# The Granular Origins of Aggregate Fluctuations: Empirical Work

*Regression Results*

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October 13, 2010

This document creates empirical results for Xavier Gabaix's 2010 Econometrica article, The Granular Origins of Aggregate Fluctuations.

The code is organized as follows. The next section below creates some lagged variables and loads an `R` class that makes it easy to produce LaTeX regression tables. In section 2 I estimate a series of regressions predicting per capita GDP growth using different estimates of the granular residual. In section 3 I consider alternative explanations using macroeconomic data to see if the granular residual series predicts a significant portion of the per capita GDP growth that is not explained by existing variables.

I use the `R` packages listed below.

```
> rm(list = ls())
> library(foreign)
> library(matlab)
> library(xtable)
> library(reshape)
> library(ggplot2)
> library(plyr)
> library(plm)
> library(graphics)
```

These are the directories I use.

```
> HOME_DIRECTORY <- "~/Dropbox/raWork/granularOrigins/Granular-FinalMaterials/Granular-MainTables/empiricalResults/"
> FIGURES_DIRECTORY <- "~/Dropbox/raWork/granularOrigins/Granular-FinalMaterials/Granular-MainTables/empiricalResults/figures/"
> DATA_DIRECTORY <- "~/Dropbox/raWork/granularOrigins/Granular-FinalMaterials/Granular-MainTables/data/"
```

# 1 Format Data and Load Regression Table Class

In this section I create lagged values of the granular residual estimates and load up the regression table `R` class to help out with the formatting.

### Load and Format Data

First, I load up the granular residual data and the cleaned macroeconomic data from file.

```
> load(file = paste(DATA_DIRECTORY, "GranularResidualData_10Oct2010.Rdata", sep = ""))
> load(file = paste(DATA_DIRECTORY, "CleanMacroeconomicData_10Oct2010.Rdata", sep = ""))
> GranularResiduals <- merge(GranularResiduals, MacroeconomicData, by = "year")
```

Then I create 1 and 2 lags of each of the granular residual variables.

```
> for (VARIABLE in names(GranularResiduals)[-1]) {
      for (LAG in 1:2) {
          NUMBER_OF_OBS <- dim(GranularResiduals)[1]
          VARIABLE_LAGGED <- paste(VARIABLE, ".lag", LAG, sep = "")
          GranularResiduals[, VARIABLE_LAGGED] <- c(rep(NA, LAG), GranularResiduals[1:(NUMBER_OF_OBS - LAG), VARIABLE])
      }
  }
```

### Load Regression Table Class

Now that I have my data set up, I turn to the regression tables. First, I create a dictionary of variable names that maps between variable names in `R` and cleaned variable labels for LaTeX.

```
> DictionaryOfVariableNames <- list(c("(Intercept)", "logChangeInPerCapitaGdp", "solowResidual", "hamiltonOilShocks", "romerMonetaryShocks",
      "yield.3Month", "termSpread", "GranularResidualUsingYearDemeaningQ100K100", "GranularResidualUsingYearAndIndustryDemeaningQ100K100",
      "GranularResidualUsingResidualEquation1Q100K100", "GranularResidualUsingResidualEquation2Q100K100", "GranularResidualUsingResidualEquation3Q100K100",
      "GranularResidualUsingResidualEquation4Q100K100", "GranularResidualUsingResidualEquation5Q100K100", "GranularResidualUsingResidualEquation6Q100K100",
      "GranularResidualUsingYearDemeaningQ1000K100", "GranularResidualUsingYearAndIndustryDemeaningQ1000K100", "GranularResidualUsingResidualEquation1Q1000K100",
      "GranularResidualUsingResidualEquation2Q1000K100", "GranularResidualUsingResidualEquation3Q1000K100", "GranularResidualUsingResidualEquation4Q1000K100",
      "GranularResidualUsingResidualEquation5Q1000K100", "GranularResidualUsingResidualEquation6Q1000K100"), c("(Intercept)", "\\text{GDP Growth}_{TIME}",
      "\\text{Solow Residual}_{TIME}", "\\text{Oil}_{TIME}", "\\text{Monetary}_{TIME}", "r_{TIME}", "\\text{Term Spread}_{TIME}", rep("\\Gamma_{TIME}",
          16)))
```

Then, I load up an `R` class which I use to format the regression output in the tables below.

```
> Stangle(paste(HOME_DIRECTORY, "createRegressionTable.Rnw", sep = ""))
> source("createRegressionTable.R")
```

# 2 Predict Per Capita GDP Growth

I run a set of baseline granular residual regressions with the productivity growth rate demeaned at the yearly overall and industry growth rates.

