regress\_cook\_ratio.txt',sep=''), header=TRUE, sep='\t')  y <- new\_years  for (d in names(dyn\_grp)) {  grp\_array[d,v,y] <- reg\_cook\_ratio[match(dyn\_grp[[d]],reg\_cook\_ratio[,'rururb']),'a']\*  (grp\_array[d,'exp\_ppp\_pc',y])^reg\_cook\_ratio[match(dyn\_grp[[d]],reg\_cook\_ratio[,'rururb']),'b'] }  ### cooking expenditure ###  v <- 'cook\_exp'  grp\_array[,v,] <- grp\_array[,'cook\_ratio',]\*grp\_array[,'exp\_ppp\_pc',]  for(d in names(dyn\_grp)) {  max\_year <- names(which.max(grp\_array[d,v,]))  if (max\_year!='2100')  { adj\_year <- as.character(seq(as.numeric(max\_year),2100,10))  grp\_array[d,'cook\_ratio',adj\_year] <- grp\_array[d,'cook\_ratio',max\_year]  grp\_array[d,v,adj\_year] <- grp\_array[d,'cook\_ratio',adj\_year]\*grp\_array[d,'exp\_ppp\_pc',adj\_year] }  }  #### Create Array of pre-credit adjustment discount rates ###  old\_disc\_rate<-grp\_array[,'disc\_rate',]  ######################################################  ### credit access case adjustment ###  if (ca!=0) { grp\_array[,'disc\_rate',policy\_years][grp\_array[,'disc\_rate',policy\_years]>(ca/100)] <- (ca/100) }  ### Targeted Stove Loan: Improved Biomass Stoves  disc\_inbms <- array(NA, dim=c(length(exp\_grp),length(years)),dimnames=list('exp\_grp'=exp\_grp,'years'=years))  disc\_inbms <- grp\_array[,'disc\_rate',]  cainbms<-as.numeric(cainbms)  if (cainbms!=0) { disc\_inbms[,policy\_years][disc\_inbms[,policy\_years]>(cainbms/100)] <- (cainbms/100) }  ### Targeted Stove Loan: LPG Stoves  disc\_gasst <- array(NA, dim=c(length(exp\_grp),length(years)),dimnames=list('exp\_grp'=exp\_grp,'years'=years))  disc\_gasst <- grp\_array[,'disc\_rate',]  cagasst<-as.numeric(cagasst)  #if (cagasst!=0) { disc\_gasst[,policy\_years][disc\_gasst[,policy\_years]>(cagasst/100)] <- (cagasst/100) }  if (cagasst!=0) {  cagasstpcts<-as.numeric(unlist(eval(strsplit(cagasstpcts,','))))  names(cagasstpcts)<-unlist(eval(strsplit(cagasstgrps,',')))  for (g in exp\_grp){ disc\_gasst[g,policy\_years][disc\_gasst[g,policy\_years]>(cagasstpcts[g]/100)] <- (cagasstpcts[g]/100)}  }  ######################################################  ### cooking demand ###  v <- 'ck\_dmd'  dmd\_2005 <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/ck\_dmd\_2005.txt',sep=''), header=TRUE, sep='\t')  grp\_array[,v,] <- dmd\_2005[,v]  reg\_dmd <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/regress/regress\_demand.txt',sep=''), header=TRUE, sep='\t')  y <- new\_years  for (d in names(dyn\_grp)) {  grp\_array[d,v,y] <- (reg\_dmd[match(dyn\_grp[[d]],reg\_dmd[,'rururb']),'b']\*log(grp\_array[d,'exp\_ppp\_pc',y])+  reg\_dmd[match(dyn\_grp[[d]],reg\_dmd[,'rururb']),'a'])\*grp\_array[d,'hh\_size',y]}  ### population data from text file ###  population <- adj\_df(read.table(paste(filepath,'lam/data/upds/population.txt',sep=''), header=TRUE, sep='\t'))  