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On the Evolution of U.S. Temperature Dynamics

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Abstract: Climate change is a multidimensional shift. While much research has documented rising mean temperature *levels*, we also examine range-based measures of daily temperature *volatility*. Specifically, using data for select U.S. cities over the past half-century, we compare the evolving time series dynamics of the average temperature level, AVG, and the diurnal temperature range, DTR (the difference between the daily maximum and minimum temperatures at a given location). We characterize trend and seasonality in these two series using linear models with time-varying coefficients. These straightforward yet flexible approximations provide evidence of evolving DTR seasonality, stable AVG seasonality, and conditionally Gaussian but heteroskedastic innovations for both DTR and AVG.

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1 Introduction

Climate change can be defined as the variation in the joint probability distribution describing the state of the atmosphere, oceans, and fresh water including ice (Hsiang and Kopp, 2018). These are complex, multidimensional physical systems, and the various features of climate change have been described using a diverse set of summary statistics. One of the most important aspects of climate change is the evolving distribution of temperature, and many subsidiary indicators have been used to measure this variation, including, for example, mean temperature, temperature range, hot and cold spell duration, frost days, growing season length, ice days, heating and cooling degree days, and start of spring dates (Masson-Delmotte et al., 2018; Reidmiller et al., 2018). Of course, the *level* of temperature – the central tendency of the distribution – has attracted the most attention, in particular, regarding the upward trend in the average daily temperature (AVG). In contrast, less attention has been given to temperature *volatility*, which can be measured by the diurnal temperature range (DTR), which is the difference between the daily maximum temperature (MAX) and minimum temperature (MIN) at a given location.

Similar to changes in temperature averages, changes in temperature ranges and variability can also have important effects on environmental and human health (Davy et al., 2017). For example, the incidence of temperature extremes such as heat waves depends critically on how the whole distribution of temperature is shifting – including both the central tendency and variability. Of course, such temperature extremes can have notable adverse effects on society and the economy. Temperature variability can stress workers and lower labor productivity, but it can also have direct effects on output. A salient example is agriculture, whose output is a function of capital, labor, and weather inputs.[1] Indeed, the very viability of certain agricultural sub-industries, notably wine or maple syrup production, is crucially dependent on temperature ranges. For example, Robinson (2006) notes that

> Diurnal temperature variation is of particular importance in viticulture. Wine regions situated in areas of high altitude experience the most dramatic swing in temperature variation during the course of a day. In grapes, this variation has the effect of producing high acid and high sugar content as the grapes' exposure to sunlight increases the ripening qualities while the sudden drop in temperature at night preserves the balance of natural acids in the grape. (p. 691)

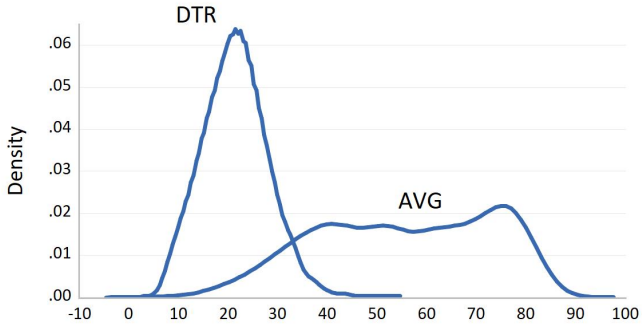
[1] Wigglesworth (2019) finds an important role of DTR in a panel study of U.S. state-level agricultural production over and above standard covariates like capital, labor, and AVG.

To better understand the full nature of the changing distribution of temperature, we examine DTR in select cities in the United States over the past half-century, quantifying both conditional-mean and conditional-variance dynamics. Our contribution is importantly methodological as we characterize the trend and seasonality in DTR using linear models that are easy to interpret but also quite adept at accounting for variation in the temperature distribution. We allow for time-varying coefficients, which provide a straightforward yet flexible approximation to more general nonlinear effects. Although our focus is on DTR, we also provide a parallel analysis for AVG, which allows valuable interpretive context and contrast. Our work reveals an *evolving* DTR conditional mean seasonal pattern, in contrast to the fixed AVG conditional mean seasonal pattern. In addition, our work reveals clear seasonality in conditional *variance* dynamics, both for DTR and AVG, although the evidence is weaker as to their evolution.

The previous research literature that examined DTR struggled for some time to develop firm conclusions about the dynamics of temperature variability. Even the direction of the trend in DTR has been somewhat contentious (Alexander and Perkins, 2013). Recent work has established that the downward trend in DTR in many locations reflects a more rapid warming of MIN than MAX – generally the result of nighttime lows rising faster than daytime highs (Davy et al., 2017). However, this differential trending of MIN and MAX, or "diurnal asymmetry," is not geographically uniform because of variation in vegetation, cloud cover, and other factors (Jackson and Forster, 2010; Sun and Pinker, 2014). Along with this trend in temperature variability, seasonal variation in DTR has also been considered by a few authors, including Ruschy et al. (1991) and Durre and Wallace (2001), who describe a lower temperature range in winter than at other times. Qu et al. (2014) also provide some evidence that the seasonality of DTR in the United States may be changing over time. To capture as much variation as possible in the distribution of DTR – including trend and seasonal – we use linear time series models with time-varying coefficients to provide simple yet powerful representations.

We proceed as follows. In section 2, we provide an introductory analysis for a representative city, Philadelphia. Then, in section 3, we broaden the analysis to include fifteen geographically dispersed U.S. cities, characterizing both conditional-mean and conditional-variance dynamics. We conclude in section 4.

Figure 1: Estimated Densities, AVG and DTR, Philadelphia



Notes to figure: We show kernel density estimates for daily AVG and DTR, 1960-2017.

2 Philadelphia

We introduce and illustrate our approach by studying temperature data measured at the Philadelphia airport (PHL) in a step-by-step fashion. We present most results graphically, while regression results on which these graphs are based appear in Appendix A.[2]. The underlying data are the daily MAX and MIN measured in degrees Fahrenheit, obtained from the U.S. National Ocean and Atmospheric Administration's Global Historical Climate Network database (GHCN-daily).[3] Our sample period is from 01/01/1960 to 12/31/2017, which covers the period of almost all recent climate change.

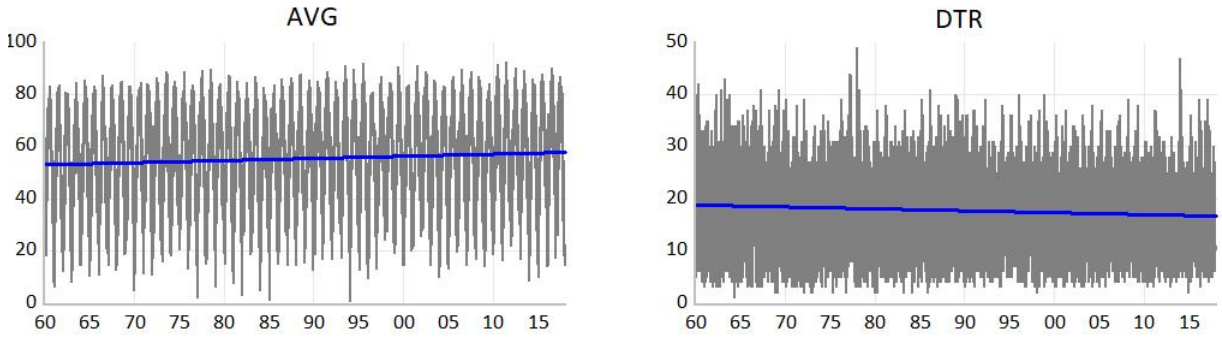
2.1 Distributions

The daily MAX and MIN are informative of both the central tendency and variability of the daily continuous-time temperature record. In particular, the daily average temperature, AVG=(MAX+MIN)/2, is a natural measure of central tendency, and the daily temperature range, DTR=MAX-MIN, is a natural measure of volatility or variability. DTR is not only a natural and intuitive estimator of daily volatility, but it is also highly efficient statistically. The "daily range" has a long and distinguished tradition of use in econometrics due to its good properties in estimating underlying quadratic variation from discretely-sampled data (Alizadeh et al., 2002). AVG has been studied and modeled extensively (Raftery et al.,

[2]EViews code is available at `https://www.sas.upenn.edu/~fdiebold/papers/paper122/DTRcode.txt`

[3]The data are available at `https://www.ncdc.noaa.gov/ghcn-daily-description`. For details, see Menne et al. (2012) and Jaffres (2019).

Figure 2: Data and Estimated Trends, AVG and DTR, Philadelphia



Notes to figure: We show time series of daily AVG and DTR (gray) together with estimated linear trends (blue), 1960-2017. The vertical axes are scaled differently in the two panels, and they are in degrees Fahrenheit.

2017), and DTR much less so.

In Figure 1, we show kernel estimates of the unconditional densities of AVG and DTR. The bimodal shape of the AVG density reflects the strong seasonality in AVG. The "winter mode" is around 40°F, and the "summer mode" is around 75°F. The AVG density contrasts sharply with the unimodal approximately-symmetric density of DTR, which is centered around 19°F and much less dispersed.

2.2 Trend

In Figure 2, we display time series plots of the entire data sample of AVG and DTR with fitted linear trends superimposed. The regression is

$$Y \to c, TIME, \tag{1}$$

where Y is AVG or DTR, c is a constant, and $TIME$ is a time trend (that is, $TIME_t = t$ and $t = 1, ..., T$). Here and throughout, we use Newey and West (1987) heteroskedasticity and autocorrelation consistent (HAC) standard errors to assess statistical significance.

The AVG trend slopes upward and is statistically significant, which is consistent with the overall global warming during this period. The steepness of this trend is surprising, as the AVG trend grows by nearly five degrees Fahrenheit over the course of the 57-year 1960-2017

sample. This increment is a bit more than twice as much as the average global increase over the same period (Rudebusch, 2019). The faster upward trend in the Philadelphia airport average temperature likely reflects two key factors: (1) average temperatures in growing cities tend to rise more quickly due to an increasing urban heat island effect and (2) average land temperatures generally grow more quickly than the global average, which includes ocean areas that are slow to warm.

As for Philadelphia temperature variability, DTR also has a significant trend, and it slopes *downward*, dropping by more than two degrees over the course of the sample – a diurnal asymmetry. The downward DTR trend arises from different trends in the underlying MAX and MIN. Both trend upward, but MIN is on a steeper incline as evening temperatures warm more quickly. Hence, the spread between MAX and MIN tends to shrink, and DTR decreases over time. As noted by Dai et al. (1999), Davy et al. (2017), and Vinnarasi et al. (2017), such a downward trend is not found at all locations; however, the relatively muted upward trend in MAX can generally be ascribed to increased cloud cover, soil moisture, and precipitation, which lead to decreased surface solar radiation and increased daytime surface evaporative cooling.

The overall picture, then, involves not only an upward trend in AVG, but also a gradual tightening of daily fluctuations around that trend. Warming is not only happening, but progressively less volatility as well. As a result, the increases in heat are becoming harder to avoid at night, with potentially adverse consequences that likely fall disproportionately on the poor and vulnerable.

2.3 Fixed Seasonality

In Figure 3, we show the actual and fitted values from regressions of de-trended AVG and DTR on 12 monthly seasonal dummies,

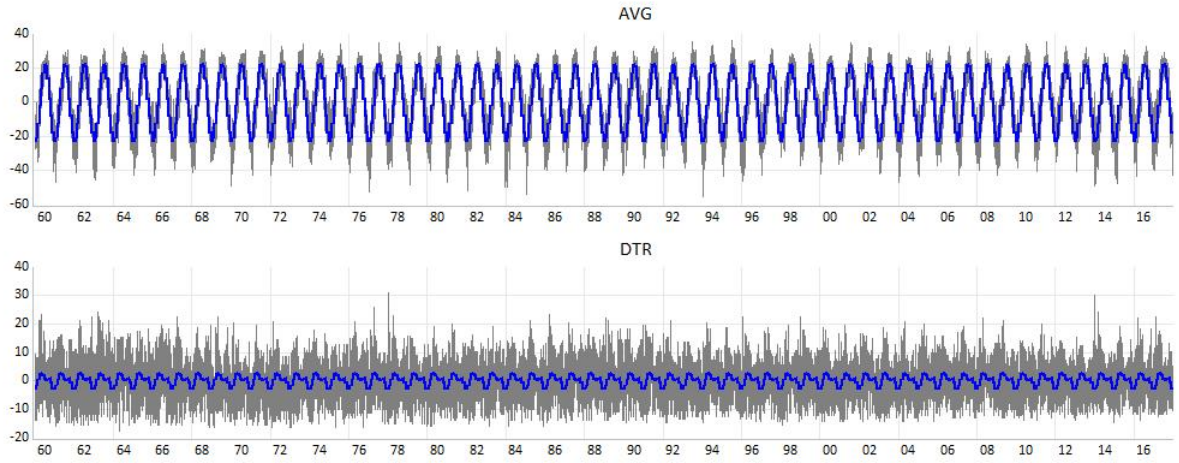
$$\widetilde{Y} \;\rightarrow\; D_1, ..., D_{12}, \tag{2}$$

where $\widetilde{Y}$ is de-trended AVG or DTR – the residuals from regression (1) – and $D_{it} = 1$ if day t is in month i, and 0 otherwise.[4] This model is effectively an intercept regression for deviations from trend, allowing for a different intercept each month.

