Fixed effect estimation of repayment

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15:02

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Contents

Need: packages lmtest, sandwich.

```
pathsaveHere ← pathsaveEstimationMemo
adw ← readRDS(paste0(path1234, "admin_data_wide.rds"))
adw[, PlannedInstallment := 120]
adw[grepl("gr|cow", Arm), PlannedInstallment := 190]
adw[, Shortfall := PlannedInstallment - value.repay]
adw[, ShortfallRate := Shortfall/PlannedInstallment]
adw[, MonthsRepaid := MonthsElapsed]
adw[grepl("gr|cow", Arm), MonthsRepaid := MonthsRepaid - 12]
adw[, MeanGRSR := mean(ShortfallRate[grepl("Yes", creditstatus) &
    !is.na(MonthsElapsed) & MonthsRepaid ≥ 1 & MonthsRepaid ≤ 6],
  na.rm = T), by = groupid]
MedianGRSR ← median(unique(adw[, .(groupid, MeanGRSR)])[, MeanGRSR],
  na.rm = T)
# adw[, GRSR := "low"]
# adw[MeanGRSR > MedianGRSR, GRSR := "high"]
# adw[, GRSR := factor(GRSR, levels = c("low", "high"))]
# adwG ← adw[, .(groupid, hhid, Shortfall, ShortfallRate, PlannedInstallment,
#   GRSR, MeanGRSR, MonthsRepaid, Date)]
# MedianGRSR ← median(unique(adw[, .(groupid, MeanGRSR)])[, MeanGRSR],
#   na.rm = T)
# merge(adw2, adwG, by = intersect(colnames(adw2), colnames(adwG)), all.X = T)
adw2 ← readRDS(paste0(path1234, "admin_data_wide2.rds"))
variablesToBeLagged ←
  c("Shortfall", "value.repay", "value.sav", "value.NetSaving",
   "value.cost", "value.rev", "value.missw", "Profit",
   "CumRepaid", "CumRepaidRate", "CumEffectiveRepaidRate", "CumMisses",
   "CumNetSaving", "CumProfit",
    "MeanGroupShortfall", "GroupNetSaving", "CumGroupNetSaving",
    "OtherShortfall", "OtherRepaid", "CumOtherRepaid", "CumOtherRepaidRate",
    "OtherNetSaving", "CumOtherNetSaving", "OtherProfit", "CumOtherProfit",
    "OtherMisses", "CumOtherMisses", "OtherCost", "OtherRevenue")
adw2[, paste0("Lag", variablesToBeLagged) :=
  shift(.SD, type = "lag"), by = hhid, .SDcols=variablesToBeLagged]
source("c:/migrate/R/startRbat/panel_estimator_functions.R")
# MonthsRepaid > 0: Only traditional has FirstYear as repayment
X ← adw2[MonthsElapsed > 0 & MonthsElapsed ≤ 36 &
    grepl("es", creditstatus) & FullyRepaid == 0 & as.Date(DisDate1) ≤ as.Date("2015-01-0
    .(value.repay, Lagvalue.repay, value.missw, Lagvalue.missw,
    value.sav, Lagvalue.sav, value.NetSaving, Lagvalue.NetSaving,
    Profit, LagProfit, value.cost, value.rev, Lagvalue.cost, Lagvalue.rev,
    Shortfall, LagShortfall, ShortfallRate,
    MeanGroupShortfall, LagMeanGroupShortfall, OtherShortfall, LagOtherShortfall,
    CumNetSaving, LagCumNetSaving,
    LagGroupNetSaving, LagCumGroupNetSaving,
    OtherNetSaving, LagOtherNetSaving,
    CumOtherNetSaving, LagCumOtherNetSaving,
    CumProfit, LagCumProfit,
    CumRepaid, LagCumRepaid,
    CumRepaidRate, LagCumRepaidRate,
    CumEffectiveRepaidRate, LagCumEffectiveRepaidRate,
    CumOtherRepaidRate, LagCumOtherRepaidRate,
    OtherRepaid, LagOtherRepaid, OtherMisses, LagOtherMisses,
    OtherProfit, LagOtherProfit, CumOtherProfit, LagCumOtherProfit,
    OtherCost, LagOtherCost, OtherRevenue, LagOtherRevenue,
```

```
    CumOtherRepaid, LagCumOtherRepaid,
    Arm, groupid, hhid, povertystatus, creditstatus, membershipstatus, GRSR,
    TradGroup, Date, LoanYear,
    MonthsElapsed, MonthsRepaid, Year, Month, StartedIn2013,
    FirstYear, SecondYear, ThirdYear)]
X[, c("LagCumRepaidRateSQ", "LagCumOtherRepaidRateSQ") :=
  .(LagCumRepaidRate^(2), LagCumOtherRepaidRate^(2))]
X[, c("LagMeanGroupNetSaving", "LagMeanCumGroupNetSaving") :=
  .(LagGroupNetSaving/.N, LagCumGroupNetSaving/.N), by = .(groupid, Date)]
X[, LagMeanCumGroupNetSaving := LagCumGroupNetSaving/1000]
X[, c("UltraPoor", "ModeratelyPoor") := 0L]
X[grepl("ltra", povertystatus), UltraPoor := 1L]
X[!grepl("ltra", povertystatus), ModeratelyPoor := 1L]
```

