

# Armenia Drought Analysis

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# 1 Setup

```
rm(list=ls())
require(tinytex) #LaTeX
require(ggplot2) #plots
require(haven) #load data
require(dplyr) #data management
require(lubridate) #data dates management
require(zoo) #for lagging
require(jtools) #tables
require(huxtable) #tables
require(lmtest) #reg tests
require(data.table) #for data filtering
require(sandwich) #regression errors
require(readxl) #for reading excel data
require(tidyr) #data
require(tidyverse) #data
require(did) #DiD (support staggered treatment)
require(panelView) #for panel data treatment visibility
require(modelsummary) #for nice DiD tables
require(fixest) #TWFE regression

latex_format = T

getwd()
setwd("...")  
set.seed(123)
```

# 2 Data Load

```
load("final_data.Rdata")
load("final_data_quartiles.Rdata")
load("final_data_deciles.Rdata")
load("final_data_household.Rdata")
```

### 3 Descriptive Evidence

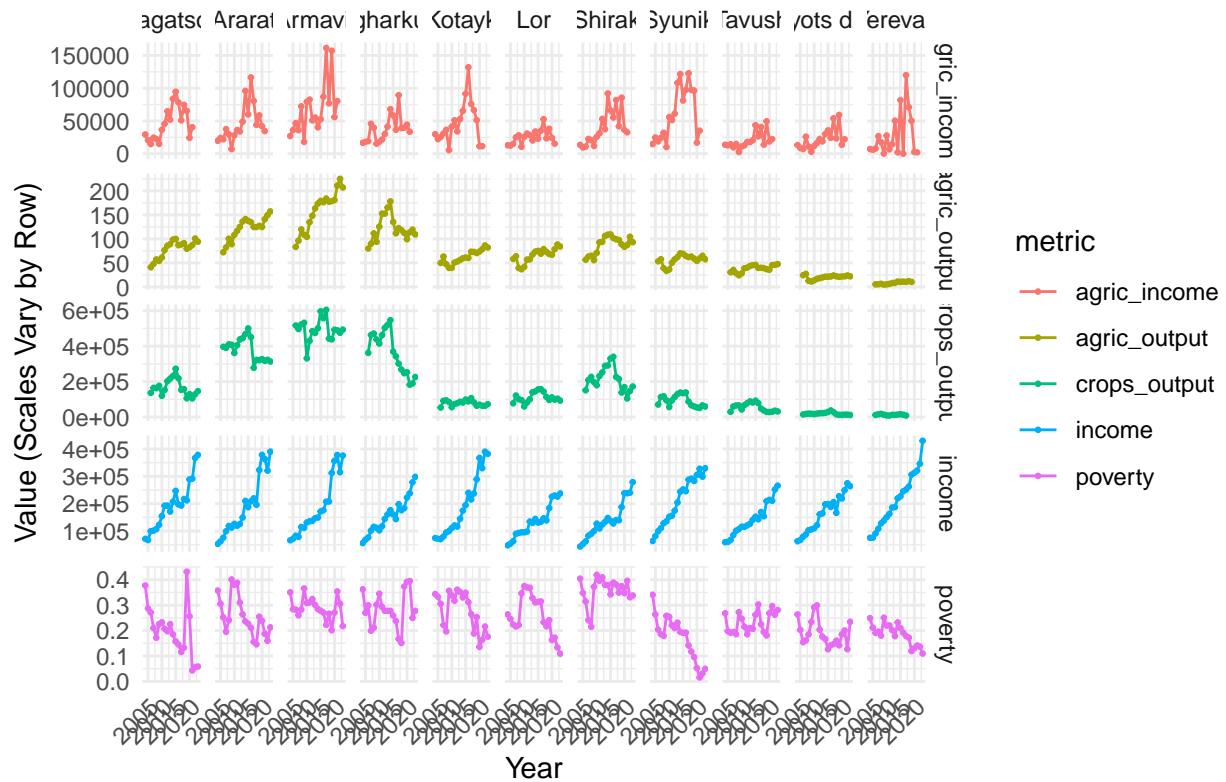
#### 3.1 Graph 1

```
# Prepare data
plot_data1 <- dataset %>%
  pivot_longer(cols = c(income, agric_income, agric_output, crops_output, poverty),
  names_to = "metric",
  values_to = "value" )

plot_data2 <- dataset %>%
  pivot_longer(cols = c(spei, share, agric_stress, Total_Rainfall, crops_land),
  names_to = "metric",
  values_to = "value" )

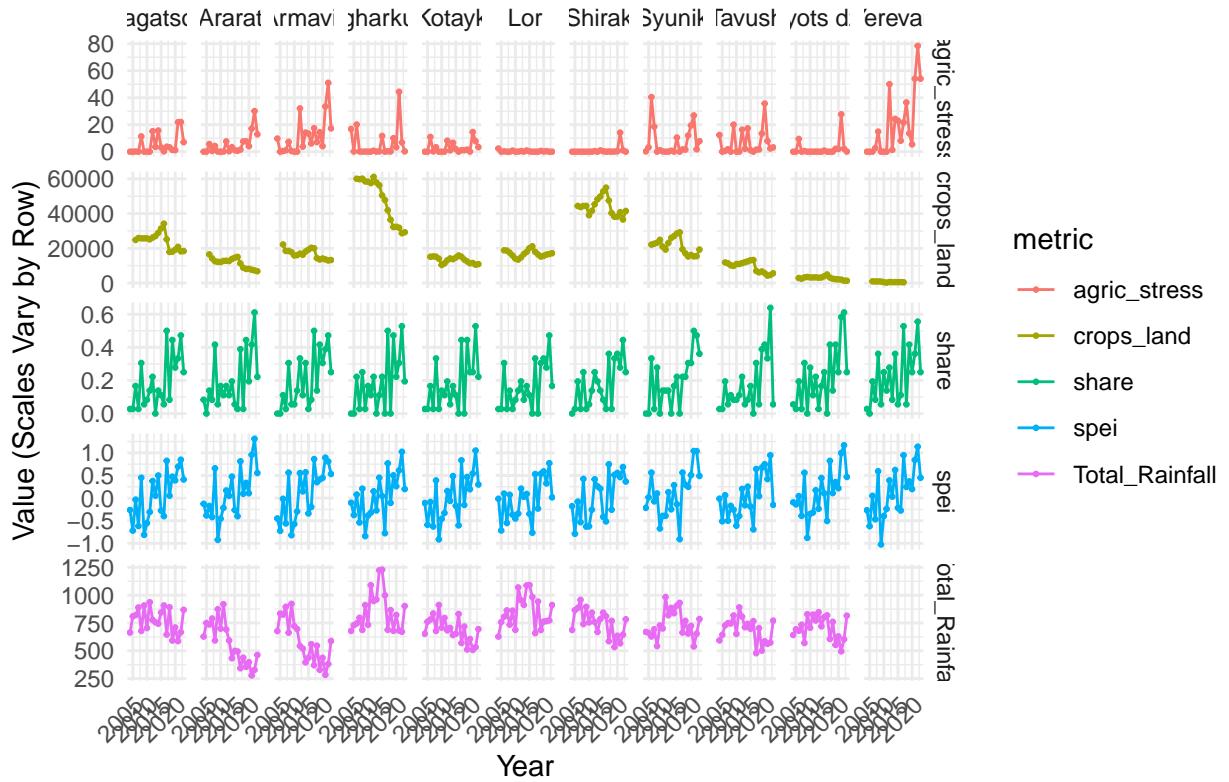
# Plot
ggplot(plot_data1, aes(x = year, y = value, color = metric)) +
  geom_line(aes(group = metric)) +
  geom_point(size = 0.5) +
  facet_grid(metric ~ district, scales = "free_y") +
  labs(
    title = "x and SPEI Over Time by District",
    x = "Year",
    y = "Value (Scales Vary by Row)") +
  theme_minimal() +
  theme(
    axis.text.x = element_text(angle = 45, hjust = 1))
```