As shown in the top panel of Figure 3, AVG displays pronounced seasonality. The

[4]There is of course no need for an intercept, which would be completely redundant and hence cause perfect multicollinearity.

Figure 3: De-Trended Data and Estimated Fixed Seasonals, AVG and DTR, Philadelphia



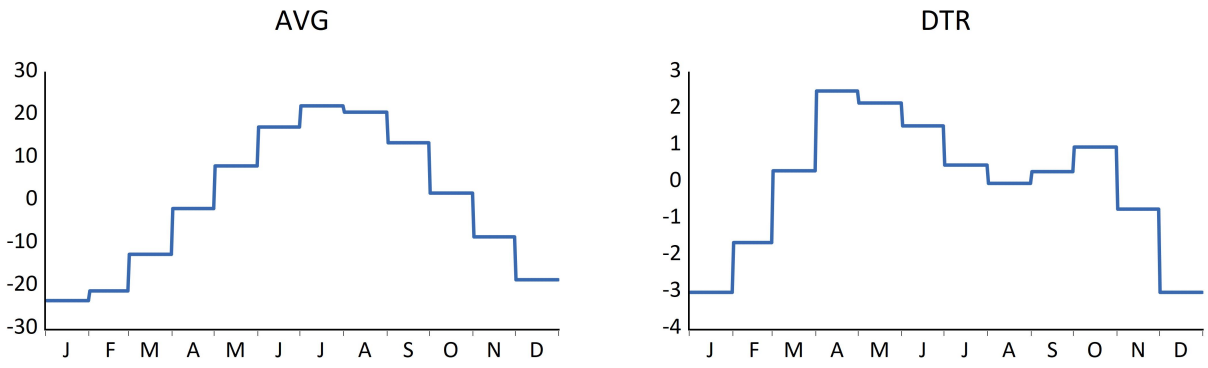
Notes to figure: We show time series of daily linearly de-trended AVG and DTR (gray) together with estimated fixed seasonals (blue) from regressions of daily linearly de-trended data on 12 monthly seasonal dummies, 1960-2017. The vertical and horizontal axes are scaled identically in the top and bottom panels. The vertical axes are in degrees Fahrenheit.

seasonality is highly significant and is responsible for a large amount AVG variation. The R^2 of the seasonal AVG regression (2) is .81. As with the upward trend in AVG, strong seasonality in deviations of AVG from its trend is hardly surprising – it's cold in the winter and hot in the summer.

There is also significant seasonality in DTR, as shown in the bottom panel of Figure 3. The DTR seasonality was hard to detect visually in the time series plot of Figure 2, because it is buried in much more noise than that of AVG. The R^2 of the seasonal DTR regression (2) is only .07.

In Figure 4, we show the estimated monthly seasonal factors for AVG (left panel) and DTR (right panel). They are simply the 12 estimated coefficients on the 12 monthly dummies in the seasonal regression (2). The seasonal pattern for AVG is as expected – smooth and unimodal, high in the summer and low in the winter, achieving its maximum in July and its minimum in January. In contrast, the seasonal pattern for DTR is clearly bi-modal, with one mode in April-May and one in October. DTR's two annual peaks (spring and fall) and two annual troughs (winter and summer) contrast sharply with AVG's single annual peak (summer) and single annual trough (winter). This "twin-peaks" or "M-shaped" DTR

Figure 4: Estimated Fixed Twelve-Month Seasonal Patterns, AVG and DTR, Philadelphia



Notes to figure: We show estimated fixed twelve-month seasonal patterns for AVG and DTR, based on regressions of daily linearly de-trended data on 12 monthly seasonal dummies, 1960-2017. The vertical axes are scaled differently in the left and right panels, and they are in degrees Fahrenheit.

pattern is common across many U.S. cites. Moreover, as we shall show, in many locations, the DTR seasonal pattern has evolved noticeably over time with climate change.

2.4 Evolving Seasonality

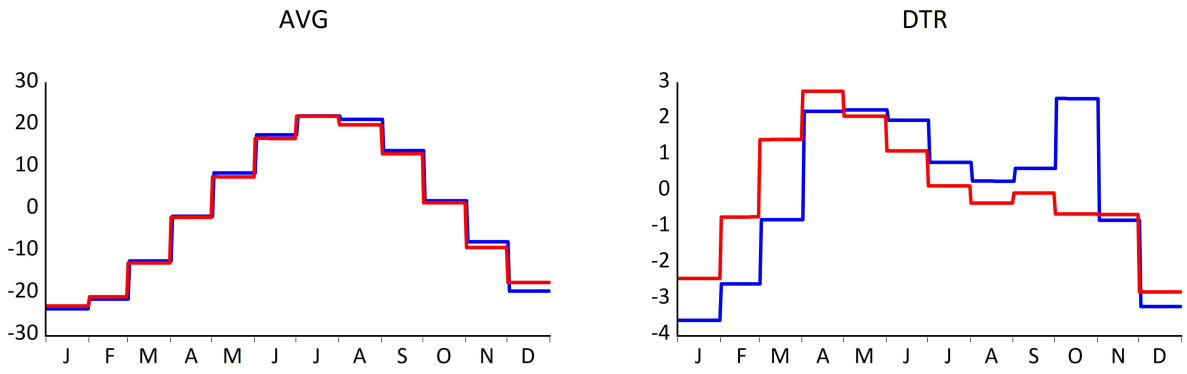
The AVG and DTR trends documented thus far are trends in *level*. More subtle are trends in *seasonality* – that is, trends in the tent-shaped AVG seasonal pattern and the M-shaped DTR seasonal pattern. In that case, the seasonal patterns shown in Figure 4, estimated over the full sample 1960-2017, would be the sample averages that would not capture the evolution of the distribution over time.

We now explore the possibility of evolving seasonality by allowing for trends in the seasonal factors. Mechanically, this involves regressing de-trended AVG or DTR not only on 12 monthly dummies, but also those same 12 dummies interacted with time,

$$\widetilde{Y} \rightarrow D_1, ..., D_{12}, \quad D_1 \cdot TIME, ..., D_{12} \cdot TIME, \tag{3}$$

where $\widetilde{Y}$ is de-trended AVG or DTR, $D_{it} = 1$ if day t is in month i and 0 otherwise, and $TIME_t = t$. Regression (3) can capture linearly-trending seasonal deviations from a linear trend. Effectively, it allows for a different intercept each month, with those intercepts themselves potentially trending at different rates. In the special case where all interaction

Figure 5: Estimated Evolving Twelve-Month Seasonal Patterns, DTR and AVG, Philadelphia, 1960 vs. 2017



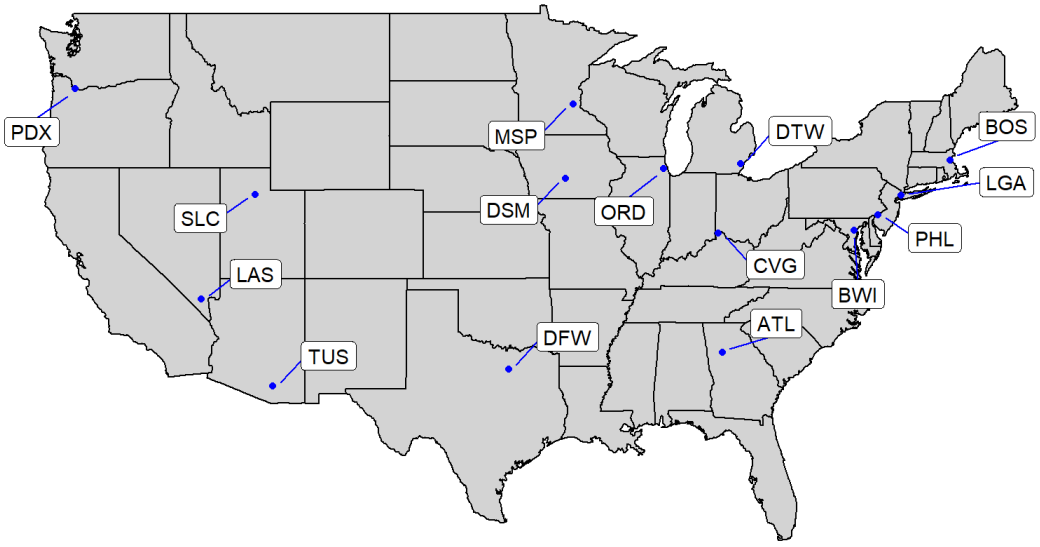
Notes to figure: We show the estimated twelve-month seasonal patterns of AVG and DTR, based on regressions of daily linearly de-trended data on 12 monthly seasonal dummies, and those same dummies interacted with time, 1960-2017. 1960 is blue, and 2017 is red. The vertical axes are scaled differently in the left and right panels, and they are in degrees Fahrenheit.

coefficients are zero, it collapses to fixed seasonal deviations from linear trend, as explored in section 2.3.

For AVG, there are no gains from estimating the more flexible seasonal specification (3). The interaction terms are universally insignificantly different from zero, clearly indicating no change over time in the AVG seasonal pattern. In the left panel of Figure 5, we show the estimated seasonal factors for AVG for the first year (1960) and last year (2017) of our sample. This range provides the maximum contrast, but the two seasonal patterns are nevertheless essentially identical.

The results for DTR, however, are very different. Unlike the AVG seasonal, which does not evolve, the DTR seasonal changes significantly over time. The January-through-March DTR interaction coefficients are significantly positive, indicating that the winter DTR low is increasing. In addition, all May-through-October interaction coefficients are negative, and the October coefficient is large and highly significantly negative. This corresponds to progressively lower DTR highs in Octobers, so that the fall DTR peak is gradually vanishing. Both effects (higher winter DTR lows, and lower fall DTR highs) are visually apparent in the right panel of Figure 5, in which we contrast the estimated DTR M-shaped seasonal pattern in the first year (1960) and last year (2017) of our sample.

Figure 6: Fifteen Cities



Note to figure: We show the fifteen cities for which we study AVG and DTR, by airport code.

3 Fifteen Cities

We now expand our analysis to include data from the airports of the fifteen U.S. cities shown in Figure 6. As with the Philadelphia case study in section 2, we obtain the underlying daily MAX and MIN data, from which we construct daily AVG and DTR, from the U.S. National Ocean and Atmospheric Administration's GHCN-daily, `https://www.ncdc.noaa.gov/ghcn-daily-description`. Our sample period is 01/01/1960-12/31/2017.[5]

We choose these city weather reporting stations because all of them have had temperature derivatives traded on the Chicago Merchantile Exchange (CME). Consideration of such CME cities is of interest for several reasons. First, these locations cover a diverse set of climates, so they can provide a check of the robustness of our Philadelphia results. Second, they are urban locations that represent large numbers of people and a sizable share of economic activity – one reason that their CME contracts are traded. Finally, the valuations of weather derivatives traded in financial markets depend on the evolution of the stochastic structure of

[5]There were a (very) few missing observations, in which case we interpolated using an average of the immediately previous and subsequent days' values, rounded to the nearest integer. The missing observations are: BWI max: 1/7/04, min: 1/6/04, DSM max: 9/15/96, min: 9/15/96, and TUS max: 5/10/10, 8/18/17, 8/19/17, min: 5/11/10, 8/18/17, 8/19/17.

temperature dynamics, which is precisely the focus of our modeling efforts and so naturally paired with the CME cities.