The overall baseline regressions are specified in the stacked equations below.

$$\Delta \text{gdp}_t = a\Gamma_t^K + b\Gamma_{t-1}^K + \varepsilon_t \tag{1}$$

$$\Delta \text{gdp}_t = a\Gamma_t^K + b\Gamma_{t-1}^K + c\Gamma_{t-2}^K + \varepsilon_t \tag{2}$$

$$\text{solow}_t = a\Gamma_t^K + b\Gamma_{t-1}^K + \varepsilon_t \tag{3}$$

$$\text{solow}_t = a\Gamma_t^K + b\Gamma_{t-1}^K + c\Gamma_{t-2}^K + \varepsilon_t \tag{4}$$

I run these specifications for the granular residuals computed with productivity growth rate innovations as industry and globally demeaned. I then estimate the $3^{rd}$ equation for each of the granular residuals computed using productivity growth rates as residuals.

### Granular Residuals Computed Using Productivity Growth Rate Innovations Demeaned at Yearly Level

First, I estimate a regression of the granular residual computed with $(Q = 100, K = 100)$ and using productivity growth rate innovations computed as the demeaned productivity growth rate using within year means.

```
> GRANULAR_RESIDUAL_SPECIFICATION <- "GranularResidualUsingYearDemeaningQ100K100"
> CAPTION <- "\\textit{\\textbf{Year Demeaned, Q=100, K=100}: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals alo
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("logChangeInPerCapitaGdp"), c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"), c(GRANULAR_RESIDUAL_SPECIFICATION))), lags = list(c(0, 1), c(0, 1,
     2), c(0, 1), c(0, 1, 2)), caption = CAPTION)
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_GranularResidualPredictsPerCapitaGdpGrowth_YearDemeanedInnovationsQ100K100Specification.tex",
     sep = ""))
```

Next, I look at the same specification, but this time using the $(Q = 1000, K = 100)$ specification.

```
> GRANULAR_RESIDUAL_SPECIFICATION <- "GranularResidualUsingYearDemeaningQ1000K100"
> CAPTION <- "\\textit{\\textbf{Year Demeaned, Q=1000, K=100}: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals al
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("logChangeInPerCapitaGdp"), c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"), c(GRANULAR_RESIDUAL_SPECIFICATION))), lags = list(c(0, 1), c(0, 1,
     2), c(0, 1), c(0, 1, 2)), caption = CAPTION)
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_GranularResidualPredictsPerCapitaGdpGrowth_YearDemeanedInnovationsQ1000K100Specification.tex",
     sep = ""))
```

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (Intercept) | 0.018** | 0.017** | 0.011** | 0.01** |
| | (0.0026) | (0.0025) | (0.002) | (0.0021) |
| $\Gamma_t$ | 1.8* | 2.5** | 2.1** | 2.3** |
| | (0.69) | (0.69) | (0.54) | (0.57) |
| $\Gamma_{t-1}$ | 2.6** | 2.9** | 1.2* | 1.3* |
| | (0.71) | (0.67) | (0.55) | (0.56) |
| $\Gamma_{t-2}$ | | 2.1** | | 0.65 |
| | | (0.71) | | (0.59) |
| N | 56 | 55 | 56 | 55 |
| $R^2$ | 0.266 | 0.382 | 0.261 | 0.281 |
| Adj. $R^2$ | 0.239 | 0.346 | 0.233 | 0.239 |

Table 1: ***Year Demeaned, Q=100, K=100***: *This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals along with 2 of its lags from 1952 to 2008. The granular residual specification uses productivity growth rate innovations computed as the demeaned productivity growth rate using the within year means.*