grp\_array[,'population',] <- as.matrix(population)  grp\_array[,'hh\_num',] <- grp\_array[,'population',]/grp\_array[,'hh\_size',]  ### stove characteristics ###  stove\_char <- adj\_df(read.table(paste(filepath,'lam/data/upds/R/Guatemala/stv\_char.txt',sep=''), header=TRUE, sep='\t'))  stove\_char$fuel <- as.character(stove\_char$fuel)  ### life year of stoves ###  lfyr\_2005 <- stove\_char$lfyr #replaced above line w this bc it means one less file to create (lfyr\_2005.txt)  for (g in exp\_grp) { stv\_array[g,,'lfyr',] <- as.matrix(lfyr\_2005) }  ### annualised stove price ###  for (s in stoves) {  stv\_array[,s,'an\_stv',] <- stove\_char[s,'price']\*grp\_array[,'disc\_rate',]\*(1+grp\_array[,'disc\_rate',])^(stv\_array[,s,'lfyr',])/  ((1+grp\_array[,'disc\_rate',])^stv\_array[,s,'lfyr',]-1)}  # Biomass Stove Loan  if (cainbms!=0){  s<-'frwd\_inbms'  stv\_array[,s,'an\_stv',] <- stove\_char[s,'price']\*disc\_inbms\*(1+disc\_inbms)^(stv\_array[,s,'lfyr',])/  ((1+disc\_inbms)^stv\_array[,s,'lfyr',]-1)}  # LPG Stove Loan  if (cagasst!=0){  s<-'lpgg\_gasst'  stv\_array[,s,'an\_stv',] <- stove\_char[s,'price']\*disc\_gasst\*(1+disc\_gasst)^(stv\_array[,s,'lfyr',])/  ((1+disc\_gasst)^stv\_array[,s,'lfyr',]-1)}  ### fuel price ###  v <- 'fuel\_price'  prices\_2005 <- adj\_df(read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/fuel\_price\_2005.txt',sep=''), header=TRUE, sep='\t'))  fuel\_adj\_2005 <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/fuel\_adj\_2005.txt',sep=''), header=TRUE, sep='\t')  options(warn=-1)  fuel\_adj\_2005[,'factor'] <- as.numeric(as.character(fuel\_adj\_2005[,'factor']))  options(warn= 1)  for (f in fuels) {  for (g in exp\_grp) {  fuel\_adj\_array[g,f] <- fuel\_adj\_2005[fuel\_adj\_2005[,'fuel']==f & fuel\_adj\_2005[,'grp']==g,][['factor']]  }  }  for (s in stoves) {  stv\_array[,s,v,'2005'] <- prices\_2005[stove\_char[s,'fuel'],]\*fuel\_adj\_array[,stove\_char[s,'fuel']]  for (y in new\_years) {  stv\_array[,s,v,y] <- MSG\_prices[stove\_char[s,'fuel'],y]\*fuel\_adj\_array[,stove\_char[s,'fuel']]  }  }  # create copy of stv\_array with different name as basis for subsidy calculation  stv\_price\_temp <-stv\_array  # lpg fuel subsidy  if (pslpgg!=0){  pslpggpcts<-as.numeric(unlist(eval(strsplit(pslpggpcts,','))))  names(pslpggpcts)<-unlist(eval(strsplit(pslpgggrps,',')))  for (g in unlist(eval(strsplit(pslpgggrps,',')))){  for (y in policy\_years) {  stv\_array[g,'lpgg\_gasst', 'fuel\_price', y]<-stv\_price\_temp[g,'lpgg\_gasst','fuel\_price',y]\*(1-pslpggpcts[g]/100)  }  }  }  # elec fuel subsidy  if (pselec!