The full set of historically-traded cities includes: Atlanta, ATL; Boston, BOS; Baltimore Washington, BWI; Chicago, ORD; Cincinnati, CVG; Dallas Fort Worth, DFW; Des Moines, DSM; Detroit, DTW; Houston, IAH; Kansas City, MCI; Las Vegas, LAS; Minneapolis St Paul, MSP; New York, LGA; Portland, PDX; Philadelphia, PHL; Sacramento, SAC; Salt Lake City, SLC, and Tuscon, TUS.[6] We exclude Houston, Kansas City, and Sacramento, however, due to large amounts of missing data, leaving fifteen cities. Presently eight cities are traded (Atlanta, Chicago, Cincinnati, Dallas, Las Vegas, Minneapolis, New York, and Sacramento), and all but Sacramento are in our fifteen.[7]

In addition to expanding our analysis to include more cities, we also employ a more sophisticated modeling approach that *jointly* captures trend, seasonality, and serial correlation, and we implement it for both conditional-mean and conditional-variance dynamics. Our approach builds on Campbell and Diebold (2005), but with several important differences. We study the variability as well as the central tendency of temperature, explore time-varying seasonality, and consider more cities and a longer data sample.

3.1 Conditional Mean Dynamics

We view the sequential approach employed in section 2 – fitting a trend and then characterizing seasonality in the de-trended data – as intuitive and transparent. We now consolidate and extend various aspects of that approach, to arrive at a simple yet powerful joint model. Regarding consolidation, we move from a multi-step sequential conditional mean modeling approach to a single-step joint approach with a single conditional mean estimation. Regarding extension, we now include an autoregressive lag in the model. The single autoregressive lag facilitates simple assessment of the strength of serial correlation in the deviations from the trend/seasonal, and it also provides potentially valuable pre-whitening for HAC covariance matrix estimation, as emphasized in Andrews and Monahan (1992).

We proceed by regressing AVG or DTR on an intercept and 11 monthly seasonal dummies to capture seasonal intercept variation (we drop July, so the included constant captures July and all estimated seasonal effects are relative to July), a linear trend and 11 seasonal dummies interacted with it to capture seasonal trend slope variation (we drop the July interaction),

[6] See `ftp://ftp.cmegroup.com/weather/usa/temperature/historical/daily`.

[7] See `https://www.cmegroup.com/trading/weather/temperature-based-indexes.html`.

Table 1: AVG, Conditional Mean Dynamics, Fifteen Cities

(1) *station*	(2) $\Delta trend$	(3) $p(nt)$	(4) $p(ns)$	(5) $p(nts)$	(6) ρ	(7) R^2
ATL	4.36*	0.00	0.00	0.00	0.76*	0.90
BOS	2.06*	0.00	0.00	0.73	0.67*	0.89
BWI	2.25*	0.00	0.00	0.80	0.71*	0.90
CVG	2.53	0.04	0.00	0.94	0.74*	0.89
DFW	3.44*	0.00	0.00	0.55	0.72*	0.89
DSM	3.93*	0.00	0.00	0.17	0.76*	0.91
DTW	4.09*	0.00	0.00	0.99	0.74*	0.91
LAS	6.05*	0.00	0.00	0.41	0.82*	0.96
LGA	4.03*	0.00	0.00	0.97	0.71*	0.91
MSP	4.72*	0.00	0.00	0.18	0.77*	0.93
ORD	2.86*	0.00	0.00	0.78	0.74*	0.90
PDX	2.55*	0.00	0.00	0.26	0.76*	0.90
PHL	4.78*	0.00	0.00	0.95	0.72*	0.91
SLC	3.92*	0.00	0.00	0.67	0.77*	0.93
TUS	4.89*	0.00	0.00	0.33	0.79*	0.93
Median	3.93	0.00	0.00	0.67	0.74	0.91

Notes to table: All results are based on daily data, 1960-2017. Column 1 reports measurement station by airport code. Column 2 reports the estimated trend movement over the entire 57-year sample in degrees Fahrenheit, using a simple regression on linear trend. The remaining columns report results from the conditional-mean regression (4). $p(nt)$ is the robust p-value for a Wald test of no trend (all coefficients on TIME and $D{\cdot}TIME$ interactions are 0), $p(ns)$ is the robust p-value for a Wald test of no seasonality (all coefficients on D's and $D{\cdot}TIME$ interactions are 0), and $p(nts)$ is the robust p-value for Wald a test of no trend in seasonality (all coefficients on $D{\cdot}TIME$ interactions are 0). ρ is the estimated autoregressive coefficient, and R^2 is the coefficient of determination. Asterisks denote significance at the one percent level. See text for details.

Table 2: DTR, Conditional Mean Dynamics, Fifteen Cities

(1) *station*	(2) $\Delta trend$	(3) $p(nt)$	(4) $p(ns)$	(5) $p(nts)$	(6) ρ	(7) R^2
ATL	-1.65*	0.00	0.00	0.14	0.38*	0.18
BOS	-0.48*	0.00	0.00	0.00	0.25*	0.10
BWI	-0.43	0.34	0.00	0.50	0.38*	0.19
CVG	-1.31*	0.00	0.00	0.04	0.32*	0.17
DFW	-1.31*	0.00	0.00	0.64	0.40*	0.17
DSM	-0.51*	0.00	0.00	0.03	0.32*	0.15
DTW	-2.88*	0.00	0.00	0.00	0.33*	0.27
LAS	-7.02*	0.00	0.00	0.13	0.46*	0.37
LGA	0.03*	0.00	0.00	0.00	0.23*	0.14
MSP	-3.07*	0.00	0.00	0.00	0.31*	0.18
ORD	-2.03*	0.00	0.00	0.00	0.30*	0.20
PDX	-1.68*	0.00	0.00	0.63	0.50*	0.45
PHL	-2.13*	0.00	0.00	0.00	0.34*	0.19
SLC	-4.21*	0.00	0.00	0.00	0.44*	0.47
TUS	0.48	0.05	0.00	0.03	0.51*	0.35
Median	-1.65	0.00	0.00	0.03	0.34	0.19

Notes to table: See Table 1.

and a first-order autoregressive lag:[8]

$$Y \rightarrow c, TIME, Y(-1), D_1, ..., D_6, D_8, ..., D_{12}, D_1 \cdot TIME, ..., D_6 \cdot TIME, D_8 \cdot TIME, ..., D_{12} \cdot TIME, \quad (4)$$

where Y is AVG or DTR, $TIME_t = t$, $Y(-1)$ denotes a 1-day lag, and $D_{it} = 1$ if day t is in month i and 0 otherwise. The joint model (4) allows for different intercepts each month, with the different intercepts potentially trending linearly at different rates, and for serially correlated deviations from the trend/seasonal.[9] We summarize the estimation results in Tables 1 and 2, in which we show the weather station identifier (airport code) in column 1, and various aspects of the estimation results in subsequent columns.[10]

[8]We continue to use HAC standard errors despite the inclusion of a first-order autoregressive lag, both because we view the autoregressive lag as a simple pre-whitening strategy rather than a definitive model of serial correlation, and to maintain robustness to heteroskedasticity in temperature shocks.

[9]We have explored – and generally confirmed – the robustness of our results by comparing them to those obtained from a more flexible model with quadratic terms as well as assessing the structural stability of regressions.

[10]Detailed regression results for all cities are in Appendix B, and underlying EViews code is at `https://www.sas.upenn.edu/~fdiebold/papers/paper122/DTRcode.txt`.

3.1.1 Trend

As shown in column 2 of Table 1, the estimated AVG trend movements over the full sample are large and positive in each city. They are also all highly statistically significant (column 3), with a median p-value of 0.00 for Wald tests of the null hypothesis of no trend. These p-values are denoted $p(nt)$, where "nt" stands for "no trend", which corresponds to zero coefficients on TIME and all TIME interactions in regression (4) (in which case it collapses to seasonal intercepts with serial correlation). The median estimated trend movement is 3.38°F, greater than the consensus estimate of the increase in the mean global temperature over the same period, as U.S. airports have warmed more quickly than the global average.

Similarly, in column 2 of Table 2, we report the estimated full-sample trend movements for DTR. All but one are negative, and most are significant at the one percent level. The median estimated trend movement is -1.45°F, with a median p-value, $p(nt)$, of 0.00 for the no-trend null hypothesis (column 3). Interestingly, LAS, which has the largest *upward* AVG trend, also has the largest *downward* DTR trend.

3.1.2 Seasonality

In column 4 of Tables 1 and 2, we report p-values for Wald tests of the hypothesis of no AVG and DTR seasonality, respectively. These p-values are denoted $p(ns)$, where "ns" stands for "no seasonality", which corresponds to zero coefficients on all included seasonal dummies and dummy interactions in regression (4) (in which case it collapses to linear trend with serial correlation). There is of course strong evidence of seasonality in AVG with all $p(ns)$'s equal to 0.00. Less well known is the similarly strong seasonality in DTR with all $p(ns)$'s again equal to 0.00.

In column 5 of Tables 1 and 2, we report p-values for Wald tests of the hypothesis of no evolving (i.e., trending) AVG and DTR seasonality, respectively. These p-values are denoted $p(nts)$, where "nts" stands for "no trending seasonality", which corresponds to zero coefficients on all seasonal dummy interactions in regression (4) (in which case it collapses to linear trend and fixed seasonal dummies with serial correlation). The results are striking. There is no evidence for evolving seasonality in AVG; the median AVG $p(nts)$ is 0.67. In contrast, there is strong evidence of evolving seasonality in DTR; the median DTR $p(nts)$ is 0.03.

3.1.3 Serial Correlation

Estimated AVG and DTR serial correlation coefficients appear in column 6 of Tables 1 and 2, respectively. All are positive and significant at the one percent level. Their magnitudes, however, are very different. All those for AVG are around 0.75, whereas all those for DTR are around 0.35.

It is interesting to note that, although the signal in both AVG and DTR is clearly driven by trend, seasonal, and cyclical components, the AVG signal is burried in much less noise. As shown in column 7 of Tables 1 and 2, respectively, all AVG regression R^2 values are around 0.9, whereas all those for DTR are around 0.2.

3.2 Conditional Variance Dynamics

To allow for residual heteroskedasticity, we proceed exactly as in the conditional mean regression, whether for AVG or DTR, except that the left-hand-side variable is now a *squared residual* from the conditional mean regression:

$$e^2 \rightarrow c, TIME, e^2(-1), D_1, ..., D_6, D_8, ..., D_{12}, D_1 \cdot TIME, ..., D_6 \cdot TIME, D_8 \cdot TIME, ..., D_{12} \cdot TIME. \quad (5)$$

The key point is that residual signs don't matter in the conditional-variance regression (5), because the residuals are *squared*. Instead the regression explains the squared variation in the residuals, which is their *volatility*, or more precisely (in conditional expectation) their conditional variance. The conditional-variance regression results appear in Tables 3 and 4, which are in precisely the same format as our earlier conditional-mean Tables 1 and 2.

Interestingly, AVG and DTR conditional variance e^2 dynamics display the same component structure as did the conditional mean dynamics, although the patterns of trend and seasonality differ. The trend patterns are similarly downward for both AVG and DTR. The seasonal patterns are similarly high in the winter for both AVG and DTR. The conditional variance trend and seasonal effects tend to be significant, but the conditional variance regressions are noisy, with R^2's around 0.05.