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (Intercept) | 0.018** | 0.018** | 0.011** | 0.011** |
| | (0.0027) | (0.0028) | (0.0021) | (0.0022) |
| $\Gamma_t$ | 0.86 | 0.9 | 1.2** | 1.2** |
| | (0.53) | (0.54) | (0.41) | (0.42) |
| $\Gamma_{t-1}$ | 1.8** | 1.9** | 1* | 1* |
| | (0.56) | (0.56) | (0.43) | (0.44) |
| $\Gamma_{t-2}$ | | 0.51 | | -0.29 |
| | | (0.56) | | (0.44) |
| N | 56 | 55 | 56 | 55 |
| $R^2$ | 0.19 | 0.213 | 0.19 | 0.208 |
| Adj. $R^2$ | 0.159 | 0.166 | 0.16 | 0.161 |

Table 2: ***Year Demeaned, Q=1000, K=100****: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals along with 2 of its lags from 1952 to 2008. The granular residual specification uses productivity growth rate innovations computed as the demeaned productivity growth rate using the within year means.*

### Granular Residuals Computed Using Productivity Growth Rate Innovations Demeaned at Year by Industry Level

Now, I run the same regression, but use the year by industry means when computing the innovations to productivity growth.

```
> GRANULAR_RESIDUAL_SPECIFICATION <- "GranularResidualUsingYearAndIndustryDemeaningQ1000K100"
> CAPTION <- "\\textit{\\textbf{Year and Industry Demeaned, Q=1000, K=100}: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("logChangeInPerCapitaGdp"), c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"), c(GRANULAR_RESIDUAL_SPECIFICATION))), lags = list(c(0, 1), c(0, 1,
     2), c(0, 1), c(0, 1, 2)), caption = CAPTION)
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_GranularResidualPredictsPerCapitaGdpGrowth_YearAndIndustryDemeanedInnovationsQ1000K100Specification.tex",
     sep = ""))
> GRANULAR_RESIDUAL_SPECIFICATION <- "GranularResidualUsingYearAndIndustryDemeaningQ100K100"
> CAPTION <- "\\textit{\\textbf{Year and Industry Demeaned, Q=100, K=100}: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("logChangeInPerCapitaGdp"), c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"),
     c(GRANULAR_RESIDUAL_SPECIFICATION)), list(c("solowResidual"), c(GRANULAR_RESIDUAL_SPECIFICATION))), lags = list(c(0, 1), c(0, 1,
     2), c(0, 1), c(0, 1, 2)), caption = CAPTION)
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_GranularResidualPredictsPerCapitaGdpGrowth_YearAndIndustryDemeanedInnovationsQ100K100Specification.tex",
     sep = ""))
```

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (Intercept) | 0.019** | 0.017** | 0.011** | 0.011** |
| | (0.0024) | (0.0022) | (0.0019) | (0.0019) |
| $\Gamma_t$ | 3.4** | 4.5** | 3.3** | 3.7** |
| | (0.86) | (0.82) | (0.68) | (0.72) |
| $\Gamma_{t-1}$ | 3.4** | 4.3** | 1.5* | 1.9** |
| | (0.82) | (0.78) | (0.65) | (0.68) |
| $\Gamma_{t-2}$ | | 2.7** | | 0.77 |
| | | (0.79) | | (0.69) |
| N | 56 | 55 | 56 | 55 |
| $R^2$ | 0.356 | 0.506 | 0.334 | 0.372 |
| Adj. $R^2$ | 0.332 | 0.477 | 0.309 | 0.335 |

Table 3: ***Year and Industry Demeaned, Q=100, K=100****: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals along with 2 of its lags from 1952 to 2008. The granular residual specification uses productivity growth rate innovations computed as the demeaned productivity growth rate using the within year and industry means.*

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| (Intercept) | 0.019** | 0.018** | 0.012** | 0.011** |
| | (0.0025) | (0.0024) | (0.002) | (0.002) |
| $\Gamma_t$ | 1.1* | 1.4* | 1.5** | 1.5** |
| | (0.54) | (0.53) | (0.44) | (0.44) |
| $\Gamma_{t-1}$ | 2.5** | 2.8** | 1.2** | 1.3** |
| | (0.54) | (0.54) | (0.44) | (0.45) |
| $\Gamma_{t-2}$ | | 0.81 | | -0.37 |
| | | (0.53) | | (0.44) |
| N | 56 | 55 | 56 | 55 |
| $R^2$ | 0.31 | 0.371 | 0.248 | 0.29 |
| Adj. $R^2$ | 0.284 | 0.334 | 0.22 | 0.248 |