If I take village*Date fixed effects, mean of Arm*Date becomes zero hence changes by Arm*Year are elimiated. So I will take village fixed effects and date (=year-month) fixed effects (not their interaction).

```
for (i in which(grepl("val|Lag|Shor|Savi|Prof|Miss|Othe|Cum", colnames(X)) &
 !grepl("GroupShortf|LagGroupNetSav", colnames(X)))) {
  X[, colnames(X)[i] := eval(parse(text=colnames(X)[i])) -
    mean(eval(parse(text=colnames(X)[i])), na.rm = T),
    by = groupid]
  X[, colnames(X)[i] := eval(parse(text=colnames(X)[i])) -
    mean(eval(parse(text=colnames(X)[i])), na.rm = T),
    by = Date]
}
```

```
# take only 1st member to form group level data
X[, gnum := 1:.N, by = .(groupid, Date)]
X[, Attributes := "traditional"]
X[!grepl("tra", Arm), Attributes := "LargeSize"]
X[grepl("gr|co", Arm), Attributes := "WithGrace"]
X[grepl("co", Arm), Attributes := "InKind"]
X[, Attributes := factor(Attributes,
  levels = c("traditional", "LargeSize", "WithGrace", "InKind"))]
X1 ← X[gnum == 1, ]
# group shortfall regressions
vfesg1 ← lm(MeanGroupShortfall ~
  GRSR + GRSR:LagMeanGroupShortfall, data = X1)
vfesg2 ← lm(MeanGroupShortfall ~
  Arm + Arm:SecondYear + Arm:ThirdYear,
  data = X1)
vfesg3 ← lm(MeanGroupShortfall ~
  Attributes + Attributes:SecondYear + Attributes:ThirdYear,
  data = X1)
vfesg4 ← lm(MeanGroupShortfall ~
  GRSR + Arm + GRSR:LagMeanGroupShortfall +
  Arm:SecondYear + Arm:ThirdYear +
  UltraPoor + UltraPoor:Arm:SecondYear + UltraPoor:Arm:ThirdYear +
  LagMeanGroupShortfall +
  LagMeanGroupNetSaving + LagMeanCumGroupNetSaving,
  data = X1)
vfesg5 ← lm(MeanGroupShortfall ~
  GRSR + Attributes + GRSR:LagMeanGroupShortfall +
  Attributes:SecondYear + Attributes:ThirdYear +
  UltraPoor + UltraPoor:Attributes:SecondYear + UltraPoor:Attributes:ThirdYear +
```

```
  LagMeanGroupShortfall +
  LagMeanGroupNetSaving + LagMeanCumGroupNetSaving,
  data = X1)
# individual shortfall regressions
vfes1 ← lm(Shortfall ~
  GRSR + GRSR:LagMeanGroupShortfall, data = X)
vfes2 ← lm(Shortfall ~
  Arm + Arm:SecondYear + Arm:ThirdYear,
  data = X)
vfes3 ← lm(MeanGroupShortfall ~
  Attributes + Attributes:SecondYear + Attributes:ThirdYear,
  data = X)
vfes4 ← lm(Shortfall ~
  GRSR + Arm + GRSR:LagMeanGroupShortfall +
  Arm:SecondYear + Arm:ThirdYear +
  UltraPoor + UltraPoor:Arm:SecondYear + UltraPoor:Arm:ThirdYear +
  LagShortfall + LagMeanGroupShortfall +
  LagMeanGroupNetSaving + LagMeanCumGroupNetSaving,
  data = X)
vfes5 ← lm(Shortfall ~
  GRSR + Attributes + GRSR:LagMeanGroupShortfall +
  Attributes:SecondYear + Attributes:ThirdYear +
  UltraPoor + UltraPoor:Attributes:SecondYear + UltraPoor:Attributes:ThirdYear +
  LagShortfall + LagMeanGroupShortfall +
  LagMeanGroupNetSaving + LagMeanCumGroupNetSaving,
  data = X)
subst.table ← matrix(
  c("Arm|Attributes|povertystatus|^se\\$.*|^p\\$.*", "",
    "traditional:", "",
    "large g", "LargeG",
    "large", "Large",
    "cow", "Cow",
    "(.*):SecondYear:(.*)", "\\1 $\\\\times$ \\2 $\\\\times$ LY2",
    "(.*):ThirdYear:(.*)", "\\1 $\\\\times$ \\2 $\\\\times$ LY3",
    "(.*):SecondYear$", "\\1 $\\\\times$ LY2",
    "(.*):ThirdYear$", "\\1 $\\\\times$ LY3",
    "SecondYear:U.*", "UltraPoor $\\\\times$ LY2",
    "ThirdYear:U.*", "UltraPoor $\\\\times$ LY3",
    "SecondYear", "LY2",
    "ThirdYear", "LY3",
    "MonthsE", "Months E",
    "Month([JFMASOND])", "\\1",
    ":", " $\\\\times$ ",
    "I\\((.*?)\\)", "\\1",
    "Lag(.*?)-Lag", "\\1$_{t-1}-$Lag",
    "Lag(.*)", "\\1$_{t-1}$",
    "value.repay", "repayment",
    #"MeanGroupS.*l\\$", "per member group shortfall$",
    "MeanGroupS.*l\\$", "group shortfall$", # it is per member, but too long to show