3.3 Shock Distributions

Armed with estimates of residual conditional standard deviations (the square roots of the fitted values from regression (5)), we can examine the densities of standardized residuals, that is the densities of the ultimate underlying AVG and DTR shocks. We show their skewness and kurtosis in Table 5. For each station, skewness is approximately 0 and kurtosis

Table 3: AVG, Conditional Variance Dynamics, Fifteen Cities

(1) *station*	(2) $\Delta trend$	(3) $p(nt)$	(4) $p(ns)$	(5) $p(nts)$	(6) ρ	(7) R^2
ATL	-0.29	0.23	0.00	0.34	0.07*	0.11
BOS	-0.01	0.02	0.00	0.02	0.07*	0.04
BWI	-0.03	0.44	0.00	0.54	0.05*	0.06
CVG	-0.43*	0.00	0.00	0.52	0.04*	0.10
DFW	-0.11	0.82	0.00	0.77	0.09*	0.11
DSM	-0.34*	0.00	0.00	0.25	0.05	0.08
DTW	-0.53*	0.00	0.00	0.07	0.05*	0.05
LAS	-0.61	0.46	0.00	0.39	0.09*	0.03
LGA	-0.04	0.36	0.00	0.52	0.06*	0.05
MSP	-0.79*	0.00	0.00	0.00	0.04*	0.08
ORD	-0.79*	0.00	0.00	0.40	0.04*	0.05
PDX	-0.03	0.38	0.00	0.30	0.10*	0.02
PHL	-0.25*	0.00	0.00	0.29	0.05*	0.06
SLC	-0.14	0.05	0.00	0.04	0.08*	0.02
TUS	0.02	0.03	0.00	0.03	0.03*	0.04
Median	-0.25	0.03	0.00	0.30	0.05	0.05

Notes to table: All results are based on daily data, 1960-2017. Column 1 reports measurement station by airport code. Column 2 reports the estimated trend movement over the entire 57-year sample in degrees Fahrenheit, using a regression of absolute residuals from conditional-mean regression (4) on linear trend. (We use absolute rather than squared residuals for the column 2 regression to keep the units in degress Fahrenheit.) The remaining columns report results from the conditional-variance regression (5). $p(nt)$ is the robust p-value for a Wald test of no trend (all coefficients on TIME and $D{\cdot}TIME$ interactions are 0), $p(ns)$ is the robust p-value for a Wald test of no seasonality (all coefficients on D's and $D{\cdot}TIME$ interactions are 0), and $p(nts)$ is the robust p-value for Wald a test of no trend in seasonality (all coefficients on $D{\cdot}TIME$ interactions are 0). ρ is the estimated autoregressive coefficient, and R^2 is the coefficient of determination. Asterisks denote significance at the one percent level. See text for details.

Table 4: DTR, Conditional Variance Dynamics, Fifteen Cities

(1) *station*	(2) $\Delta trend$	(3) $p(nt)$	(4) $p(ns)$	(5) $p(nts)$	(6) ρ	(7) R^2
ATL	-0.86*	0.00	0.00	0.00	0.01	0.10
BOS	-0.28	0.13	0.00	0.65	0.07*	0.03
BWI	-0.32	0.31	0.00	0.90	0.04*	0.04
CVG	-0.64*	0.00	0.00	0.72	0.03*	0.05
DFW	-0.44	0.12	0.00	0.91	0.03*	0.11
DSM	-0.50*	0.01	0.00	0.87	0.01	0.06
DTW	-1.14*	0.00	0.00	0.00	0.05*	0.03
LAS	-1.23*	0.00	0.00	0.00	0.04*	0.04
LGA	-0.47*	0.00	0.00	0.14	0.06*	0.03
MSP	-1.44*	0.00	0.00	0.26	0.04*	0.03
ORD	-1.05*	0.00	0.00	0.02	0.04*	0.03
PDX	-0.79*	0.00	0.00	0.01	0.00	0.05
PHL	-0.89*	0.00	0.00	0.02	0.07*	0.05
SLC	-0.77*	0.00	0.00	0.02	0.05*	0.02
TUS	0.21	0.15	0.00	0.63	0.01	0.04
Median	-0.77	0.00	0.00	0.14	0.04	0.04

Notes to table: See Table 3.

is approximately 3, corresponding to conditional normality. Indeed for DTR the median skewness and kurtosis are 0.00 and 3.00, respectively.

4 Concluding Remarks

Climate change is one of the most consequential and pressing issues of our time. We have focused on DTR as an important summary statistic for characterizing climate change. We have provided new stochastic time series representations of DTR that can capture in particular its evolving seasonality. Throughout we have also provided parallel contrasting results for AVG. Indeed the results in Tables 1-5 provide a detailed summary of both DTR and AVG stochastic structure.

Our results may prove useful for assessing and improving structural climate models. In previous research, Braganza et al. (2010), Zhou et al. (2010), Lewis and Karoly (2013), and Rader et al. (2018) show that DTR is a useful metric to help assess the accuracy and degree of fit of global climate models. They generally found that these models persistently

Table 5: Skewness and Kurtosis, Standardized Residuals, Fifteen Cities

(1)	(2)	(3)	(4)	(5)
	AVG		DTR	
station	*skew*	*kurt*	*skew*	*kurt*
ATL	-0.68	3.74	-0.32	3.19
BOS	0.06	2.96	0.43	3.23
BWI	-0.13	3.15	-0.09	2.92
CVG	-0.31	3.23	0	2.86
DFW	-0.64	4.10	-0.08	3.25
DSM	-0.18	3.17	0.13	2.96
DTW	-0.07	3.14	0.09	2.98
LAS	-0.76	4.51	-0.44	3.07
LGA	-0.14	3.02	0.43	3.55
MSP	-0.12	3.17	0.22	3.00
ORD	-0.13	3.24	0.16	2.90
PDX	0.04	3.14	0.11	2.80
PHL	-0.20	3.09	-0.06	3.02
SLC	-0.50	3.77	-0.28	2.98
TUS	-0.69	4.16	-0.53	3.37
Median	-0.18	3.17	0.00	3.00

Notes to table: We show sample skewness and kurtosis of residuals from the conditional-mean regression (4) divided by square roots of fitted values from the conditional-variance regression (5). See text for details.

underestimated the trend in DTR, which was likely related to deficiencies in modeling water vapor and cloud cover processes. Our new results on the evolving seasonality of DTR may provide an additional, more refined, benchmark for such evaluations.

Our results may also prove useful for assessing financial market efficiency, that is, for assessing whether the temperature forecasts embedded in financial asset prices accurately reflect temperature's underlying dynamics. Schlenker and Taylor (2019) address this issue focusing on AVG, and it may be of interest to extend their analysis to incorporate our more complete model of AVG dynamics, or to consider a multivariate modeling of AVG and DTR extending the univariate approach undertaken in this paper.

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Appendices

A Sequential and Joint Regression Results for Philadelphia

PHL Trend Regression, AVG

Dependent Variable: AVG_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample: 1/01/1960 12/31/2017
Included observations: 21185
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	53.02047	0.860367	61.62542	0.0000
TIME	0.000226	6.97E-05	3.237848	0.0012

R-squared	0.006068	Mean dependent var	55.41086
Adjusted R-squared	0.006021	S.D. dependent var	17.71674
S.E. of regression	17.66333	Akaike info criterion	8.580953
Sum squared resid	6608952.	Schwarz criterion	8.581704
Log likelihood	-90891.74	Hannan-Quinn criter.	8.581198
F-statistic	129.3170	Durbin-Watson stat	0.107062
Prob(F-statistic)	0.000000	Wald F-statistic	10.48366
Prob(Wald F-statistic)	0.001206		

PHL Trend Regression, DTR

Dependent Variable: DTR_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample: 1/01/1960 12/31/2017
Included observations: 21185
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.81577	0.171811	109.5146	0.0000
TIME	-0.000100	1.30E-05	-7.722985	0.0000

R-squared	0.009040	Mean dependent var	17.75171
Adjusted R-squared	0.008993	S.D. dependent var	6.461139
S.E. of regression	6.432020	Akaike info criterion	6.560549
Sum squared resid	876359.4	Schwarz criterion	6.561300
Log likelihood	-69490.61	Hannan-Quinn criter.	6.560794
F-statistic	193.2414	Durbin-Watson stat	1.220993
Prob(F-statistic)	0.000000	Wald F-statistic	59.64450
Prob(Wald F-statistic)	0.000000		

PHL Fixed Seasonal Regression, AVG

Dependent Variable: AVGDET_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample: 1/01/1960 12/31/2017
Included observations: 21185
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D1	-23.30393	0.501435	-46.47449	0.0000
D2	-21.02927	0.482270	-43.60480	0.0000
D3	-12.45912	0.432459	-28.80997	0.0000
D4	-1.758657	0.380855	-4.617651	0.0000
D5	8.244852	0.350938	23.49374	0.0000
D6	17.32183	0.273401	63.35694	0.0000
D7	22.24082	0.218207	101.9252	0.0000
D8	20.79500	0.240577	86.43813	0.0000
D9	13.65797	0.337038	40.52355	0.0000
D10	1.849370	0.382281	4.837729	0.0000
D11	-8.365280	0.381983	-21.89963	0.0000
D12	-18.38047	0.453931	-40.49180	0.0000

R-squared	0.810549	Mean dependent var	-4.09E-16
Adjusted R-squared	0.810451	S.D. dependent var	17.66291
S.E. of regression	7.689949	Akaike info criterion	6.918272
Sum squared resid	1252072.	Schwarz criterion	6.922781
Log likelihood	-73269.79	Hannan-Quinn criter.	6.919743
Durbin-Watson stat	0.599680		

Notes: The regression is based on de-trended data. See text for details.

PHL Fixed Seasonal Regression, DTR

Dependent Variable: DTRDET_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample: 1/01/1960 12/31/2017
Included observations: 21185
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D1	-2.991512	0.192368	-15.55099	0.0000
D2	-1.635110	0.231828	-7.053111	0.0000
D3	0.330347	0.259911	1.271004	0.2037
D4	2.503174	0.249080	10.04967	0.0000
D5	2.176853	0.224701	9.687776	0.0000
D6	1.552979	0.203088	7.646812	0.0000
D7	0.481646	0.176516	2.728617	0.0064
D8	-0.018021	0.161591	-0.111525	0.9112
D9	0.301301	0.198622	1.516957	0.1293
D10	0.977539	0.232409	4.206109	0.0000
D11	-0.717284	0.227973	-3.146351	0.0017
D12	-2.989081	0.189615	-15.76399	0.0000

R-squared	0.072506	Mean dependent var	-4.12E-16
Adjusted R-squared	0.072024	S.D. dependent var	6.431868
S.E. of regression	6.195915	Akaike info criterion	6.486224
Sum squared resid	812818.0	Schwarz criterion	6.490733
Log likelihood	-68693.33	Hannan-Quinn criter.	6.487695
Durbin-Watson stat	1.317632		

The regression is based on de-trended data. See text for details.

PHL Evolving Seasonal Regression, AVG

Dependent Variable: AVGDET_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample: 1/01/1960 12/31/2017
Included observations: 21185
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D1	-23.64611	0.917908	-25.76088	0.0000
D2	-21.28787	0.914906	-23.26781	0.0000
D3	-12.23296	0.909260	-13.45376	0.0000
D4	-1.611997	0.788622	-2.044069	0.0410
D5	8.723673	0.694282	12.56503	0.0000
D6	17.74138	0.472155	37.57531	0.0000
D7	22.26663	0.396004	56.22834	0.0000
D8	21.46530	0.458948	46.77065	0.0000
D9	14.03163	0.725289	19.34628	0.0000
D10	2.092955	0.757859	2.761666	0.0058
D11	-7.665536	0.745067	-10.28839	0.0000
D12	-19.43088	0.896796	-21.66700	0.0000
D1*TIME	3.28E-05	7.58E-05	0.433257	0.6648
D2*TIME	2.47E-05	7.77E-05	0.318247	0.7503
D3*TIME	-2.16E-05	7.55E-05	-0.285878	0.7750
D4*TIME	-1.39E-05	6.18E-05	-0.225743	0.8214
D5*TIME	-4.54E-05	5.85E-05	-0.775604	0.4380
D6*TIME	-3.97E-05	4.00E-05	-0.992529	0.3210
D7*TIME	-2.43E-06	3.33E-05	-0.073084	0.9417
D8*TIME	-6.30E-05	3.76E-05	-1.673848	0.0942
D9*TIME	-3.50E-05	5.66E-05	-0.618641	0.5362
D10*TIME	-2.28E-05	6.08E-05	-0.374342	0.7082
D11*TIME	-6.52E-05	5.89E-05	-1.107436	0.2681
D12*TIME	9.76E-05	7.39E-05	1.320912	0.1865

R-squared	0.810805	Mean dependent var	-4.09E-16
Adjusted R-squared	0.810600	S.D. dependent var	17.66291
S.E. of regression	7.686924	Akaike info criterion	6.918051
Sum squared resid	1250378.	Schwarz criterion	6.927070
Log likelihood	-73255.45	Hannan-Quinn criter.	6.920993
Durbin-Watson stat	0.600496		

The regression is based on de-trended data. See text for details.