## x and SPEI Over Time by District



```
ggplot(plot_data2, aes(x = year, y = value, color = metric)) +
  geom_line(aes(group = metric)) +
  geom_point(size = 0.5) +
  facet_grid(metric ~ district, scales = "free_y") +
  labs(
    title = "x and SPEI Over Time by District",
    x = "Year",
    y = "Value (Scales Vary by Row)") +
  theme_minimal() +
  theme(
    axis.text.x = element_text(angle = 45, hjust = 1))
```

## x and SPEI Over Time by District

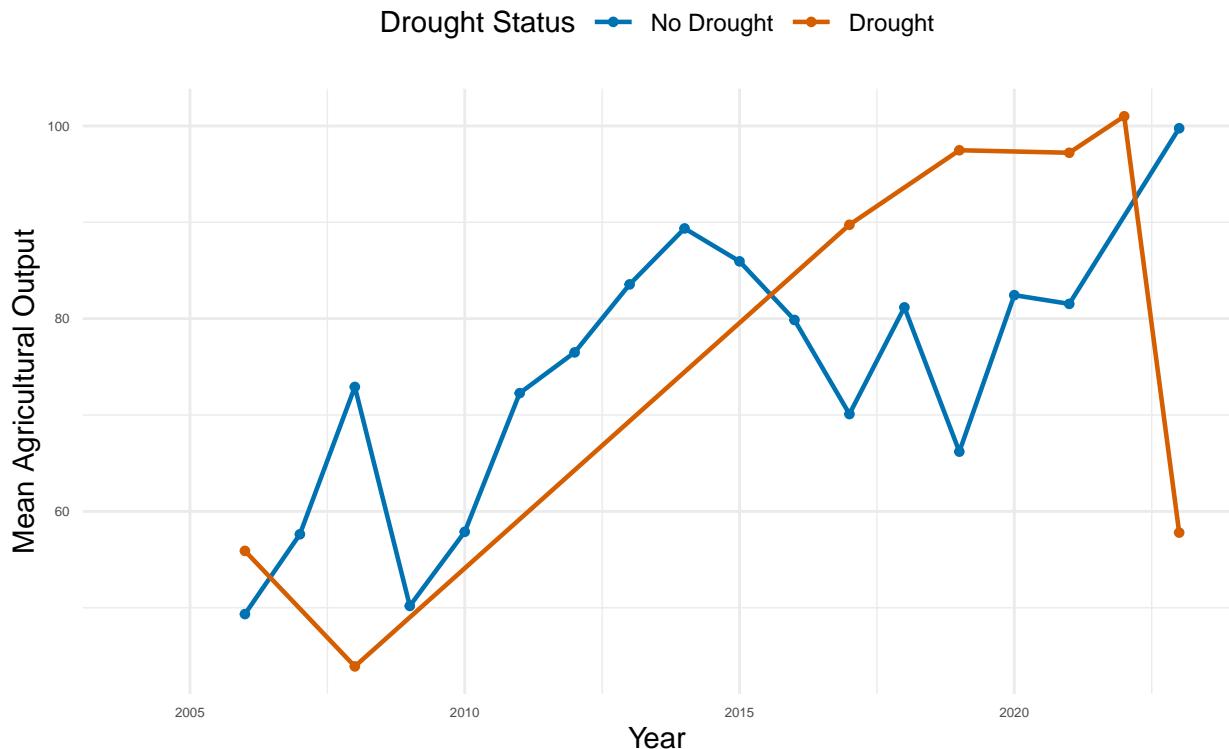


## 3.2 Graph with Drought Dummy

```
# Compute, for each years, the mean of agricultural output between districts
# that experience drought vs no drought
agrlic_plot <- dataset %>%
  group_by(year, drought_dummy) %>%
  summarise(mean_agric = mean(agric_output, na.rm = TRUE), n_district = n())

ggplot(agrlic_plot, aes(x = year, y = mean_agric,
                        color = factor(drought_dummy), group = factor(drought_dummy))) +
  geom_line(linewidth = 0.8) +
  geom_point(size = 1.2) +
  scale_color_manual(values = c("0" = "#0072B2", "1" = "#D55E00"),
                     labels = c("No Drought", "Drought")) +
  labs(x = "Year", y = "Mean Agricultural Output", color = "Drought Status",
       title = "Impact of Drought on Agricultural Output") +
  theme_minimal() +
  theme(legend.position = "top",
        axis.text.x = element_text(size = 5),
        axis.text.y = element_text(size = 5),
        plot.title = element_text(size = 20, face = "bold", hjust = 0.5),
        strip.text = element_text(size = 4, face = "bold"))
```