Table 4: ***Year and Industry Demeaned, Q=1000, K=100***: *This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals along with 2 of its lags from 1952 to 2008. The granular residual specification uses productivity growth rate innovations computed as the demeaned productivity growth rate using the within year and industry means.*

Next, I plot the predicted values from the $(Q = 100, K = 100)$ specification.

```
> PlotData <- RegressionObject@data[RegressionObject@data$year %in% seq(1952, 2008), c("year", "logChangeInPerCapitaGdp")]
> PlotData$predicted <- c(NA, predict(RegressionObject@results[[1]][[1]]) - RegressionObject@results[[2]][[1]]$coef[1])
> names(PlotData) <- c("year", "logChangeInPerCapitaGdp", "predicted")
> PlotData$year <- as.numeric(as.character(PlotData$year))
> PlotData$year2 <- PlotData$year - trunc(PlotData$year/100) * 100
> PlotData$year2 <- as.character(PlotData$year2)
> PlotData[nchar(PlotData$year2) == 1, ]$year2 <- paste("0", PlotData[nchar(PlotData$year2) == 1, ]$year2, sep = "")
> pdf(paste(FIGURES_DIRECTORY, "ScatterPlot_PredictedValuesGdpGrowth_YearAndIndustryDemeanedProductivityGrowthInnovationsQ100K100.pdf",
      sep = ""), height = 5, width = 9)
> p <- ggplot(PlotData, aes(x = predicted, y = logChangeInPerCapitaGdp, label = year2))
> p <- p + geom_text(size = 3)
> p <- p + stat_smooth(method = "lm", se = FALSE)
> p <- p + ylab("Growth of GDP per capita") + xlab("Current + Lagged Value")
> print(p)
> dev.off()
> tiff(paste(FIGURES_DIRECTORY, "figureIV.tiff", sep = ""), height = 400, width = 700)
> p <- ggplot(PlotData, aes(x = predicted, y = logChangeInPerCapitaGdp, label = year2))
> p <- p + geom_text(size = 5)
> p <- p + stat_smooth(method = "lm", se = FALSE)
> p <- p + ylab("Growth of GDP per capita") + xlab("Current + Lagged Value")
> print(p)
> dev.off()
> postscript(paste(FIGURES_DIRECTORY, "figureIV.eps", sep = ""), height = 5, width = 9)
> p <- ggplot(PlotData, aes(x = predicted, y = logChangeInPerCapitaGdp, label = year2))
> p <- p + geom_text(size = 5)
> p <- p + stat_smooth(method = "lm", se = FALSE)
> p <- p + ylab("Growth of GDP per capita") + xlab("Current + Lagged Value")
> print(p)
> dev.off()
> COEFFICIENT_0L <- RegressionObject@results[[2]][[1]]$coef[2]
> COEFFICIENT_1L <- RegressionObject@results[[2]][[1]]$coef[3]
```

### Granular Residuals Computed Using Productivity Growth Rate Innovations Estimated as Residuals

Next, I estimate equation 3 from above for each of the granular residuals estimated using productivity growth innovations computed as residuals for both the $(Q = 100, K = 100)$ and $(Q = 1000, K = 100)$ specifications.

```
> CAPTION <- "\\textit{\\textbf{Residual Productivity Innovations, Q=100, K=100}: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary gr
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
      c("GranularResidualUsingResidualEquation1Q100K100")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation2Q100K100")),
      list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation3Q100K100")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation4Q100K100")),
      list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation5Q100K100")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation6Q100K100"))),
      lags = list(c(0, 1, 2)), caption = CAPTION)
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_GranularResidualPredictsPerCapitaGdpGrowth_ResidualInnovationsQ100K100Specification.tex",
      sep = ""))
> CAPTION <- "\\textit{\\textbf{Residual Productivity Innovations, Q=1000, K=100}: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary g
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
      c("GranularResidualUsingResidualEquation1Q1000K100")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation2Q1000K100")),
      list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation3Q1000K100")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation4Q1000K100")),
      list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation5Q1000K100")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingResidualEquation6Q1000K100"))),
      lags = list(c(0, 1, 2)), caption = CAPTION)
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_GranularResidualPredictsPerCapitaGdpGrowth_ResidualInnovationsQ1000K100Specification.tex",
      sep = ""))
```