=0){  pselecpcts<-as.numeric(unlist(eval(strsplit(pselecpcts,','))))  names(pselecpcts)<-unlist(eval(strsplit(pselecgrps,',')))  for (g in unlist(eval(strsplit(pselecgrps,',')))){  for (y in policy\_years) {  stv\_array[g,'elec\_elest', 'fuel\_price', y]<-stv\_price\_temp[g,'elec\_elest','fuel\_price',y]\*(1-pselecpcts[g]/100)  }  }  }  ### total cooking price ###  v <- 'cook\_price'  for (s in stoves) {  stv\_array[,s,v,] <- (stv\_array[,s,'fuel\_price',]/stove\_char[s,][['eff']]) +  (stv\_array[,s,'an\_stv',]/grp\_array[,'ck\_dmd',])  }  ###############################################################  ###################### *Estimating fuel/stove demands by groups* ######################  ### create a matrix with coefficients ###  coeff\_exp\_grp <- read.table(paste(filepath,'lam/data/upds/R/Guatemala/2005/coeff\_exp\_grp\_2005.txt',sep=''), header=TRUE, sep='\t')  for (s in adv\_stv) {  for (g in exp\_grp) {  stv\_coeff\_array[g,s,'a',] <- coeff\_exp\_grp[coeff\_exp\_grp[,'stove']==s & coeff\_exp\_grp[,'grp']==g,][['a']]  stv\_coeff\_array[g,s,'b',] <- coeff\_exp\_grp[coeff\_exp\_grp[,'stove']==s & coeff\_exp\_grp[,'grp']==g,][['b']]  }  }  ### adjust coefficients 'a' for the future years for dynamic groups to reflect increase in their purchasing power  for (tech in adv\_stv) {  for (g in names(dyn\_grp)) {  ### increase in purchasing power compared to 2005 is added to the coefficient a  stv\_coeff\_array[g,tech,'a',] <- stv\_coeff\_array[g,tech,'a',]+(grp\_array[g,'cook\_exp',]-grp\_array[g,'cook\_exp','2005'])  }  }  for (s in adv\_stv){  constraint\_array[,s,]<-grp\_array[,'ck\_dmd',]  }  s<-'frwd\_inbms'  old\_yr<-c('2005','2010')  constraint\_array[,s,old\_yr]<-grp\_array[,'ck\_dmd',old\_yr]\*0.1  ########################################  ### calculate demands for non-three stoves using demand curves ###  v <- 'orig\_dmd'  for (s in adv\_stv) {  demand\_array[,s,v,] <- (stv\_array[,s,'cook\_price',]/stv\_coeff\_array[,s,'a',])^(1/stv\_coeff\_array[,s,'b',])  ## demand adjustment for the dynamic groups  demand\_array[,s,v,] <- demand\_array[,s,v,]\*(grp\_array[,'ck\_dmd',]/grp\_array[,'ck\_dmd','2005'])  ## if demands are NA, its replaced by 0  demand\_array[,s,v,][is.na(demand\_array[,s,v,])] <- 0  }  # Tier 1 Demand  ## Tier 1 cooking price array  tier1\_cookprice <- array(NA, dim=c(length(exp\_grp),length(tier1),length(years)),  dimnames=list('exp\_grp'=exp\_grp,'stoves'=tier1,'years'=years))  for (s in tier1){  for (g in exp\_grp){  for (y in years){  tier1\_cookprice[g,s,y] <- stv\_array[g,s,'cook\_price',y]  }  }  }  ### Calculate Tier 1 Demand  for (g in exp\_grp){  for (y in years){  totdmd<-0  # set s = cheapest fuel for that tier, exp\_grp, and year  s <- names(tier1\_cookprice[g,,y])[order(tier1\_cookprice[g,,y])[1]]  ########################################### 5% BUFFER ##########################  #tier1\_cookprice[g,s,y]>0 &&  if (y!