# Impact of Drought on Agricultural Output



### 3.3 With Quartiles

```
# Data Prep
dataset_prep_q <- dataset_quartiles %>%
  mutate(drought_status = factor(drought_dummy,
    levels = c(0, 1),
    labels = c("No Drought Event", "Drought Event")),
  income_quartile = factor(national_quartile,
    levels = c(1, 2, 3, 4),
    labels = c("Q1 (Poorest)", "Q2", "Q3", "Q4 (Richest)")))

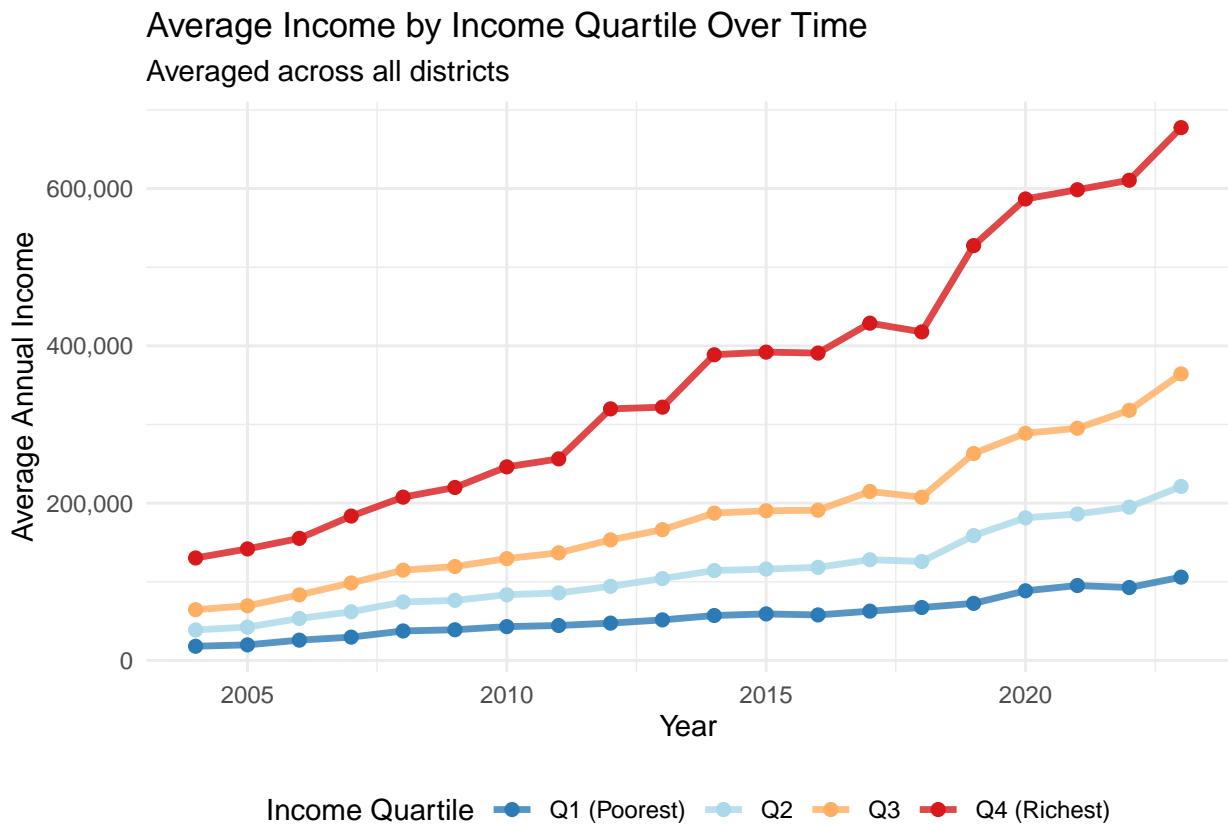
# A1. Aggregate the data: Find the mean income for each year and quartile
plot1_data_q <- dataset_prep_q %>%
  group_by(year, income_quartile) %>%
  summarize(avg_income = mean(income, na.rm = TRUE),
  avg_agr_income = mean(agric_income, na.rm = TRUE), .groups = 'drop')

# A2. Create the plot q
ggplot(plot1_data_q, aes(x = year, y = avg_income, color = income_quartile, group = income_quartile)) +
  geom_line(lineWidth = 1.2, alpha = 0.8) +
  geom_point(size = 2) +
  # --- Aesthetics & Labels ---
```

```

scale_y_continuous(labels = scales::comma) + # Formats y-axis labels (e.g., 50,000)
scale_color_brewer(palette = "RdYlBu", direction = -1) +
labs(
  title = "Average Income by Income Quartile Over Time",
  subtitle = "Averaged across all districts",
  x = "Year",
  y = "Average Annual Income",
  color = "Income Quartile") +
theme_minimal() + theme(legend.position = "bottom")

```



```

# B1. Aggregate data: Mean income by year, quartile, AND drought status
plot2_data_q <- dataset_prep_q %>%
  group_by(year, income_quartile, drought_status) %>%
  summarize(avg_income = mean(income, na.rm = TRUE),
           avg_agric_income = mean(agric_income, na.rm = TRUE), .groups = 'drop')

# B2. Create the faceted plot q
ggplot(plot2_data_q, aes(x = year, y = avg_income, color = drought_status, group = drought_status)) +
  geom_line(linewidth = 1.1, alpha = 0.9) +
  # Create 4 separate plots, one for each 'income_quartile'
  facet_wrap(~ income_quartile, scales = "free_y") +
  # --- Aesthetics & Labels ---