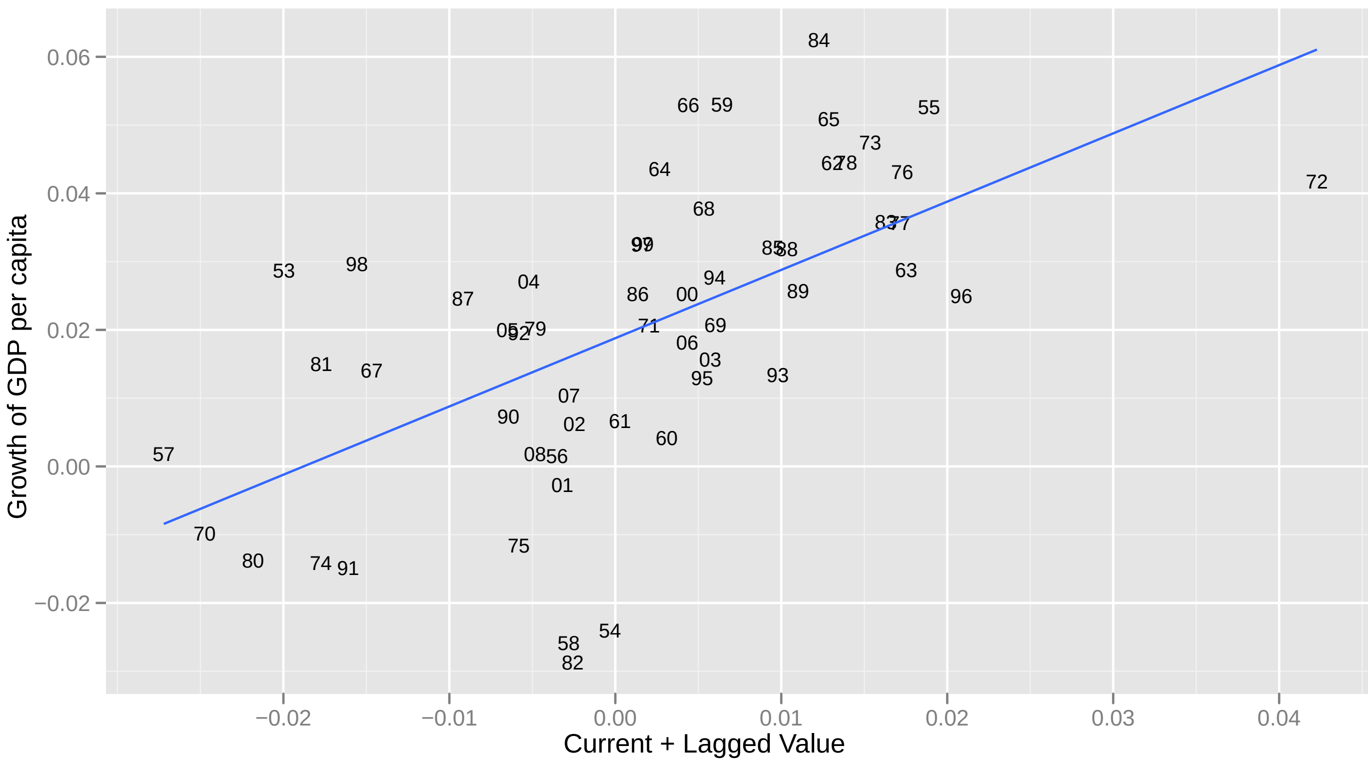


Figure 1: ***Growth of GDP per Capita against*** $3.4\Gamma_t + 3.4\Gamma_{t-1}$: *Industry-demeaned granular residual and its lagged value. The display of* $3.4\Gamma_t + 3.4\Gamma_{t-1}$ *is motivated by Table 2, which yields regression coefficients on* $\Gamma_t$ *and* $\Gamma_{t-1}$ *of that magnitude.*