PHL Evolving Seasonal Regression, DTR

Dependent Variable: DTRDET_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample: 1/01/1960 12/31/2017
Included observations: 21185
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D1	-3.573516	0.363325	-9.835601	0.0000
D2	-2.566527	0.448222	-5.726018	0.0000
D3	-0.789095	0.512080	-1.540962	0.1233
D4	2.218789	0.587126	3.779068	0.0002
D5	2.262578	0.441418	5.125705	0.0000
D6	1.987942	0.469947	4.230139	0.0000
D7	0.815669	0.401014	2.034017	0.0420
D8	0.294241	0.368614	0.798236	0.4247
D9	0.653211	0.466555	1.400072	0.1615
D10	2.621864	0.514676	5.094198	0.0000
D11	-0.799358	0.512271	-1.560420	0.1187
D12	-3.201644	0.420064	-7.621792	0.0000
D1*TIME	5.58E-05	3.13E-05	1.782775	0.0746
D2*TIME	8.91E-05	3.63E-05	2.453206	0.0142
D3*TIME	0.000107	3.62E-05	2.952952	0.0032
D4*TIME	2.70E-05	4.38E-05	0.617480	0.5369
D5*TIME	-8.13E-06	3.63E-05	-0.223813	0.8229
D6*TIME	-4.11E-05	3.32E-05	-1.237224	0.2160
D7*TIME	-3.15E-05	2.87E-05	-1.096358	0.2729
D8*TIME	-2.94E-05	2.72E-05	-1.078317	0.2809
D9*TIME	-3.30E-05	3.38E-05	-0.977116	0.3285
D10*TIME	-0.000154	3.76E-05	-4.090476	0.0000
D11*TIME	7.65E-06	3.80E-05	0.201179	0.8406
D12*TIME	1.98E-05	3.20E-05	0.617898	0.5366

R-squared	0.076429	Mean dependent var	-4.12E-16
Adjusted R-squared	0.075425	S.D. dependent var	6.431868
S.E. of regression	6.184552	Akaike info criterion	6.483118
Sum squared resid	809380.3	Schwarz criterion	6.492137
Log likelihood	-68648.43	Hannan-Quinn criter.	6.486061
Durbin-Watson stat	1.323264		

The regression is based on de-trended data. See text for details.

PHL Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.20203	0.406242	52.19058	0.0000
TIME	6.68E-05	1.13E-05	5.890710	0.0000
D1	-13.00377	0.398518	-32.63032	0.0000
D2	-12.01654	0.399985	-30.04244	0.0000
D3	-9.477612	0.366252	-25.87730	0.0000
D4	-6.497795	0.316712	-20.51640	0.0000
D5	-3.590633	0.271226	-13.23852	0.0000
D6	-1.031422	0.224911	-4.585914	0.0000
D8	-0.281529	0.207881	-1.354279	0.1757
D9	-2.623407	0.270530	-9.697284	0.0000
D10	-5.887328	0.305137	-19.29406	0.0000
D11	-8.778265	0.325337	-26.98210	0.0000
D12	-11.86465	0.382181	-31.04459	0.0000
D1*TIME	7.51E-06	2.78E-05	0.270704	0.7866
D2*TIME	-5.17E-06	2.81E-05	-0.183774	0.8542
D3*TIME	-7.90E-06	2.69E-05	-0.293868	0.7689
D4*TIME	-6.22E-06	2.30E-05	-0.270271	0.7870
D5*TIME	-1.02E-05	2.24E-05	-0.455154	0.6490
D6*TIME	-2.41E-05	1.84E-05	-1.313423	0.1891
D8*TIME	-2.11E-05	1.68E-05	-1.254882	0.2095
D9*TIME	-1.35E-05	2.12E-05	-0.637214	0.5240
D10*TIME	-1.09E-05	2.32E-05	-0.470157	0.6382
D11*TIME	-1.16E-05	2.26E-05	-0.515052	0.6065
D12*TIME	1.82E-05	2.72E-05	0.668393	0.5039
AVG_PHL(-1)	0.718329	0.005105	140.7124	0.0000

R-squared	0.908718	Mean dependent var	55.41201
Adjusted R-squared	0.908614	S.D. dependent var	17.71637
S.E. of regression	5.355669	Akaike info criterion	6.195368
Sum squared resid	606907.6	Schwarz criterion	6.204763
Log likelihood	-65596.33	Hannan-Quinn criter.	6.198433
F-statistic	8776.620	Durbin-Watson stat	1.782252
Prob(F-statistic)	0.000000	Wald F-statistic	10401.85
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.95271	0.302723	42.78740	0.0000
TIME	-8.61E-05	1.93E-05	-4.453194	0.0000
D1	-2.922818	0.369270	-7.915131	0.0000
D2	-2.173920	0.412045	-5.275928	0.0000
D3	-1.035858	0.441871	-2.344253	0.0191
D4	0.964259	0.481586	2.002259	0.0453
D5	0.990373	0.408136	2.426577	0.0153
D6	0.804887	0.403563	1.994453	0.0461
D8	-0.301248	0.360100	-0.836567	0.4028
D9	-0.093547	0.418681	-0.223433	0.8232
D10	1.209749	0.443337	2.728733	0.0064
D11	-1.082676	0.440556	-2.457523	0.0140
D12	-2.615967	0.393432	-6.649102	0.0000
D1*TIME	6.07E-05	2.91E-05	2.088017	0.0368
D2*TIME	7.69E-05	3.20E-05	2.406160	0.0161
D3*TIME	9.12E-05	3.15E-05	2.895508	0.0038
D4*TIME	3.91E-05	3.56E-05	1.097937	0.2722
D5*TIME	1.26E-05	3.16E-05	0.398334	0.6904
D6*TIME	-9.59E-06	2.88E-05	-0.333302	0.7389
D8*TIME	-1.36E-06	2.63E-05	-0.051623	0.9588
D9*TIME	-2.09E-06	3.02E-05	-0.069050	0.9450
D10*TIME	-8.02E-05	3.22E-05	-2.489722	0.0128
D11*TIME	2.43E-05	3.23E-05	0.753026	0.4514
D12*TIME	3.13E-05	2.92E-05	1.070849	0.2842
DTR_PHL(-1)	0.339047	0.007669	44.20912	0.0000

R-squared	0.190049	Mean dependent var	17.75151
Adjusted R-squared	0.189130	S.D. dependent var	6.461226
S.E. of regression	5.818225	Akaike info criterion	6.361047
Sum squared resid	716268.9	Schwarz criterion	6.370442
Log likelihood	-67351.21	Hannan-Quinn criter.	6.364112
F-statistic	206.8665	Durbin-Watson stat	1.997036
Prob(F-statistic)	0.000000	Wald F-statistic	149.6270
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.53425	0.856703	14.63081	0.0000
TIME	-8.55E-05	6.71E-05	-1.274025	0.2027
D1	27.95462	3.314398	8.434298	0.0000
D2	27.40326	3.694701	7.416908	0.0000
D3	19.65243	3.217091	6.108760	0.0000
D4	16.33077	2.814383	5.802609	0.0000
D5	15.64959	2.275583	6.877178	0.0000
D6	7.851489	1.614614	4.862766	0.0000
D8	1.684095	1.451363	1.160355	0.2459
D9	10.15016	1.696774	5.982032	0.0000
D10	15.41559	1.868326	8.251017	0.0000
D11	21.81678	2.580458	8.454616	0.0000
D12	25.32869	2.912196	8.697454	0.0000
D1*TIME	0.000147	0.000289	0.508400	0.6112
D2*TIME	2.29E-05	0.000311	0.073498	0.9414
D3*TIME	0.000468	0.000278	1.683618	0.0923
D4*TIME	0.000376	0.000229	1.646811	0.0996
D5*TIME	-0.000170	0.000170	-1.000579	0.3170
D6*TIME	-0.000154	0.000129	-1.191914	0.2333
D8*TIME	-0.000147	0.000104	-1.409849	0.1586
D9*TIME	-0.000204	0.000130	-1.572636	0.1158
D10*TIME	-0.000131	0.000150	-0.870783	0.3839
D11*TIME	-5.66E-05	0.000223	-0.253438	0.7999
D12*TIME	-0.000102	0.000226	-0.449544	0.6530
E2_AVG_PHL(-1)	0.045064	0.008634	5.219394	0.0000

R-squared	0.056834	Mean dependent var	28.65058
Adjusted R-squared	0.055765	S.D. dependent var	44.80583
S.E. of regression	43.53862	Akaike info criterion	10.38635
Sum squared resid	40107347	Schwarz criterion	10.39575
Log likelihood	-109982.1	Hannan-Quinn criter.	10.38942
F-statistic	53.12346	Durbin-Watson stat	2.002735
Prob(F-statistic)	0.000000	Wald F-statistic	71.11827
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.37441	2.025807	11.04469	0.0000
TIME	-0.000393	0.000143	-2.754483	0.0059
D1	10.66203	3.499646	3.046602	0.0023
D2	15.43329	3.251396	4.746665	0.0000
D3	23.89886	3.584542	6.667200	0.0000
D4	27.07562	3.612763	7.494436	0.0000
D5	23.21550	3.713078	6.252359	0.0000
D6	10.56819	2.869652	3.682741	0.0002
D8	-0.077822	2.467053	-0.031545	0.9748
D9	11.83351	3.131250	3.779164	0.0002
D10	15.76030	3.429174	4.595946	0.0000
D11	12.79291	3.141156	4.072675	0.0000
D12	11.53788	2.921364	3.949484	0.0001
D1*TIME	0.000435	0.000282	1.542890	0.1229
D2*TIME	0.000121	0.000256	0.471372	0.6374
D3*TIME	0.000287	0.000279	1.029384	0.3033
D4*TIME	0.000150	0.000283	0.531146	0.5953
D5*TIME	-0.000227	0.000269	-0.845246	0.3980
D6*TIME	-0.000307	0.000211	-1.455570	0.1455
D8*TIME	-9.88E-05	0.000176	-0.560119	0.5754
D9*TIME	-0.000565	0.000219	-2.586589	0.0097
D10*TIME	-0.000220	0.000244	-0.898320	0.3690
D11*TIME	0.000126	0.000236	0.535258	0.5925
D12*TIME	6.74E-05	0.000211	0.319497	0.7494
E2_DTR_PHL(-1)	0.067617	0.011837	5.712522	0.0000

R-squared	0.046411	Mean dependent var	33.80817
Adjusted R-squared	0.045329	S.D. dependent var	49.85206
S.E. of regression	48.70908	Akaike info criterion	10.61079
Sum squared resid	50198927	Schwarz criterion	10.62018
Log likelihood	-112359.2	Hannan-Quinn criter.	10.61385
F-statistic	42.90654	Durbin-Watson stat	2.001013
Prob(F-statistic)	0.000000	Wald F-statistic	56.51759
Prob(Wald F-statistic)	0.000000		

B Joint Regression Results for Fifteen Cities (For Online Publication Only)

ATL Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_ATL
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.65668	0.368134	50.67912	0.0000
TIME	4.31E-05	8.36E-06	5.158912	0.0000
D1	-9.113740	0.364790	-24.98354	0.0000
D2	-8.102563	0.343568	-23.58360	0.0000
D3	-6.126929	0.311442	-19.67278	0.0000
D4	-3.898269	0.254831	-15.29745	0.0000
D5	-2.110587	0.214417	-9.843366	0.0000
D6	-0.601911	0.169737	-3.546140	0.0004
D8	-0.248123	0.147878	-1.677889	0.0934
D9	-1.685299	0.211015	-7.986645	0.0000
D10	-4.062270	0.257433	-15.77993	0.0000
D11	-6.628765	0.287659	-23.04382	0.0000
D12	-8.354915	0.338702	-24.66744	0.0000
D1*TIME	2.03E-05	2.59E-05	0.784709	0.4326
D2*TIME	2.16E-05	2.46E-05	0.879463	0.3792
D3*TIME	1.75E-05	2.41E-05	0.727108	0.4672
D4*TIME	-7.91E-06	1.93E-05	-0.409594	0.6821
D5*TIME	-3.18E-06	1.71E-05	-0.186383	0.8521
D6*TIME	3.35E-06	1.33E-05	0.251499	0.8014
D8*TIME	1.65E-06	1.20E-05	0.137048	0.8910
D9*TIME	-6.93E-06	1.62E-05	-0.427428	0.6691
D10*TIME	-9.00E-06	1.98E-05	-0.453315	0.6503
D11*TIME	4.50E-06	2.01E-05	0.224367	0.8225
D12*TIME	7.69E-06	2.38E-05	0.322565	0.7470
AVG_ATL(-1)	0.759924	0.004566	166.4330	0.0000