='2005'){  if ((abs(tier1\_cookprice[g,s,y]-tier1\_cookprice[g,s\_old,y])/tier1\_cookprice[g,s,y])<0.05){  s<-s\_old  }  }  ##################################################################################  demand\_array[g,s,'demand\_UE',y]<-min(demand\_array[g,s,'orig\_dmd',y],constraint\_array[g,s,y],grp\_array[g,'ck\_dmd',y])  totdmd<-demand\_array[g,s,'demand\_UE',y]  s\_old <- s  # loop through stove types in that tier from 2nd cheapest to most expensive  tcp <- tier1\_cookprice[g,,y][names(tier1\_cookprice[g,,y])!=s]  for (i in order(tcp)) {  s2<-names(tcp)[i]  if (min(constraint\_array[g,s2,y],demand\_array[g,s2,'orig\_dmd',y])<=totdmd){  demand\_array[g,s2,'demand\_UE',y]<-0  } else if (demand\_array[g,s2,'orig\_dmd',y]<min(constraint\_array[g,s2,y],grp\_array[g,'ck\_dmd',y])){  demand\_array[g,s2,'demand\_UE',y]<-demand\_array[g,s2,'orig\_dmd',y]-totdmd  } else {demand\_array[g,s2,'demand\_UE',y]<-min(constraint\_array[g,s2,y],grp\_array[g,'ck\_dmd',y])-totdmd}  totdmd<-totdmd+demand\_array[g,s2,'demand\_UE',y]  }  }  }  # Total Tier 1 demand  tier1\_totdmd<-array(NA, dim=c(length(exp\_grp),length(years)),  dimnames=list('exp\_grp'=exp\_grp,'years'=years))  for (y in years){  for (g in exp\_grp){  tier1\_totdmd[g,y]<-sum(demand\_array[g,,"demand\_UE",y],na.rm=T)  }  }  ### Tier 2 cooking price array  tier2\_cookprice <- array(NA, dim=c(length(exp\_grp),length(tier2),length(years)),  dimnames=list('exp\_grp'=exp\_grp,'stoves'=tier2,'years'=years))  for (s in tier2){  for (g in exp\_grp){  for (y in years){  tier2\_cookprice[g,s,y] <- stv\_array[g,s,'cook\_price',y]  }  }  }  ### Calculate Tier 2 Demand  for (y in years){  for (g in exp\_grp){  s<-'frwd\_inbms'  if ((demand\_array[g,s,'orig\_dmd',y])>min(constraint\_array[g,s,y],(round(grp\_array[g,'ck\_dmd',y],4)-round(tier1\_totdmd[g,y],4))))  {demand\_array[g,s,'demand\_UE',y]<-min(constraint\_array[g,s,y],(round(grp\_array[g,'ck\_dmd',y],4)-round(tier1\_totdmd[g,y],4)))}  else {demand\_array[g,s,'demand\_UE',y]<-demand\_array[g,s,'orig\_dmd',y]}  }  }  # Total advanced stove demand  tier12\_totdmd<-array(NA, dim=c(length(exp\_grp),length(years)),  dimnames=list('exp\_grp'=exp\_grp,'years'=years))  for (y in years){  for (g in exp\_grp){  tier12\_totdmd[g,y]<-sum(demand\_array[g,,"demand\_UE",y],na.rm=T)  }}  ### Three stone stove demand ###  f='frwd\_three'  d='demand\_UE'  for (y in years){  for (g in exp\_grp){  demand\_array[g,f,d,y]<-round(grp\_array[g,'ck\_dmd',y],4)-round(tier12\_totdmd[g,y],4)  }  }  ### adjust if estimate exceeds expected demand  MESSAGE\_demand[,,,'GJ'] <- demand\_array[,,'demand\_UE',]  for (y in years) {  ## set all the negative values to zero  MESSAGE\_demand[,,y,'GJ'][MESSAGE\_demand[,,y,'GJ']<0] <- 0  }  ### convert to GWyr and multiply by number of hhs ###  for (s in stoves) { MESSAGE\_demand[,s,,'GWyr']<- MESSAGE\_demand[,s,,'GJ']\*grp\_array[,'hh\_num',]\*1e6 }  MESSAGE\_demand[,,,'GWyr'] <- MESSAGE\_demand[,,,'GWyr']\*(1/3.6)\*(1/1000)\*(1/8760)  for (grp in exp\_grp) { MESSAGE\_demand[grp,,,'GWyr\_FE'] <- MESSAGE\_demand[grp,,,'GWyr']/stv\_eff }  