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| (Intercept) | 0.017** | 0.017** | 0.018** | 0.019** | 0.02** | 0.019** |
| | (0.0025) | (0.0022) | (0.0024) | (0.0024) | (0.0022) | (0.0021) |
| $\Gamma_t$ | 2.5** | 4.5** | 2.8** | 2.6** | 4.2** | 4.4** |
| | (0.69) | (0.82) | (0.68) | (0.7) | (0.83) | (0.84) |
| $\Gamma_{t-1}$ | 2.9** | 4.3** | 2.7** | 2.9** | 3.8** | 4.6** |
| | (0.67) | (0.78) | (0.68) | (0.68) | (0.81) | (0.77) |
| $\Gamma_{t-2}$ | 2.1** | 2.7** | 2.1** | 2.1** | 2.9** | 2.9** |
| | (0.71) | (0.79) | (0.7) | (0.72) | (0.82) | (0.81) |
| N | 55 | 55 | 55 | 55 | 55 | 55 |
| $R^2$ | 0.382 | 0.506 | 0.395 | 0.388 | 0.456 | 0.516 |
| Adj. $R^2$ | 0.346 | 0.477 | 0.359 | 0.352 | 0.423 | 0.487 |

Table 5: ***Residual Productivity Innovations, Q=100, K=100***: *This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals along with 2 of its lags from 1952 to 2008.*

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| (Intercept) | 0.018** | 0.018** | 0.016** | 0.023** | 0.016** | 0.023** |
| | (0.0028) | (0.0024) | (0.003) | (0.0029) | (0.0027) | (0.0027) |
| $\Gamma_t$ | 0.9 | 1.4* | 1.3* | 1.3* | 1.3* | 1.4* |
| | (0.54) | (0.53) | (0.57) | (0.58) | (0.57) | (0.58) |
| $\Gamma_{t-1}$ | 1.9** | 2.8** | 1.9** | 1.7** | 2.3** | 2.1** |
| | (0.56) | (0.54) | (0.6) | (0.61) | (0.6) | (0.6) |
| $\Gamma_{t-2}$ | 0.51 | 0.81 | 0.55 | 0.47 | 0.7 | 0.64 |
| | (0.56) | (0.53) | (0.59) | (0.6) | (0.59) | (0.6) |
| N | 55 | 55 | 55 | 55 | 55 | 55 |
| $R^2$ | 0.213 | 0.371 | 0.222 | 0.2 | 0.278 | 0.255 |
| Adj. $R^2$ | 0.166 | 0.334 | 0.176 | 0.152 | 0.236 | 0.212 |

Table 6: ***Residual Productivity Innovations, Q=1000, K=100****: This table presents the results of regressions of the per capita GDP growth and Solow residuals in each year on the contemporary granular residuals along with 2 of its lags from 1952 to 2008.*

# 3 Macroeconomic Regressions

In this section I run regressions of the per capita GDP growth rate on the granular residual with different numbers of lags as well as other macro economic variables to see if the granular residual predicts some part of GDP growth that is unexplained by existing hypotheses.

### Macroeconomic Contemporaneous Table

First, I run a set of regressions of the growth in the per capita GDP on the granular residual estimated using industry and year demeaned productivity growth rate innovations and 2 lagged values along with several macroeconomic variables.

```
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
     c("hamiltonOilShocks")), list(c("logChangeInPerCapitaGdp"), c("romerMonetaryShocks")), list(c("logChangeInPerCapitaGdp"), c("hamiltonOilShocks",
     "romerMonetaryShocks")), list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingYearAndIndustryDemeaningQ100K100")), list(c("logChangeInPerCapitaGdp"),
     c("hamiltonOilShocks", "romerMonetaryShocks", "GranularResidualUsingYearAndIndustryDemeaningQ100K100")), list(c("logChangeInPerCapitaGdp"),
     c("yield.3Month", "termSpread")), list(c("logChangeInPerCapitaGdp"), c("yield.3Month", "termSpread", "GranularResidualUsingYearAndIndustryDemeaningQ100K100")),
     list(c("logChangeInPerCapitaGdp"), c("yield.3Month", "termSpread", "GranularResidualUsingYearAndIndustryDemeaningQ100K100", "hamiltonOilShocks",
         "romerMonetaryShocks"))), lags = list(c(0, 1, 2)), caption = "\\textit{\\textbf{Contemporaneous Table, Macroeconomic Data}: This table presents the results of regressions of per capita GDP growth on a va
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_MacroeconomicContemporaneousTableWith2Lags.tex", sep = ""))
```