    "^OtherR.*d\\$", "Mean other repayment$",
    "^CumR.*d\\$", "Cumulative repayment$",
    "^CumR.*e\\$", "Cumulative repayment rate$",
    "^CumR.*Q\\$", "Cumulative repayment rate$^{2}",
    "^CumN.*g\\$", "Cumulative net saving$",
    "CumOtherO.*d\\$", "Other cumulative repayments$",
    "CumOtherR.*e\\$", "Other cumulative repayment rate$",
```

```
    "CumOtherR.*Q\\$", "Other cumulative repayment rate$^{2}",
    "MeanCumGroupNet.*g\\$", "Per member cumulative group net saving (1000Tk)$",
    "value.NetSaving\\$", "Net saving$",
    "MeanG.*g\\$", "Per member group net saving$",
    "\\^2", "$^{2}$"), byrow = T, ncol = 2)
reglists.header ← c("vfesg", "vfes")
filenamelist ← c("Group", "Individual")
datas ← c("X1", "X")
for (m in 1:length(reglists.header)) {
  rlist ← eval(parse(text=paste("list(", paste0(reglists.header[m], 1:5, collapse = ",")),
  dataX ← get(datas[m])
  ClusterList ← lapply(rlist, function(x)
      if (!is.null(x$na.action)) matrix(dataX[-x$na.action, groupid]) else
      matrix(dataX[, groupid])
    )
  ro ← lapply(1:length(rlist), function(j)
     clx(rlist[[j]], cluster = ClusterList[[j]], returnV = T, deviation = F))
  ro.estlist ← lapply(ro, "[[", 1)
  ro.estlist ← lapply(ro.estlist, function(x) x[, -3, drop = F])
  # unify covariate names so default (traditional) is not duplicated in latextab
  ro.estlist ← lapply(ro.estlist, function(x) {
    rownames(x) ← gsub("Arm", "Attributes", rownames(x))
    x
    })
  ro.estlist ← lapply(ro.estlist, function(x) {
    rownames(x) ← gsub("Armtraditional:|Attributestraditional:", "", rownames(x))
    x
    })
  r.N ← unlist(lapply(ro, "[[", 8))
  r.M ← unlist(lapply(ro, "[[", 6))
  r.R ← unlist(lapply(rlist, function(x) round(summary(x)$adj, 3)))
  r.tab ← tabs2latex3(ro.estlist, digits = 2, use.Pvalue = T, xx.yyy = T)
  # reorder rows: rn.new #
  rtab ← r.tab
  rn ← rownames(r.tab)
  source(paste0(pathprogram,
    "ReorderingOfRowsInEstimatedResultsRepaymentTable.R"))
  rn ←
  rn[rn.new]
  rn0 ← rn
  r.tab ← r.tab[rn.new, ]
  rn ← rownames(r.tab)
  for (i in 1:nrow(subst.table))
    rn ← gsub(subst.table[i, 1], subst.table[i, 2], rn)
  rn ← paste0("\\makebox[3cm]{\\scriptsize\\hfill ", rn, "}")
  r.tb ← rbind(as.matrix(cbind(covariates = rn, r.tab)),
    c("\\makebox[3cm]{\\scriptsize\\hfill number of clusters}", r.M),
    c("\\bar{R}^{2}", r.R),
    c("N", r.N))
  r.ltxtb ← latextab(r.tb[1:(grep("fill LY3\\}$", rn)-1), ],
    hleft = "\\scriptsize\\hfil$", hcenter = c(5, rep(1.1, ncol(r.tb)-1)), hright = "$",
    headercolor = "gray90", adjustlineskip = "-.6ex", delimiterline= NULL,
    alternatecolor2 = "gray90")
  write.tablev(r.ltxtb,
    paste0(pathsaveHere, "Shortfall", filenamelist[m], "EstimationResults1.tex")
    , colnamestrue = F)
```

```
  r.ltxtb ← latextab(r.tb[grep("fill LY3\\}$", rn):nrow(r.tb), ],
    hleft = "\\scriptsize\\hfil$", hcenter = c(5, rep(1.1, ncol(r.tb)-1)), hright = "$",
    headercolor = "gray90", adjustlineskip = "-.6ex", delimiterline= NULL,
    alternatecolor2 = "gray90")
  write.tablev(r.ltxtb ,
    paste0(pathsaveHere, "Shortfall", filenamelist[m], "EstimationResults2.tex")
    , colnamestrue = F)
  assign(paste0(reglists.header[m], "list"), rlist)
  assign(paste0(reglists.header[m], ".estlist"), ro.estlist)
  assign(paste0(reglists.header[m], ".N"), r.N)
  assign(paste0(reglists.header[m], ".M"), r.M)
  assign(paste0(reglists.header[m], ".R"), r.R)
  assign(paste0(reglists.header[m], "list"), rlist)
  assign(paste0(reglists.header[m], "Xlist"), ClusterList)
}
```

```
ShortfallTabFN ← "Group fixed effects estimates of repayment shortfall. Group fixed effec
```