R-squared	0.898511	Mean dependent var	62.18646
Adjusted R-squared	0.898396	S.D. dependent var	15.01719
S.E. of regression	4.786795	Akaike info criterion	5.970779
Sum squared resid	484824.8	Schwarz criterion	5.980174
Log likelihood	-63217.49	Hannan-Quinn criter.	5.973844
F-statistic	7805.259	Durbin-Watson stat	1.636254
Prob(F-statistic)	0.000000	Wald F-statistic	10641.97
Prob(Wald F-statistic)	0.000000		

ATL Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_ATL
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.46736	0.252924	45.33911	0.0000
TIME	-1.47E-05	1.62E-05	-0.902015	0.3671
D1	0.145404	0.391109	0.371773	0.7101
D2	1.478135	0.417905	3.537012	0.0004
D3	2.304231	0.373442	6.170253	0.0000
D4	2.840155	0.356016	7.977612	0.0000
D5	1.874663	0.332089	5.645066	0.0000
D6	0.668304	0.335856	1.989855	0.0466
D8	-0.175510	0.273537	-0.641631	0.5211
D9	0.015980	0.329001	0.048573	0.9613
D10	1.756665	0.419355	4.188974	0.0000
D11	1.560144	0.390462	3.995634	0.0001
D12	0.689326	0.369229	1.866933	0.0619
D1*TIME	1.04E-05	2.96E-05	0.351457	0.7252
D2*TIME	-3.95E-05	3.15E-05	-1.255535	0.2093
D3*TIME	-5.07E-05	2.84E-05	-1.785744	0.0742
D4*TIME	-6.46E-05	2.68E-05	-2.410933	0.0159
D5*TIME	-6.05E-05	2.58E-05	-2.340342	0.0193
D6*TIME	-2.19E-05	2.61E-05	-0.838424	0.4018
D8*TIME	-1.03E-05	2.30E-05	-0.449477	0.6531
D9*TIME	-1.63E-05	2.71E-05	-0.601882	0.5473
D10*TIME	-5.48E-05	3.33E-05	-1.649079	0.0991
D11*TIME	-3.13E-05	2.98E-05	-1.051788	0.2929
D12*TIME	-5.91E-05	2.89E-05	-2.043743	0.0410
DTR_ATL(-1)	0.380285	0.007764	48.98211	0.0000

R-squared	0.182495	Mean dependent var	19.44779
Adjusted R-squared	0.181568	S.D. dependent var	6.419358
S.E. of regression	5.807416	Akaike info criterion	6.357328
Sum squared resid	713610.2	Schwarz criterion	6.366723
Log likelihood	-67311.82	Hannan-Quinn criter.	6.360393
F-statistic	196.8087	Durbin-Watson stat	2.003125
Prob(F-statistic)	0.000000	Wald F-statistic	149.3844
Prob(Wald F-statistic)	0.000000		

ATL Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_ATL
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.919110	0.498543	9.866967	0.0000
TIME	-1.87E-05	3.67E-05	-0.510521	0.6097
D1	36.43876	3.654830	9.970029	0.0000
D2	35.95182	3.291918	10.92124	0.0000
D3	31.02168	2.376857	13.05155	0.0000
D4	18.49468	1.845402	10.02204	0.0000
D5	8.896469	1.309034	6.796209	0.0000
D6	3.313362	0.917767	3.610241	0.0003
D8	-0.401402	0.674634	-0.594993	0.5519
D9	6.768741	1.222243	5.537965	0.0000
D10	13.86950	1.720376	8.061897	0.0000
D11	24.64334	2.235512	11.02358	0.0000
D12	34.75059	2.773041	12.53158	0.0000
D1*TIME	-0.000135	0.000279	-0.482191	0.6297
D2*TIME	-0.000316	0.000240	-1.318671	0.1873
D3*TIME	-0.000132	0.000187	-0.707461	0.4793
D4*TIME	-4.03E-05	0.000143	-0.281829	0.7781
D5*TIME	-1.50E-05	0.000103	-0.145393	0.8844
D6*TIME	-0.000107	6.54E-05	-1.640193	0.1010
D8*TIME	5.77E-05	5.37E-05	1.074540	0.2826
D9*TIME	-7.10E-05	8.95E-05	-0.793189	0.4277
D10*TIME	-4.40E-05	0.000133	-0.330928	0.7407
D11*TIME	-8.13E-05	0.000177	-0.457994	0.6470
D12*TIME	-0.000375	0.000208	-1.801129	0.0717
E2_AVG_ATL(-1)	0.067373	0.010279	6.554627	0.0000

R-squared	0.108267	Mean dependent var	22.88745
Adjusted R-squared	0.107255	S.D. dependent var	42.55455
S.E. of regression	40.20774	Akaike info criterion	10.22718
Sum squared resid	34205349	Schwarz criterion	10.23657
Log likelihood	-108296.1	Hannan-Quinn criter.	10.23024
F-statistic	107.0344	Durbin-Watson stat	2.002646
Prob(F-statistic)	0.000000	Wald F-statistic	139.2439
Prob(Wald F-statistic)	0.000000		

ATL Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_ATL
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.33254	1.199101	11.11878	0.0000
TIME	-0.000141	9.09E-05	-1.549547	0.1213
D1	45.58401	3.372381	13.51686	0.0000
D2	54.59629	3.628976	15.04455	0.0000
D3	50.19468	3.223925	15.56943	0.0000
D4	34.46872	3.598059	9.579809	0.0000
D5	15.92517	2.725067	5.843956	0.0000
D6	5.343335	2.168251	2.464352	0.0137
D8	-2.119909	1.539113	-1.377358	0.1684
D9	8.915622	2.167426	4.113462	0.0000
D10	20.23476	2.679370	7.552059	0.0000
D11	32.34471	2.918997	11.08076	0.0000
D12	41.72887	3.655564	11.41516	0.0000
D1*TIME	-0.000696	0.000263	-2.646276	0.0081
D2*TIME	-0.001044	0.000263	-3.973654	0.0001
D3*TIME	-0.000735	0.000266	-2.760840	0.0058
D4*TIME	-0.000562	0.000278	-2.021117	0.0433
D5*TIME	-0.000395	0.000199	-1.989461	0.0467
D6*TIME	-0.000116	0.000160	-0.727703	0.4668
D8*TIME	0.000214	0.000124	1.727629	0.0841
D9*TIME	4.85E-05	0.000171	0.283647	0.7767
D10*TIME	-0.000101	0.000203	-0.496913	0.6193
D11*TIME	-0.000340	0.000225	-1.509423	0.1312
D12*TIME	-0.000613	0.000270	-2.269981	0.0232
E2_DTR_ATL(-1)	0.005220	0.008243	0.633302	0.5265

R-squared	0.096608	Mean dependent var	33.68547
Adjusted R-squared	0.095583	S.D. dependent var	52.26192
S.E. of regression	49.70152	Akaike info criterion	10.65113
Sum squared resid	52265356	Schwarz criterion	10.66052
Log likelihood	-112786.4	Hannan-Quinn criter.	10.65419
F-statistic	94.27581	Durbin-Watson stat	2.000651
Prob(F-statistic)	0.000000	Wald F-statistic	110.4384
Prob(Wald F-statistic)	0.000000		

BOS Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_BOS
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.11171	0.421558	57.19667	0.0000
TIME	2.33E-05	1.42E-05	1.643572	0.1003
D1	-14.87671	0.430484	-34.55810	0.0000
D2	-14.08775	0.421067	-33.45723	0.0000
D3	-11.42400	0.384767	-29.69070	0.0000
D4	-8.214698	0.327656	-25.07112	0.0000
D5	-4.749007	0.310113	-15.31382	0.0000
D6	-1.461635	0.290332	-5.034353	0.0000
D8	-0.643648	0.245075	-2.626329	0.0086
D9	-3.336688	0.288199	-11.57772	0.0000
D10	-6.461668	0.323325	-19.98505	0.0000
D11	-9.607569	0.350506	-27.41059	0.0000
D12	-13.68081	0.417285	-32.78528	0.0000
D1*TIME	1.61E-05	3.09E-05	0.519794	0.6032
D2*TIME	7.11E-06	3.10E-05	0.229208	0.8187
D3*TIME	-4.34E-06	2.89E-05	-0.150391	0.8805
D4*TIME	5.44E-06	2.45E-05	0.222303	0.8241
D5*TIME	-8.34E-06	2.51E-05	-0.332988	0.7391
D6*TIME	-2.89E-05	2.42E-05	-1.190993	0.2337
D8*TIME	1.20E-05	2.01E-05	0.593881	0.5526
D9*TIME	1.71E-05	2.29E-05	0.748493	0.4542
D10*TIME	-5.03E-06	2.55E-05	-0.196769	0.8440
D11*TIME	-1.15E-05	2.58E-05	-0.443627	0.6573
D12*TIME	4.66E-05	3.04E-05	1.532438	0.1254
AVG_BOS(-1)	0.669853	0.005317	125.9872	0.0000

R-squared	0.889059	Mean dependent var	51.65776
Adjusted R-squared	0.888933	S.D. dependent var	17.29076
S.E. of regression	5.762434	Akaike info criterion	6.341776
Sum squared resid	702598.2	Schwarz criterion	6.351171
Log likelihood	-67147.10	Hannan-Quinn criter.	6.344842
F-statistic	7065.177	Durbin-Watson stat	1.801634
Prob(F-statistic)	0.000000	Wald F-statistic	8123.904
Prob(Wald F-statistic)	0.000000		

BOS Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_BOS
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.56869	0.297483	42.25014	0.0000
TIME	-3.30E-05	1.98E-05	-1.661285	0.0967
D1	-2.042373	0.378363	-5.397926	0.0000
D2	-1.884719	0.412521	-4.568783	0.0000
D3	-2.224313	0.377953	-5.885152	0.0000
D4	-0.692097	0.462241	-1.497265	0.1343
D5	0.202367	0.467195	0.433152	0.6649
D6	0.888487	0.399962	2.221427	0.0263
D8	-0.525453	0.347904	-1.510342	0.1310
D9	-0.918598	0.385085	-2.385445	0.0171
D10	-0.749156	0.367736	-2.037214	0.0416
D11	-2.907198	0.384264	-7.565629	0.0000
D12	-2.463196	0.397033	-6.204006	0.0000
D1*TIME	1.90E-05	2.96E-05	0.639879	0.5223
D2*TIME	4.70E-05	3.32E-05	1.418233	0.1561
D3*TIME	7.69E-05	2.99E-05	2.575137	0.0100
D4*TIME	2.40E-05	3.52E-05	0.682723	0.4948
D5*TIME	-1.41E-05	3.93E-05	-0.359789	0.7190
D6*TIME	-4.60E-05	3.15E-05	-1.460755	0.1441
D8*TIME	-7.15E-06	2.66E-05	-0.268357	0.7884
D9*TIME	1.27E-05	2.99E-05	0.425052	0.6708
D10*TIME	-1.42E-05	2.85E-05	-0.498183	0.6184
D11*TIME	8.13E-05	2.94E-05	2.765695	0.0057
D12*TIME	2.21E-05	2.94E-05	0.749891	0.4533
DTR_BOS(-1)	0.254582	0.007693	33.09349	0.0000

R-squared	0.097789	Mean dependent var	15.14360
Adjusted R-squared	0.096766	S.D. dependent var	6.147233
S.E. of regression	5.842246	Akaike info criterion	6.369287
Sum squared resid	722195.6	Schwarz criterion	6.378682
Log likelihood	-67438.49	Hannan-Quinn criter.	6.372352
F-statistic	95.55785	Durbin-Watson stat	2.019624
Prob(F-statistic)	0.000000	Wald F-statistic	80.07684
Prob(Wald F-statistic)	0.000000		