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (Intercept) | 0.023** | 0.02** | 0.022** | 0.017** | 0.019** | 0.016* | 0.02** | 0.023** |
| | (0.003) | (0.0029) | (0.003) | (0.0022) | (0.0023) | (0.0065) | (0.005) | (0.0048) |
| $\text{Oil}_t$ | -9.8e-05 | | -8.3e-05 | | -4.6e-05 | | | -7.9e-05 |
| | (0.00011) | | (0.00012) | | (8.6e-05) | | | (7.5e-05) |
| $\text{Oil}_{t-1}$ | -0.00028* | | -0.00026* | | -0.00021* | | | -0.00019* |
| | (0.00012) | | (0.00012) | | (8.8e-05) | | | (7.5e-05) |
| $\text{Oil}_{t-2}$ | -0.00019 | | -0.00019 | | -0.00012 | | | -4.3e-05 |
| | (0.00012) | | (0.00012) | | (8.9e-05) | | | (6.8e-05) |
| $\text{Monetary}_t$ | | -0.0088 | -0.03 | | -0.057 | | | -0.044 |
| | | (0.059) | (0.058) | | (0.043) | | | (0.032) |
| $\text{Monetary}_{t-1}$ | | -0.08 | -0.065 | | 0.012 | | | -0.013 |
| | | (0.061) | (0.059) | | (0.047) | | | (0.033) |
| $\text{Monetary}_{t-2}$ | | -0.061 | -0.048 | | 0.031 | | | 0.095** |
| | | (0.059) | (0.058) | | (0.046) | | | (0.033) |
| $\Gamma_t$ | | | | 4.5** | 4.2** | | 3.7** | 4** |
| | | | | (0.82) | (0.88) | | (0.69) | (0.66) |
| $\Gamma_{t-1}$ | | | | 4.3** | 4.5** | | 2.8** | 3.6** |
| | | | | (0.78) | (0.85) | | (0.71) | (0.68) |
| $\Gamma_{t-2}$ | | | | 2.7** | 2.7** | | 2.6** | 2.8** |
| | | | | (0.79) | (0.8) | | (0.69) | (0.63) |
| $r_t$ | | | | | | 0.66* | 0.69** | 0.83** |
| | | | | | | (0.26) | (0.2) | (0.19) |
| $r_{t-1}$ | | | | | | -1.6** | -1.5** | -1.5** |
| | | | | | | (0.35) | (0.28) | (0.27) |
| $r_{t-2}$ | | | | | | 1** | 0.85** | 0.7** |
| | | | | | | (0.29) | (0.23) | (0.22) |
| $\text{Term Spread}_t$ | | | | | | -0.49 | -0.11 | -0.13 |
| | | | | | | (0.52) | (0.41) | (0.38) |
| $\text{Term Spread}_{t-1}$ | | | | | | 0.17 | -0.34 | -0.37 |
| | | | | | | (0.52) | (0.41) | (0.42) |
| $\text{Term Spread}_{t-2}$ | | | | | | 0.31 | -0.02 | -0.18 |
| | | | | | | (0.39) | (0.32) | (0.33) |
| N | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 |
| $R^2$ | 0.133 | 0.0768 | 0.189 | 0.506 | 0.582 | 0.551 | 0.755 | 0.832 |
| Adj. $R^2$ | 0.0824 | 0.0225 | 0.0878 | 0.477 | 0.498 | 0.495 | 0.706 | 0.767 |

Table 7: ***Contemporaneous Table, Macroeconomic Data***: *This table presents the results of regressions of per capita GDP growth on a variety of explanatory variables at a yearly level. The granular residual is computed using Q=100 and K=100 and is demeaned with the industry means with 2 lags.*