```

```

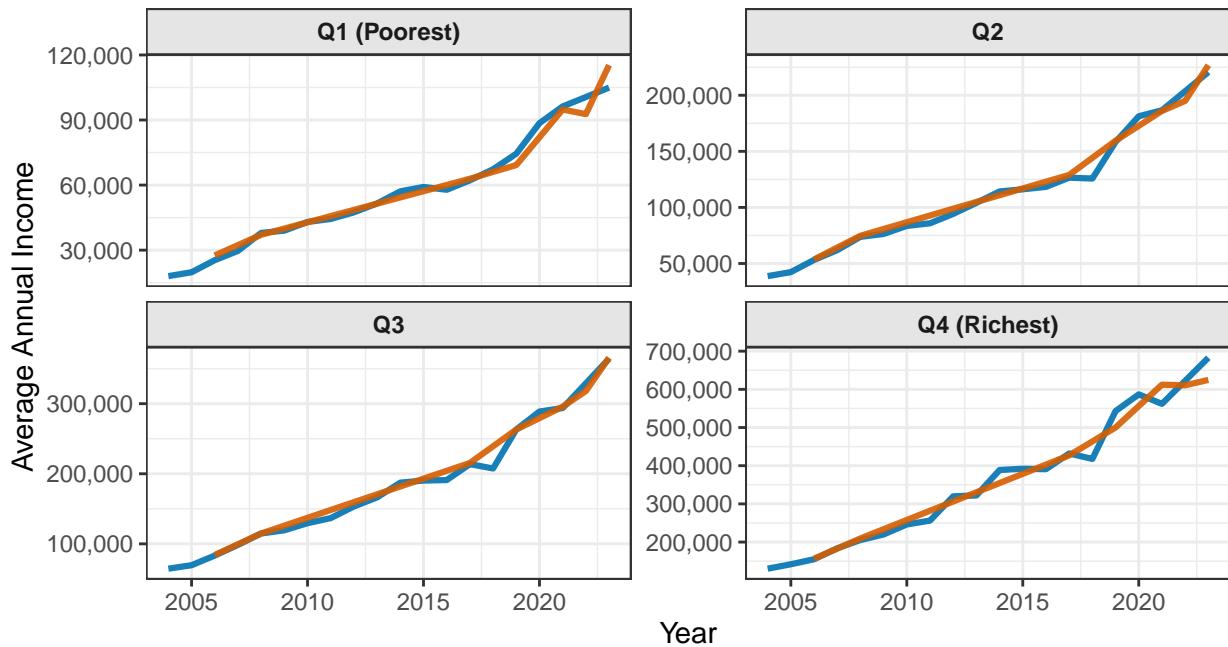
scale_y_continuous(labels = scales::comma) +
scale_color_manual(values = c("No Drought Event" = "#0072B2", "Drought Event" = "#D55E00")) +
labs(
  title = "Impact of Drought Events on Income, by Income Quartile",
  subtitle = "Average income trends faceted by income group",
  x = "Year",
  y = "Average Annual Income",
  color = "Drought Status") +
theme_bw() + # A clean theme
theme(
  legend.position = "top",
  strip.background = element_rect(fill = "grey90"), # Style the facet labels
  strip.text = element_text(face = "bold"))

```

## Impact of Drought Events on Income, by Income Quartile

Average income trends faceted by income group

Drought Status — No Drought Event — Drought Event



## 4 TWFE Regressions

### 4.1 Data Subset Selection

Variables Units \* Armenian Dram (currency): + Income + Agriculture income + Agriculture output + Food consumption \* Tons (1000kg) + Grains harvest + Vegetables harvest + Fruits harvest + Potatoes harvest \* Tons per hectare (1000kg / 10000km<sup>2</sup>) + Grains output per field + Vegetables output per field + Fruits output per field + Potatoes output per field

```
# Base case
twfe_data = dataset

# Taking logs for all dependent variables
twfe_data$income = log(twfe_data$income)
twfe_data$agric_income = log(twfe_data$agric_income)
twfe_data$agric_output = log(twfe_data$agric_output)
twfe_data$fdcons = log(twfe_data$fdcons)

twfe_data$grains_harvest = log(twfe_data$grains_harvest)
twfe_data$vegetables_harvest = log(twfe_data$vegetables_harvest)
twfe_data$fruits_harvest = log(twfe_data$fruits_harvest)
twfe_data$potatoes_harvest = log(twfe_data$potatoes_harvest)

twfe_data$output_per_field_grains = log(twfe_data$output_per_field_grains)
twfe_data$output_per_field_vegetables = log(twfe_data$output_per_field_vegetables)
twfe_data$output_per_field_fruits = log(twfe_data$output_per_field_fruits)
twfe_data$output_per_field_potatoes = log(twfe_data$output_per_field_potatoes)

# Excluding Yerevan
#twfe_data = subset(dataset, district != "Yerevan")

# Selecting majority-rural districts
#twfe_data = subset(dataset, urban < 0.5)

# Selecting the poorest income decile
#twfe_data = subset(dataset_deciles, national_decile == 1)

# Selecting the poorest income quartile
#twfe_data = subset(dataset_quartiles, national_quartile == 1)

# Selecting poorer regions
#twfe_data = subset(control, poverty > 0.3)

# Selecting a certain timeframe
#twfe_data = subset(control, year > 2015)
```