TABLE 1: GROUP LEVEL EFFECTS OF REPAYMENT SHORTFALL

covariates	(1)	(2)	(3)	(4)	(5)
(Intercept)	25.45 (0.5)	126.04 (0.0)	126.04 (0.0)	65.73 (0.0)	65.73 (0.0)
Large		−40.93 (3.6)		−15.09 (3.2)	
LargeGrace		−106.17 (0.0)		−47.79 (0.0)	
Cow		−95.74 (0.0)		−44.78 (0.0)	
LargeSize			−40.93 (3.6)		−15.09 (3.2)
WithGrace			−106.17 (0.0)		−47.79 (0.0)
InKind			−95.74 (0.0)		−44.78 (0.0)
UltraPoor				−13.76 (1.3)	−13.76 (1.3)
LY2		111.93 (0.0)	111.93 (0.0)	27.87 (1.0)	27.87 (1.0)
Large × LY2		107.12 (0.0)		19.92 (1.5)	
LargeGrace × LY2		145.34 (0.0)		71.54 (0.1)	
Cow × LY2		123.64 (0.0)		61.61 (0.1)	
LargeSize × LY2			107.12 (0.0)		19.92 (1.5)
WithGrace × LY2			145.34 (0.0)		71.54 (0.1)
InKind × LY2			123.64 (0.0)		61.61 (0.1)
UltraPoor × LY2				−1.31 (88.1)	−1.31 (88.1)
Large × UltraPoor × LY2				20.99 (4.2)	
LargeGrace × UltraPoor × LY2				−6.79 (73.6)	
Cow × UltraPoor × LY2				−0.74 (96.7)	
LargeSize × UltraPoor × LY2					20.99 (4.2)
WithGrace × UltraPoor × LY2					−6.79 (73.6)
InKind × UltraPoor × LY2					−0.74 (96.7)