for (s in all\_stv){  MESSAGE\_demand[,s,,'GJ/cap']<-MESSAGE\_demand[,s,,'GJ']/grp\_array[,'hh\_size',]  }  capture.output(print(round(MESSAGE\_demand,4), print.gap=3),file=paste(filepath2,coreid,'\_MESSAGE\_demand.upd',sep =''))  # This is the effective demand output by expenditure group, and period: 'MESSAGE\_demand'  # This data can be used to estimate emissions and policy costs  }  #-----------------  # END  #-----------------  -----------------  INPUT DATA FILES  -----------------  fuel\_price\_2005.txt  fuel fuel\_price  frwd 13.57719  lpgg 55.41017  elec 122.8793  exp\_ppp\_pc\_geam.txt  grp 2005 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100  R1 429.7 429.7 429.7 429.7 429.7 429.7 429.7 429.7 429.7 429.7 429.7  R2 1200.7 1200.7 1200.7 1200.7 1200.7 1200.7 1200.7 1200.7 1200.7 1200.7 1200.7  R3 4453.0 4652.7 6453.4 9940.4 15062.6 21790.1 29993.2 40104.7 52562.1 68264.7 88388.2  U1 1115.8 1115.8 1115.8 1115.8 1115.8 1115.8 1115.8 1115.8 1115.8 1115.8 1115.8  U2 7263.5 7282.5 10548.1 15573.3 21301.4 27256.3 33033.3 38969.1 45215.1 52149.5 60106.2  hh\_size\_2005.txt  grp hh\_size  R1 6.4212  R2 5.6894  R3 4.8334  U1 5.3383  U2 4.2372  regress\_hh\_size.txt  rururb a b  exp\_grpR20 11.7622 -0.8465  exp\_grpU20 9.8379 -0.6487  disc\_rate\_2005.txt  grp disc\_rate  R1 0.6723  R2 0.5501  R3 0.3951  U1 0.5791  U2 0.3514  cook\_ratio\_2005.txt  fuel cook\_ratio  R1 0.2218  R2 0.1037  R3 0.0371  U1 0.1269  U2 0.0258  regress\_cook\_ratio.txt  rururb a b  exp\_grpR20 22.07 -0.755  exp\_grpU20 38.165 -0.811  ck\_dmd\_2005.txt  grp ck\_dmd  R1 13.7751  R2 10.8580  R3 7.9409  U1 13.7751  U2 8.7261  regress\_demand.txt  rururb a b  exp\_grpR20 1.6812 0.0809  exp\_grpU20 2.5136 -0.1083  population.txt  grp 2005 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100  R1 1.716 1.781 0.991 0.409 0.176 0.073 0.026 0.001 0.000 0.000 0.000  R2 2.289 2.428 2.041 1.334 0.859 0.574 0.411 0.299 0.207 0.143 0.097  R3 2.708 3.056 5.101 6.799 7.604 7.864 8.004 7.986 7.854 7.647 7.386  U1 1.223 1.447 1.168 0.788 0.539 0.376 0.273 0.190 0.118 0.056 0.003  U2 4.774 5.664 8.790 12.362 15.707 18.593 21.366 23.568 25.101 25.988 26.287  stv\_char.txt  stove fuel eff lfyr price  frwd\_three frwd 0.15 3 0.00  frwd\_inbms frwd 0.25 10 100.00  lpgg\_gasst lpgg 0.6 15 164.96  elec\_elest elec 0.75 15 205.56  coeff\_exp\_grp\_2005.txt  stove grp a b  frwd\_inbms R1 111.1851 -0.5985  frwd\_inbms R2 133.6494 -0.6271  frwd\_inbms R3 91.8983 -0.4151  frwd\_inbms U1 100.9593 -0.4258  frwd\_inbms U2 61.0530 -0.2754  lpgg\_gasst R1 53.0895 -0.4133  lpgg\_gasst R2 98.6868 -0.3251  lpgg\_gasst R3 110.0172 -0.2363  lpgg\_gasst U1 139.2596 -0.3207  lpgg\_gasst U2 136.8973 -0.2113  elec\_elest R1 53.0895 -0.4133  elec\_elest R2 98.6868 -0.3251  elec\_elest R3 110.0172 -0.2363  elec\_elest U1 139.2596 -0.3207  elec\_elest U2 136.8973 -0.2113 |