BOS Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_BOS
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.87978	1.234119	14.48789	0.0000
TIME	6.69E-05	0.000102	0.658500	0.5102
D1	26.48844	3.519728	7.525708	0.0000
D2	22.42097	4.084364	5.489465	0.0000
D3	8.392528	2.940174	2.854433	0.0043
D4	11.49762	3.233316	3.555983	0.0004
D5	12.07533	2.816132	4.287912	0.0000
D6	10.22617	2.097302	4.875868	0.0000
D8	2.547318	1.741602	1.462629	0.1436
D9	7.735152	2.077183	3.723867	0.0002
D10	13.53279	2.416819	5.599422	0.0000
D11	12.58743	2.761281	4.558547	0.0000
D12	28.03470	3.758604	7.458807	0.0000
D1*TIME	0.000123	0.000306	0.401655	0.6879
D2*TIME	-0.000145	0.000339	-0.428515	0.6683
D3*TIME	0.000649	0.000269	2.411012	0.0159
D4*TIME	0.000134	0.000263	0.508593	0.6110
D5*TIME	-5.09E-05	0.000227	-0.224688	0.8222
D6*TIME	-0.000178	0.000174	-1.025570	0.3051
D8*TIME	-0.000278	0.000144	-1.935589	0.0529
D9*TIME	-0.000275	0.000163	-1.682187	0.0925
D10*TIME	-0.000377	0.000197	-1.915779	0.0554
D11*TIME	0.000184	0.000228	0.806273	0.4201
D12*TIME	-0.000427	0.000280	-1.523575	0.1276
E2_AVG_BOS(-1)	0.067533	0.008468	7.974869	0.0000

R-squared	0.039036	Mean dependent var	33.16668
Adjusted R-squared	0.037946	S.D. dependent var	49.56856
S.E. of regression	48.61901	Akaike info criterion	10.60709
Sum squared resid	50013446	Schwarz criterion	10.61648
Log likelihood	-112319.9	Hannan-Quinn criter.	10.61015
F-statistic	35.81115	Durbin-Watson stat	2.008989
Prob(F-statistic)	0.000000	Wald F-statistic	33.33443
Prob(Wald F-statistic)	0.000000		

BOS Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_BOS
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.18361	1.521558	17.20842	0.0000
TIME	-0.000121	0.000123	-0.984405	0.3249
D1	4.274125	3.119809	1.369996	0.1707
D2	4.861338	2.909744	1.670710	0.0948
D3	6.582907	2.854222	2.306376	0.0211
D4	18.92629	5.343923	3.541647	0.0004
D5	25.81966	3.643491	7.086517	0.0000
D6	10.92097	2.935213	3.720673	0.0002
D8	-0.847825	2.087216	-0.406199	0.6846
D9	1.306998	2.351469	0.555822	0.5783
D10	4.376414	2.571417	1.701946	0.0888
D11	0.135085	2.465734	0.054785	0.9563
D12	5.999733	3.538519	1.695549	0.0900
D1*TIME	0.000156	0.000260	0.600902	0.5479
D2*TIME	-6.66E-05	0.000227	-0.293190	0.7694
D3*TIME	0.000373	0.000250	1.489651	0.1363
D4*TIME	0.000361	0.000418	0.864407	0.3874
D5*TIME	-0.000349	0.000285	-1.226529	0.2200
D6*TIME	-6.54E-05	0.000231	-0.283318	0.7769
D8*TIME	-6.99E-05	0.000171	-0.409465	0.6822
D9*TIME	-4.14E-05	0.000192	-0.216008	0.8290
D10*TIME	-0.000205	0.000200	-1.026676	0.3046
D11*TIME	4.19E-05	0.000189	0.221309	0.8249
D12*TIME	-0.000181	0.000266	-0.680364	0.4963
E2_DTR_BOS(-1)	0.069557	0.012333	5.639817	0.0000

R-squared	0.030783	Mean dependent var	34.08829
Adjusted R-squared	0.029684	S.D. dependent var	53.33802
S.E. of regression	52.54042	Akaike info criterion	10.76222
Sum squared resid	58406560	Schwarz criterion	10.77162
Log likelihood	-113963.1	Hannan-Quinn criter.	10.76529
F-statistic	28.00007	Durbin-Watson stat	2.007356
Prob(F-statistic)	0.000000	Wald F-statistic	18.54643
Prob(Wald F-statistic)	0.000000		

BWI Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_BWI
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.40063	0.423605	52.88096	0.0000
TIME	3.44E-05	1.21E-05	2.829921	0.0047
D1	-13.21851	0.409527	-32.27750	0.0000
D2	-12.17017	0.429383	-28.34335	0.0000
D3	-9.595500	0.381431	-25.15658	0.0000
D4	-6.656892	0.331237	-20.09710	0.0000
D5	-3.803424	0.286829	-13.26024	0.0000
D6	-1.033982	0.233717	-4.424077	0.0000
D8	-0.275647	0.211245	-1.304869	0.1920
D9	-2.582815	0.281612	-9.171528	0.0000
D10	-6.044592	0.320733	-18.84619	0.0000
D11	-9.069485	0.342183	-26.50480	0.0000
D12	-12.16212	0.396815	-30.64938	0.0000
D1*TIME	1.01E-05	2.92E-05	0.344575	0.7304
D2*TIME	-3.27E-06	2.99E-05	-0.109342	0.9129
D3*TIME	-1.18E-06	2.89E-05	-0.040964	0.9673
D4*TIME	3.29E-06	2.47E-05	0.133531	0.8938
D5*TIME	-7.48E-07	2.42E-05	-0.030953	0.9753
D6*TIME	-1.75E-05	1.93E-05	-0.908987	0.3634
D8*TIME	-2.86E-05	1.74E-05	-1.648230	0.0993
D9*TIME	-2.61E-05	2.23E-05	-1.171957	0.2412
D10*TIME	-2.14E-05	2.47E-05	-0.866873	0.3860
D11*TIME	-1.58E-05	2.41E-05	-0.654007	0.5131
D12*TIME	1.96E-05	2.84E-05	0.689383	0.4906
AVG_BWI(-1)	0.706187	0.005255	134.3894	0.0000

R-squared	0.896465	Mean dependent var	55.59814
Adjusted R-squared	0.896347	S.D. dependent var	17.39790
S.E. of regression	5.601277	Akaike info criterion	6.285046
Sum squared resid	663849.0	Schwarz criterion	6.294441
Log likelihood	-66546.21	Hannan-Quinn criter.	6.288111
F-statistic	7633.593	Durbin-Watson stat	1.797618
Prob(F-statistic)	0.000000	Wald F-statistic	9131.184
Prob(Wald F-statistic)	0.000000		

BWI Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_BWI
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.76766	0.297477	42.91981	0.0000
TIME	-2.26E-05	2.03E-05	-1.115865	0.2645
D1	-2.346735	0.390405	-6.011033	0.0000
D2	-1.904946	0.433199	-4.397396	0.0000
D3	-0.488516	0.430853	-1.133832	0.2569
D4	1.168805	0.460008	2.540833	0.0111
D5	1.056513	0.424347	2.489739	0.0128
D6	0.743739	0.393230	1.891356	0.0586
D8	-0.260550	0.360140	-0.723469	0.4694
D9	-0.099770	0.435387	-0.229153	0.8188
D10	0.988378	0.490924	2.013303	0.0441
D11	-0.850239	0.453763	-1.873752	0.0610
D12	-2.236918	0.417588	-5.356754	0.0000
D1*TIME	2.21E-05	3.15E-05	0.702081	0.4826
D2*TIME	5.93E-05	3.62E-05	1.639026	0.1012
D3*TIME	3.18E-05	3.30E-05	0.963381	0.3354
D4*TIME	2.55E-06	3.60E-05	0.071004	0.9434
D5*TIME	-2.01E-05	3.42E-05	-0.588395	0.5563
D6*TIME	-1.89E-05	3.06E-05	-0.617060	0.5372
D8*TIME	-1.70E-08	2.83E-05	-0.000599	0.9995
D9*TIME	3.34E-06	3.45E-05	0.096987	0.9227
D10*TIME	-3.15E-05	3.84E-05	-0.820293	0.4121
D11*TIME	4.71E-05	3.62E-05	1.299037	0.1939
D12*TIME	2.61E-05	3.33E-05	0.783866	0.4331
DTR_BWI(-1)	0.382535	0.007092	53.93548	0.0000

R-squared	0.188963	Mean dependent var	19.89483
Adjusted R-squared	0.188043	S.D. dependent var	7.464953
S.E. of regression	6.726569	Akaike info criterion	6.651187
Sum squared resid	957375.6	Schwarz criterion	6.660582
Log likelihood	-70424.37	Hannan-Quinn criter.	6.654252
F-statistic	205.4090	Durbin-Watson stat	1.975608
Prob(F-statistic)	0.000000	Wald F-statistic	174.8504
Prob(Wald F-statistic)	0.000000		

BWI Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_BWI
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.28482	0.865915	14.18709	0.0000
TIME	-7.21E-06	7.41E-05	-0.097380	0.9224
D1	30.21893	3.181434	9.498526	0.0000
D2	30.69389	3.908153	7.853809	0.0000
D3	25.11787	3.458287	7.263095	0.0000
D4	21.47042	3.211001	6.686519	0.0000
D5	17.29064	2.834396	6.100292	0.0000
D6	8.255295	1.767867	4.669637	0.0000
D8	1.369034	1.377813	0.993628	0.3204
D9	9.784488	1.865460	5.245081	0.0000
D10	14.98482	2.063729	7.261042	0.0000
D11	22.98074	2.787517	8.244159	0.0000
D12	27.62961	3.169854	8.716366	0.0000
D1*TIME	0.000108	0.000276	0.390188	0.6964
D2*TIME	1.45E-05	0.000337	0.043056	0.9657
D3*TIME	0.000571	0.000303	1.882328	0.0598
D4*TIME	0.000226	0.000260	0.871047	0.3837
D5*TIME	-0.000126	0.000215	-0.586188	0.5578
D6*TIME	-0.000207	0.000140	-1.483243	0.1380
D8*TIME	-0.000126	0.000108	-1.157587	0.2470
D9*TIME	-0.000110	0.000151	-0.729517	0.4657
D10*TIME	-2.55E-05	0.000173	-0.147191	0.8830
D11*TIME	6.10E-05	0.000235	0.260002	0.7949
D12*TIME	-0.000103	0.000253	-0.406630	0.6843
E2_AVG_BWI(-1)	0.047314	0.008254	5.731999	0.0000

R-squared	0.060930	Mean dependent var	31.33840
Adjusted R-squared	0.059865	S.D. dependent var	49.45146
S.E. of regression	47.94841	Akaike info criterion	10.57931
Sum squared resid	48643300	Schwarz criterion	10.58870
Log likelihood	-112025.7	Hannan-Quinn criter.	10.58237
F-statistic	57.20024	Durbin-Watson stat	2.001727
Prob(F-statistic)	0.000000	Wald F-statistic	72.34894
Prob(Wald F-statistic)	0.000000		

BWI Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_BWI
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.42629	2.010185	13.14620	0.0000
TIME	-0.000230	0.000156	-1.473601	0.1406
D1	23.36978	4.063351	5.751356	0.0000
D2	29.26739	4.549401	6.433240	0.0000
D3	40.95244	4.693665	8.725045	0.0000
D4	38.59196	4.801223	8.037944	0.0000
D5	28.86395	4.070836	7.090424	0.0000
D6	9.767494	3.037817	3.215301	0.0013
D8	-1.300264	2.687169	-0.483879	0.6285
D9	11.16537	3.269945	3.414545	0.0006
D10	19.94449	3.695555	5.396886	0.0000
D11	17.29907	3.489799	4.957038	0.0000
D12	18.05913	3.536845	5.106001	0.0000
D1*TIME	-1.74E-05	0.000309	-0.056104	0.9553
D2*TIME	-6.49E-05	0.000359	-0.180662	0.8566
D3*TIME	-0.000112	0.000375	-0.299050	0.7649
D4*TIME	0.000141	0.000380	0.371875	0.7100
D5*TIME	-2.13E-07	0.000332	-0.000640	0.9995
D6*TIME	-0.000152	0.000240	-0.632247	0.5272
D8*TIME	8.89E-05	0.000204	0.435353	0.6633
D9*TIME	-3.24E-05	0.000251	-0.129004	0.8974
D10*TIME	0.000143	0.000289	0.494968	0.6206
D11*TIME	0.000483	0.000290	1.662115	0.0965
D12*TIME	2.99E-05	0.000274	0.109372	0.9129
E2_DTR_BWI(-1)	0.025373	0.007816	3.246527	0.0012