### 4.2 Regression Loop

```
# 1. Define dependent variables
dependent_vars <- c("income", "agric_income", "agric_output", "fdcons",
                    "grains_harvest", "vegetables_harvest", "fruits_harvest",
```

```

        "potatoes_harvest", "output_per_field_grains",
        "output_per_field_vegetables", "output_per_field_fruits",
        "output_per_field_potatoes")

# 2. Define independent variables as a list of groups
iv_groups <- list(
  "SPEI" = c(
    "spei",
    "spei + spei_lag1",
    "spei + spei_lag1 + spei_lag2"),
  "Share" = c(
    "share",
    "share + share_lag1",
    "share + share_lag1 + share_lag2"),
  "AgricStress" = c(
    "agric_stress",
    "agric_stress + agric_stress_lag1",
    "agric_stress + agric_stress_lag1 + agric_stress_lag2") )

# 3. Define names
model_names <- c(
  "Model 1: 0 Lags",
  "Model 2: 1 Lag",
  "Model 3: 2 Lags")

# 4. Loop for each dependent variable for each group of independent variables
for (dv in dependent_vars) {

  # Create a latex version of the dv name
  dv_safe <- gsub("_", "\\\\", dv)
  cat(paste0("\n\n\\subsection{Dependent Variable: ", dv_safe, "}\n\n"))

  for (group_name in names(iv_groups)) {
    cat(paste0("\n\n\\subsubsection{Regressed on: ", group_name, "}\n\n"))

    models_list <- list()
    current_iv_formulas <- iv_groups[[group_name]]

    for (i in 1:length(current_iv_formulas)) {
      fml_string <- sprintf("%s ~ %s | district + year",
                            dv,
                            current_iv_formulas[i])
      models_list[[i]] <- feols(
        as.formula(fml_string),
        data = twfe_data,
        cluster = ~ district)
    }
    names(models_list) <- model_names

    print(etable(
      models_list,
      # title argument removed
      fixef_sizes = TRUE,
      fitstat = c("n", "r2"),

```

```
tex = latex_format)) } }
```

## 4.3 Dependent Variable: income

### 4.3.1 Regressed on: SPEI

Dependent Variable:	income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0260 (0.0266)	0.0263 (0.0252)	0.0254 (0.0264)
spei_lag1		-0.0201 (0.0505)	-0.0199 (0.0496)
spei_lag2			-0.0174 (0.0522)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R <sup>2</sup>	0.95771	0.95775	0.95778

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.3.2 Regressed on: Share

Dependent Variable:	income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.1165 (0.0908)	-0.1618 (0.1105)	-0.1685 (0.1155)
share_lag1		-0.2229 (0.1517)	-0.2596 (0.1846)
share_lag2			-0.2104 (0.1685)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R <sup>2</sup>	0.95781	0.95839	0.95888

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.3.3 Regressed on: AgricStress

Dependent Variable:	income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	$-4.75 \times 10^{-5}$ (0.0007)	-0.0002 (0.0006)	-0.0002 (0.0006)
agric_stress_lag1		0.0007 (0.0008)	0.0007 (0.0007)
agric_stress_lag2			-0.0002 (0.0010)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R <sup>2</sup>	0.95764	0.95776	0.95777

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

## 4.4 Dependent Variable: agric\_income

### 4.4.1 Regressed on: SPEI

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.2773 (0.2633)	0.2786 (0.2720)	0.2814 (0.2893)
spei_lag1		0.0586 (0.2790)	0.0572 (0.2737)
spei_lag2			0.0400 (0.2727)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	197	197	197
R <sup>2</sup>	0.71669	0.71680	0.71685

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.4.2 Regressed on: Share

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.3389 (0.4318)	-0.3282 (0.4687)	-0.3893 (0.4920)
share_lag1		0.0552 (0.7967)	-0.1080 (0.8750)
share_lag2			-0.8570* (0.4538)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	197	197	197
R <sup>2</sup>	0.71444	0.71445	0.71667

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

#### 4.4.3 Regressed on: AgricStress

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0020 (0.0052)	-0.0020 (0.0055)	-0.0014 (0.0063)
agric_stress_lag1		0.0106 (0.0099)	0.0119 (0.0099)
agric_stress_lag2			-0.0151 (0.0088)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	197	197	197
R <sup>2</sup>	0.71419	0.71963	0.72936

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

## 4.5 Dependent Variable: agric\_output

### 4.5.1 Regressed on: SPEI

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0578 (0.0556)	0.0597 (0.0519)	0.0666 (0.0544)
spei_lag1		0.0986 (0.0580)	0.0994* (0.0545)
spei_lag2			0.1435* (0.0744)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.97508	0.97550	0.97640

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.5.2 Regressed on: Share

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.1182 (0.1120)	0.1643 (0.1325)	0.1763 (0.1352)
share_lag1		0.2021 (0.1329)	0.2415 (0.1372)
share_lag2			0.1923 (0.1527)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.97502	0.97522	0.97540

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.5.3 Regressed on: AgricStress

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	0.0031 (0.0019)	0.0029 (0.0017)	0.0029 (0.0017)
agric_stress_lag1		0.0023 (0.0014)	0.0023 (0.0014)
agric_stress_lag2			$7.04 \times 10^{-5}$ (0.0019)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.97572	0.97617	0.97617