Table 2: Group level effects of repayment shortfall (continued)

covariates	(1)	(2)	(3)	(4)	(5)
LY3		19.52 (42.4)	19.52 (42.4)	−31.64 (13.3)	−31.64 (13.3)
Large × LY3		−95.53 (1.0)		−249.06 (5.2)	
LargeGrace × LY3		99.89 (0.0)		25.51 (43.6)	
Cow × LY3		44.32 (7.0)		−0.61 (98.2)	
LargeSize × LY3			−95.53 (1.0)		−249.06 (5.2)
WithGrace × LY3			99.89 (0.0)		25.51 (43.6)
InKind × LY3			44.32 (7.0)		−0.61 (98.2)
UltraPoor × LY3				6.33 (78.9)	6.33 (78.9)
Large × UltraPoor × LY3				181.57 (15.8)	
LargeGrace × UltraPoor × LY3				−7.88 (80.0)	
Cow × UltraPoor × LY3				−14.04 (70.9)	
LargeSize × UltraPoor × LY3					181.57 (15.8)
WithGrace × UltraPoor × LY3					−7.88 (80.0)
InKind × UltraPoor × LY3					−14.04 (70.9)
GRSRhigh	114.97 (0.0)			83.41 (0.0)	83.41 (0.0)
GRSRlow × group shortfall$_{t-1}$	0.68 (0.0)				
GRSRhigh × group shortfall$_{t-1}$	0.44 (0.0)			−0.23 (0.0)	−0.23 (0.0)
group shortfall$_{t-1}$				0.62 (0.0)	0.62 (0.0)
Per member group net saving$_{t-1}$				−0.03 (0.3)	−0.03 (0.3)
Per member cumulative group net saving (1000Tk)$_{t-1}$				−0.03 (12.8)	−0.03 (12.8)
number of clusters	92	92	92	92	92
$\bar{R}^2$	0.213	0.077	0.077	0.24	0.24
N	4147	4173	4173	4147	4147

Source: Estimated with GUK administrative data.

Notes: 1. Group fixed effects estimates of repayment shortfall. Group fixed effects are controlled by differncing out respecive means from the data matrix. Intercept terms are omitted in estimating equations. Shortfall is (planned installment) - (actual repayment). OtherShortfall indicates mean shortfall of other members in a group. Group repayment shortfall rates (GRSR) is (shortfall)/(planned installment). GRSR is defined as high if the first six months' repayment shortfall rate is above median, low if otherwise. Median GRSR is -1.42.

2. ***, **, * indicate statistical significance at 1%, 5%, 10%, respetively. Standard errors are clustered at group (village) level.

Table 3: Individual level effects of repayment shortfall

covariates	(1)	(2)	(3)	(4)	(5)
(Intercept)	−27.39 (0.0)	1.84 (87.6)	144.89 (0.0)	11.60 (31.6)	11.60 (31.6)
Large		58.91 (0.0)		40.35 (0.0)	
LargeGrace		−140.65 (0.0)		−122.40 (0.0)	
Cow		−143.77 (0.0)		−125.60 (0.0)	
LargeSize			−37.79 (0.1)		40.35 (0.0)
WithGrace			−98.64 (0.0)		−122.40 (0.0)
InKind			−98.96 (0.0)		−125.60 (0.0)
UltraPoor				2.48 (41.7)	2.48 (41.7)
LY2		13.25 (38.4)	103.10 (0.0)	11.77 (32.3)	11.77 (32.3)
Large × LY2		−40.90 (0.0)		−23.36 (3.4)	
LargeGrace × LY2		219.59 (0.0)		182.96 (0.0)	
Cow × LY2		235.19 (0.0)		193.21 (0.0)	
LargeSize × LY2			92.88 (0.0)		−23.36 (3.4)
WithGrace × LY2			138.54 (0.0)		182.96 (0.0)
InKind × LY2			113.47 (0.0)		193.21 (0.0)
UltraPoor × LY2				−8.60 (6.6)	−8.60 (6.6)
Large × UltraPoor × LY2				−7.76 (27.6)	
LargeGrace × UltraPoor × LY2				−0.39 (96.4)	
Cow × UltraPoor × LY2				3.40 (69.2)	
LargeSize × UltraPoor × LY2					−7.76 (27.6)
WithGrace × UltraPoor × LY2					−0.39 (96.4)
InKind × UltraPoor × LY2					3.40 (69.2)