### Macroeconomic Predictive Table

Next, I run a variant on the specification above, but this time I leave out the contemporaneous terms.

```
> RegressionObject <- new("RegressionObject", data = GranularResiduals, variableNameDictionary = DictionaryOfVariableNames, formulas = list(list(c("logChangeInPerCapitaGdp"),
      c("hamiltonOilShocks")), list(c("logChangeInPerCapitaGdp"), c("romerMonetaryShocks")), list(c("logChangeInPerCapitaGdp"), c("hamiltonOilShocks",
      "romerMonetaryShocks")), list(c("logChangeInPerCapitaGdp"), c("yield.3Month")), list(c("logChangeInPerCapitaGdp"), c("termSpread",
      "yield.3Month")), list(c("logChangeInPerCapitaGdp"), c("hamiltonOilShocks", "romerMonetaryShocks", "termSpread", "yield.3Month")),
      list(c("logChangeInPerCapitaGdp"), c("GranularResidualUsingYearAndIndustryDemeaningQ100K100")), list(c("logChangeInPerCapitaGdp"),
          c("hamiltonOilShocks", "romerMonetaryShocks", "termSpread", "yield.3Month", "GranularResidualUsingYearAndIndustryDemeaningQ100K100"))),
      lags = list(c(1, 2)), caption = "\\textit{\\textbf{Predictive Table, Macroeconomic Data}: This table presents the results of regressions of per capita GDP growth on a variety of explanatory variables at a ye
> write(RegressionObject@xtable, file = paste(FIGURES_DIRECTORY, "RegressionTable_MacroeconomicPredictiveTableWith2Lags.tex", sep = ""))
```

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| (Intercept) | 0.022** | 0.02** | 0.022** | 0.026** | 0.015 | 0.015 | 0.019** | 0.021** |
| | (0.0029) | (0.0029) | (0.0029) | (0.0057) | (0.0075) | (0.0079) | (0.0027) | (0.0073) |
| $\text{Oil}_{t-1}$ | -0.00027* | | -0.00024* | | | -8.7e-05 | | -0.00017 |
| | (0.00012) | | (0.00012) | | | (0.00013) | | (0.00012) |
| $\text{Oil}_{t-2}$ | -0.00018 | | -0.00017 | | | -6.9e-05 | | -0.00012 |
| | (0.00012) | | (0.00012) | | | (0.00012) | | (0.00011) |
| $\text{Monetary}_{t-1}$ | | -0.083 | -0.08 | | | -0.042 | | -0.051 |
| | | (0.057) | (0.055) | | | (0.055) | | (0.05) |
| $\text{Monetary}_{t-2}$ | | -0.059 | -0.038 | | | -0.024 | | 0.043 |
| | | (0.057) | (0.056) | | | (0.054) | | (0.053) |
| $r_{t-1}$ | | | | -0.75** | -0.6 | -0.45 | | -0.41 |
| | | | | (0.2) | (0.32) | (0.37) | | (0.34) |
| $r_{t-2}$ | | | | 0.65** | 0.56 | 0.43 | | 0.39 |
| | | | | (0.19) | (0.32) | (0.37) | | (0.34) |
| $\text{Term Spread}_{t-1}$ | | | | | 0.32 | 0.38 | | 0.4 |
| | | | | | (0.6) | (0.64) | | (0.58) |
| $\text{Term Spread}_{t-2}$ | | | | | 0.45 | 0.27 | | -0.38 |
| | | | | | (0.47) | (0.54) | | (0.53) |
| $\Gamma_{t-1}$ | | | | | | | 3.5** | 3.3** |
| | | | | | | | (0.96) | (1) |
| $\Gamma_{t-2}$ | | | | | | | 1.2 | 2.3* |
| | | | | | | | (0.92) | (0.97) |
| N | 55 | 55 | 55 | 55 | 55 | 55 | 55 | 55 |
| $R^2$ | 0.121 | 0.0764 | 0.175 | 0.22 | 0.288 | 0.312 | 0.215 | 0.463 |
| Adj. $R^2$ | 0.0871 | 0.0409 | 0.109 | 0.191 | 0.231 | 0.192 | 0.185 | 0.341 |

Table 8: ***Predictive Table, Macroeconomic Data****: This table presents the results of regressions of per capita GDP growth on a variety of explanatory variables at a yearly level. The granular residual is computed using Q=100 and K=100 and is demeaned with the industry means with 2 lags.*