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

## 4.6 Dependent Variable: fdcons

### 4.6.1 Regressed on: SPEI

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0400 (0.0943)	0.0407 (0.0950)	0.0393 (0.0952)
spei_lag1		-0.0648 (0.0517)	-0.0645 (0.0522)
spei_lag2			-0.0296 (0.1102)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R <sup>2</sup>	0.90580	0.90611	0.90617

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.6.2 Regressed on: Share

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.0860 (0.1944)	-0.1811 (0.2304)	-0.1932 (0.2334)
share_lag1		-0.4673 (0.2695)	-0.5340* (0.2667)
share_lag2			-0.3819 (0.3588)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R <sup>2</sup>	0.90574	0.90757	0.90875

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

#### 4.6.3 Regressed on: AgricStress

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0002 (0.0020)	$8.21 \times 10^{-5}$ (0.0018)	$7.39 \times 10^{-5}$ (0.0018)
agric_stress_lag1		-0.0012 (0.0015)	-0.0012 (0.0013)
agric_stress_lag2			-0.0003 (0.0020)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R <sup>2</sup>	0.90568	0.90593	0.90594

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

## 4.7 Dependent Variable: grains\_harvest

### 4.7.1 Regressed on: SPEI

Dependent Variable:	grains_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.4503*** (0.1064)	-0.4573*** (0.1065)	-0.4691*** (0.1071)
spei_lag1		-0.2992** (0.1010)	-0.3025** (0.1207)
spei_lag2			-0.2425* (0.1214)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R <sup>2</sup>	0.94570	0.94719	0.94817

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.7.2 Regressed on: Share

Dependent Variable:	grains_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.7772** (0.2690)	-0.9705*** (0.2807)	-1.008*** (0.2698)
share_lag1		-0.8358** (0.3403)	-1.012** (0.3457)
share_lag2			-0.9098** (0.4027)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R <sup>2</sup>	0.94375	0.94509	0.94660

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.7.3 Regressed on: AgricStress

Model:	grains_harvest		
	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0118*** (0.0030)	-0.0113*** (0.0028)	-0.0115*** (0.0028)
agric_stress_lag1		-0.0080* (0.0043)	-0.0079* (0.0043)
agric_stress_lag2			-0.0052 (0.0044)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R <sup>2</sup>	0.94656	0.94848	0.94914

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

## 4.8 Dependent Variable: vegetables\_harvest

### 4.8.1 Regressed on: SPEI

Model:	vegetables_harvest		
	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.1150 (0.0697)	-0.1191 (0.0697)	-0.1240 (0.0725)
spei_lag1		-0.2078 (0.1572)	-0.2084 (0.1617)
spei_lag2			-0.1035 (0.0929)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.95674	0.95738	0.95753

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.8.2 Regressed on: Share

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.1733 (0.1950)	-0.2713 (0.1901)	-0.2927 (0.1953)
share_lag1		-0.4297 (0.3137)	-0.5002 (0.3758)
share_lag2			-0.3438 (0.2918)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.95661	0.95693	0.95712

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

#### 4.8.3 Regressed on: AgricStress

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0047 (0.0048)	-0.0044 (0.0046)	-0.0044 (0.0046)
agric_stress_lag1		-0.0043 (0.0052)	-0.0042 (0.0051)
agric_stress_lag2			-0.0014 (0.0039)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.95716	0.95767	0.95771

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

## 4.9 Dependent Variable: fruits\_harvest

### 4.9.1 Regressed on: SPEI

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.2105 (0.1612)	0.2145 (0.1631)	0.2239 (0.1622)
spei_lag1		0.2010 (0.1169)	0.2022* (0.1042)
spei_lag2			0.1975 (0.1402)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.91392	0.91480	0.91565

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.9.2 Regressed on: Share

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.6161 (0.3458)	0.8515** (0.2807)	0.8986** (0.2913)
share_lag1		1.033** (0.3621)	1.188** (0.4138)
share_lag2			0.7552* (0.4113)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.91406	0.91675	0.91813

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.9.3 Regressed on: AgricStress

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	0.0062** (0.0022)	0.0058*** (0.0018)	0.0059** (0.0020)
agric_stress_lag1		0.0061* (0.0034)	0.0059* (0.0030)
agric_stress_lag2			0.0043 (0.0032)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.91457	0.91610	0.91670

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

## 4.10 Dependent Variable: potatoes\_harvest

### 4.10.1 Regressed on: SPEI

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.0864 (0.0585)	-0.0913 (0.0683)	-0.0931 (0.0699)
spei_lag1		-0.2477 (0.1406)	-0.2479 (0.1438)
spei_lag2			-0.0391 (0.0848)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.97357	0.97447	0.97449