TABLE 4: INDIVIDUAL LEVEL EFFECTS OF REPAYMENT SHORTFALL (CONTINUED)

covariates	(1)	(2)	(3)	(4)	(5)
LY3		−39.18 (3.6)	87.29 (0.0)	−23.27 (5.8)	−23.27 (5.8)
Large × LY3		−140.50 (0.0)		−105.47 (0.0)	
LargeGrace × LY3		206.36 (0.0)		157.92 (0.0)	
Cow × LY3		207.16 (0.0)		174.52 (0.0)	
LargeSize × LY3			−14.43 (20.1)		−105.47 (0.0)
WithGrace × LY3			129.87 (0.0)		157.92 (0.0)
InKind × LY3			107.75 (0.0)		174.52 (0.0)
UltraPoor × LY3				−6.86 (23.3)	−6.86 (23.3)
Large × UltraPoor × LY3				−3.81 (78.8)	
LargeGrace × UltraPoor × LY3				15.02 (4.7)	
Cow × UltraPoor × LY3				−9.88 (62.8)	
LargeSize × UltraPoor × LY3					−3.81 (78.8)
WithGrace × UltraPoor × LY3					15.02 (4.7)
InKind × UltraPoor × LY3					−9.88 (62.8)
GRSRhigh	127.12 (0.3)			128.55 (0.0)	128.55 (0.0)
GRSRlow × group shortfall$_{t-1}$	0.19 (0.0)				
GRSRhigh × group shortfall$_{t-1}$	−0.45 (0.1)			−0.55 (0.0)	−0.55 (0.0)
Shortfall$_{t-1}$				0.29 (0.0)	0.29 (0.0)
group shortfall$_{t-1}$				−0.05 (23.2)	−0.05 (23.2)
Per member group net saving$_{t-1}$				−0.04 (8.6)	−0.04 (8.6)
Per member cumulative group net saving (1000Tk)$_{t-1}$				−0.05 (0.3)	−0.05 (0.3)
number of clusters	92	92	92	92	92
$\bar{R}^2$	0.01	0.069	0.107	0.116	0.116
N	47213	47395	47395	47213	47213

Source: Estimated with GUK administrative data.

Notes: 1. Group fixed effects estimates of repayment shortfall. Group fixed effects are controlled by differncing out respecive means from the data matrix. Intercept terms are omitted in estimating equations. Shortfall is (planned installment) - (actual repayment). OtherShortfall indicates mean shortfall of other members in a group. Group repayment shortfall rates (GRSR) is (shortfall)/(planned installment). GRSR is defined as high if the first six months' repayment shortfall rate is above median, low if otherwise. Median GRSR is -1.42.

2. ***, **, * indicate statistical significance at 1%, 5%, 10%, respetively. Standard errors are clustered at group (village) level.

Finding .1 TABLE **??** shows group level repayment shortfall has a positive autocorrelation hence is persistent. The coefficient is larger in groups with low shortfall rates, hinting loan repayment discipline, albeit weak, as a group. TABLE **??** also shows persistence for individuals, although the magnitude is much smaller. Lagged shortfall of others tends to reduce own shortfall, and this relationship, again, indicating some loan discipline as a group member. Individual shortfall is negative correlated with lagged group net saving and lagged group cumulative net saving, sugesting a possibility that a neative shock is shared within a group. Group level shortfall gets smaller in the third year in all arms, indicating stronger efforts in repayment in the final loan year.