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.10.2 Regressed on: Share

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.3500 (0.2041)	-0.5348* (0.2540)	-0.5406* (0.2604)
share_lag1		-0.8109** (0.3189)	-0.8300** (0.3329)
share_lag2			-0.0928 (0.2677)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.97369	0.97481	0.97482

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.10.3 Regressed on: AgricStress

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0005 (0.0026)	-0.0002 (0.0025)	-0.0002 (0.0025)
agric_stress_lag1		-0.0042 (0.0034)	-0.0041 (0.0033)
agric_stress_lag2			-0.0020 (0.0016)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.97347	0.97395	0.97403

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

## 4.11 Dependent Variable: output\_per\_field\_grains

### 4.11.1 Regressed on: SPEI

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.2324*** (0.0584)	-0.2349*** (0.0563)	-0.2379*** (0.0524)
spei_lag1		-0.1082 (0.0719)	-0.1090 (0.0768)
spei_lag2			-0.0598 (0.0758)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R <sup>2</sup>	0.78380	0.78558	0.78612

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.11.2 Regressed on: Share

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.4843** (0.2120)	-0.4983** (0.2098)	-0.5060** (0.2134)
share_lag1		-0.0607 (0.2006)	-0.0972 (0.1848)
share_lag2			-0.1884 (0.2824)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R <sup>2</sup>	0.78048	0.78055	0.78114

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

#### 4.11.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0071** (0.0022)	-0.0071** (0.0023)	-0.0070** (0.0023)
agric_stress_lag1	0.0005 (0.0027)	0.0004 (0.0026)	
agric_stress_lag2		0.0013 (0.0022)	
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R <sup>2</sup>	0.78933	0.78940	0.78977

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.12 Dependent Variable: output\_per\_field\_vegetables

##### 4.12.1 Regressed on: SPEI

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0175 (0.0438)	0.0145 (0.0492)	0.0092 (0.0508)
spei_lag1		-0.1505 (0.1425)	-0.1512 (0.1481)
spei_lag2			-0.1108 (0.1046)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.81793	0.82015	0.82134

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.12.2 Regressed on: Share

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.0835 (0.1599)	0.0650 (0.1552)	0.0650 (0.1582)
share_lag1		-0.0810 (0.1714)	-0.0810 (0.2072)
share_lag2			$-5.39 \times 10^{-5}$ (0.2109)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.81799	0.81806	0.81806

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.12.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0033 (0.0037)	-0.0030 (0.0035)	-0.0030 (0.0035)
agric_stress_lag1		-0.0037 (0.0042)	-0.0037 (0.0041)
agric_stress_lag2			-0.0005 (0.0023)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.81989	0.82240	0.82243

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

## 4.13 Dependent Variable: output\_per\_field\_fruits

### 4.13.1 Regressed on: SPEI

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.1856 (0.1434)	0.1887 (0.1457)	0.1952 (0.1438)
spei_lag1		0.1567 (0.1054)	0.1575 (0.0973)
spei_lag2			0.1367 (0.1568)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.79919	0.80052	0.80152

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

### 4.13.2 Regressed on: Share

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.5624 (0.3438)	0.7888** (0.2894)	0.8309** (0.3019)
share_lag1		0.9934** (0.3737)	1.132** (0.4357)
share_lag2			0.6764 (0.4382)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.79960	0.80578	0.80853

*Clustered (district) standard-errors in parentheses*  
*Signif. Codes: \*\*\*: 0.01, \*\*: 0.05, \*: 0.1*

#### 4.13.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	0.0053*** (0.0015)	0.0049*** (0.0012)	0.0050*** (0.0013)
agric_stress_lag1		0.0052* (0.0028)	0.0051* (0.0025)
agric_stress_lag2			0.0034 (0.0028)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.80018	0.80294	0.80384

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.14 Dependent Variable: output\_per\_field\_potatoes

##### 4.14.1 Regressed on: SPEI

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.0961* (0.0434)	-0.1006 (0.0607)	-0.1018 (0.0622)
spei_lag1		-0.2282 (0.1451)	-0.2283 (0.1473)
spei_lag2			-0.0243 (0.0680)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.80594	0.81511	0.81521

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.14.2 Regressed on: Share

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.1459 (0.1639)	-0.2399 (0.1776)	-0.2216 (0.1901)
share_lag1		-0.4124* (0.2125)	-0.3520* (0.1922)
share_lag2			0.2948 (0.2023)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.80487	0.80833	0.81003

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1

#### 4.14.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0021 (0.0017)	-0.0017 (0.0016)	-0.0017 (0.0016)
agric_stress_lag1		-0.0051 (0.0033)	-0.0050 (0.0033)
agric_stress_lag2			-0.0008 (0.0011)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R <sup>2</sup>	0.80581	0.81430	0.81445

*Clustered (district) standard-errors in parentheses*

*Signif. Codes:* \*\*\*: 0.01, \*\*: 0.05, \*: 0.1