R-squared	0.044542	Mean dependent var	45.19529
Adjusted R-squared	0.043459	S.D. dependent var	63.94224
S.E. of regression	62.53739	Akaike info criterion	11.11059
Sum squared resid	82747358	Schwarz criterion	11.11998
Log likelihood	-117652.8	Hannan-Quinn criter.	11.11365
F-statistic	41.09840	Durbin-Watson stat	1.999512
Prob(F-statistic)	0.000000	Wald F-statistic	47.50487
Prob(Wald F-statistic)	0.000000		

ORD Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_ORD
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.43259	0.391261	47.11072	0.0000
TIME	4.45E-05	1.42E-05	3.142744	0.0017
D1	-13.40797	0.508005	-26.39337	0.0000
D2	-11.75431	0.452991	-25.94823	0.0000
D3	-9.156683	0.413998	-22.11771	0.0000
D4	-5.760527	0.349325	-16.49044	0.0000
D5	-3.230203	0.333080	-9.697992	0.0000
D6	-0.942793	0.291253	-3.237018	0.0012
D8	-0.278930	0.250865	-1.111875	0.2662
D9	-2.432256	0.297890	-8.164959	0.0000
D10	-5.074655	0.350371	-14.48366	0.0000
D11	-8.772729	0.363794	-24.11453	0.0000
D12	-12.00549	0.441832	-27.17210	0.0000
D1*TIME	2.35E-05	3.47E-05	0.675570	0.4993
D2*TIME	-1.58E-05	3.36E-05	-0.471081	0.6376
D3*TIME	1.19E-05	3.15E-05	0.376949	0.7062
D4*TIME	-3.99E-05	2.63E-05	-1.517856	0.1291
D5*TIME	-2.42E-05	2.58E-05	-0.937185	0.3487
D6*TIME	-1.69E-05	2.29E-05	-0.740101	0.4592
D8*TIME	-2.07E-05	1.99E-05	-1.040502	0.2981
D9*TIME	-1.79E-05	2.41E-05	-0.742982	0.4575
D10*TIME	-4.68E-05	2.69E-05	-1.740597	0.0818
D11*TIME	-1.60E-05	2.68E-05	-0.597249	0.5503
D12*TIME	-1.32E-06	3.28E-05	-0.040147	0.9680
AVG_ORD(-1)	0.744096	0.004854	153.2867	0.0000

R-squared	0.902587	Mean dependent var	49.69781
Adjusted R-squared	0.902476	S.D. dependent var	20.06592
S.E. of regression	6.266341	Akaike info criterion	6.509442
Sum squared resid	830851.2	Schwarz criterion	6.518837
Log likelihood	-68923.01	Hannan-Quinn criter.	6.512507
F-statistic	8168.742	Durbin-Watson stat	1.744531
Prob(F-statistic)	0.000000	Wald F-statistic	9314.715
Prob(Wald F-statistic)	0.000000		

ORD Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_ORD
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.94425	0.357510	41.80096	0.0000
TIME	-7.74E-05	2.09E-05	-3.696823	0.0002
D1	-3.649383	0.454079	-8.036895	0.0000
D2	-3.646854	0.516808	-7.056499	0.0000
D3	-3.027067	0.528216	-5.730738	0.0000
D4	-1.037120	0.481841	-2.152414	0.0314
D5	0.765390	0.486082	1.574611	0.1154
D6	0.901261	0.468847	1.922291	0.0546
D8	-0.003739	0.455212	-0.008214	0.9934
D9	0.269803	0.549406	0.491082	0.6234
D10	0.599424	0.554832	1.080371	0.2800
D11	-3.225466	0.520735	-6.194068	0.0000
D12	-4.009905	0.474653	-8.448070	0.0000
D1*TIME	2.14E-06	3.52E-05	0.060902	0.9514
D2*TIME	3.61E-05	3.93E-05	0.918464	0.3584
D3*TIME	8.93E-05	3.89E-05	2.297397	0.0216
D4*TIME	8.50E-05	3.65E-05	2.329347	0.0199
D5*TIME	2.26E-05	3.43E-05	0.659597	0.5095
D6*TIME	4.90E-06	3.32E-05	0.147477	0.8828
D8*TIME	-4.69E-05	3.16E-05	-1.482879	0.1381
D9*TIME	-6.00E-06	3.94E-05	-0.152101	0.8791
D10*TIME	-7.95E-05	4.07E-05	-1.953112	0.0508
D11*TIME	3.48E-05	3.81E-05	0.914509	0.3605
D12*TIME	-1.51E-05	3.45E-05	-0.436635	0.6624
DTR_ORD(-1)	0.302978	0.007926	38.22521	0.0000

R-squared	0.203846	Mean dependent var	18.51053
Adjusted R-squared	0.202943	S.D. dependent var	7.544707
S.E. of regression	6.735767	Akaike info criterion	6.653920
Sum squared resid	959995.5	Schwarz criterion	6.663315
Log likelihood	-70453.32	Hannan-Quinn criter.	6.656985
F-statistic	225.7302	Durbin-Watson stat	2.019938
Prob(F-statistic)	0.000000	Wald F-statistic	156.0950
Prob(Wald F-statistic)	0.000000		

ORD Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_ORD
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	20.77809	1.531919	13.56344	0.0000
TIME	-0.000229	0.000114	-2.002538	0.0452
D1	44.26805	4.417925	10.02010	0.0000
D2	33.88464	5.241439	6.464758	0.0000
D3	22.85822	4.273988	5.348218	0.0000
D4	28.76482	3.919149	7.339558	0.0000
D5	19.48821	3.366831	5.788297	0.0000
D6	10.24150	2.677143	3.825533	0.0001
D8	0.355179	2.083598	0.170464	0.8646
D9	13.11517	2.900562	4.521595	0.0000
D10	21.77621	2.756315	7.900480	0.0000
D11	24.62006	4.100563	6.004068	0.0000
D12	36.79813	4.284738	8.588186	0.0000
D1*TIME	-0.000474	0.000364	-1.302481	0.1928
D2*TIME	-0.000304	0.000400	-0.760336	0.4471
D3*TIME	0.000435	0.000334	1.302845	0.1926
D4*TIME	-0.000273	0.000296	-0.922415	0.3563
D5*TIME	-3.66E-05	0.000269	-0.136188	0.8917
D6*TIME	-0.000183	0.000200	-0.916003	0.3597
D8*TIME	-0.000211	0.000152	-1.386002	0.1658
D9*TIME	-0.000409	0.000208	-1.964940	0.0494
D10*TIME	-0.000341	0.000211	-1.616642	0.1060
D11*TIME	-7.16E-06	0.000307	-0.023322	0.9814
D12*TIME	-0.000465	0.000325	-1.429600	0.1528
E2_AVG_ORD(-1)	0.040520	0.008041	5.039301	0.0000

R-squared	0.048755	Mean dependent var	39.21880
Adjusted R-squared	0.047676	S.D. dependent var	61.93726
S.E. of regression	60.44278	Akaike info criterion	11.04245
Sum squared resid	77297140	Schwarz criterion	11.05185
Log likelihood	-116931.1	Hannan-Quinn criter.	11.04552
F-statistic	45.18431	Durbin-Watson stat	2.004838
Prob(F-statistic)	0.000000	Wald F-statistic	60.72208
Prob(Wald F-statistic)	0.000000		

ORD Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_ORD
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	38.41437	2.641792	14.54103	0.0000
TIME	-0.000997	0.000180	-5.534205	0.0000
D1	14.64568	4.335281	3.378254	0.0007
D2	10.37432	4.564839	2.272658	0.0231
D3	19.75173	4.665049	4.233982	0.0000
D4	19.42593	4.340276	4.475735	0.0000
D5	19.51693	4.252716	4.589287	0.0000
D6	1.838590	4.011759	0.458300	0.6467
D8	-3.470154	3.519777	-0.985902	0.3242
D9	11.07359	3.852656	2.874274	0.0041
D10	17.39280	4.361424	3.987873	0.0001
D11	14.13262	4.177033	3.383411	0.0007
D12	11.06852	4.378528	2.527910	0.0115
D1*TIME	0.000170	0.000335	0.508190	0.6113
D2*TIME	0.000446	0.000346	1.288905	0.1974
D3*TIME	0.000777	0.000351	2.210510	0.0271
D4*TIME	0.001432	0.000354	4.050691	0.0001
D5*TIME	0.000400	0.000315	1.270505	0.2039
D6*TIME	0.000613	0.000285	2.151418	0.0315
D8*TIME	0.000340	0.000252	1.351704	0.1765
D9*TIME	8.00E-05	0.000281	0.284385	0.7761
D10*TIME	0.000341	0.000317	1.076724	0.2816
D11*TIME	0.000138	0.000304	0.451977	0.6513
D12*TIME	0.000197	0.000313	0.631349	0.5278
E2_DTR_ORD(-1)	0.040419	0.008452	4.782062	0.0000

R-squared	0.031770	Mean dependent var	45.31901
Adjusted R-squared	0.030671	S.D. dependent var	64.60838
S.E. of regression	63.60985	Akaike info criterion	11.14459
Sum squared resid	85609774	Schwarz criterion	11.15399
Log likelihood	-118013.0	Hannan-Quinn criter.	11.14766
F-statistic	28.92664	Durbin-Watson stat	2.001480
Prob(F-statistic)	0.000000	Wald F-statistic	37.56678
Prob(Wald F-statistic)	0.000000		

CVG Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_CVG
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	19.10402	0.385050	49.61441	0.0000
TIME	2.15E-05	1.23E-05	1.749172	0.0803
D1	-12.15561	0.475498	-25.56397	0.0000
D2	-10.91309	0.441466	-24.72008	0.0000
D3	-8.322855	0.384756	-21.63153	0.0000
D4	-5.293558	0.338058	-15.65874	0.0000
D5	-3.008837	0.293580	-10.24876	0.0000
D6	-0.675263	0.227237	-2.971629	0.0030
D8	-0.344123	0.203183	-1.693658	0.0903
D9	-2.264991	0.279939	-8.091008	0.0000
D10	-5.184869	0.331139	-15.65766	0.0000
D11	-8.414552	0.346617	-24.27620	0.0000
D12	-10.84735	0.411066	-26.38833	0.0000
D1*TIME	3.13E-05	3.38E-05	0.926896	0.3540
D2*TIME	1.85E-05	3.33E-05	0.554357	0.5793
D3*TIME	2.73E-05	3.01E-05	0.906283	0.3648
D4*TIME	5.01E-06	2.61E-05	0.192039	0.8477
D5*TIME	6.68E-06	2.35E-05	0.283853	0.7765
D6*TIME	-1.44E-05	1.82E-05	-0.789526	0.4298
D8*TIME	-1.59E-06	1.70E-05	-0.093243	0.9257
D9*TIME	-1.07E-05	2.24E-05	-0.475716	0.6343
D10*TIME	-1.24E-05	2.58E-05	-0.482122	0.6297
D11*TIME	1.04E-05	2.51E-05	0.415438	0.6778
D12*TIME	1.04E-05	3.01E-05	0.346881	0.7287
AVG_CVG(-1)	0.744201	0.004772	155.9629	0.0000

R-squared	0.890861	Mean dependent var	53.94727
Adjusted R-squared	0.890738	S.D. dependent var	18.51297
S.E. of regression	6.119436	Akaike info criterion	6.461996
Sum squared resid	792351.5	Schwarz criterion	6.471391
Log likelihood	-68420.46	Hannan-Quinn criter.	6.465061
F-statistic	7196.409	Durbin-Watson stat	1.687517
Prob(F-statistic)	0.000000	Wald F-statistic	8813.488
Prob(Wald F-statistic)	0.000000		

CVG Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_CVG
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.38233	0.331058	43.44355	0.0000
TIME	-6.24E-05	2.17E-05	-2.874383	0.0041
D1	-2.574059	0.448206	-5.743022	0.0000
D2	-1.986382	0.478138	-4.154411	0.0000
D3	-1.137376	0.447194	-2.543361	0.0110
D4	0.621812	0.480752	1.293417	0.1959
D5	1.170734	0.439244	2.665337	0.0077
D6	0.802911	0.389804	2.059783	0.0394
D8	0.336830	0.406096	0.829435	0.4069
D9	0.521035	0.534523	0.974766	0.3297
D10	1.095169	0.543112	2.016470	0.0438
D11	-2.508523	0.532436	-4.711403	0.0000
D12	-3.104876	0.443877	-6.994899	0.0000
D1*TIME	1.65E-05	3.56E-05	0.463915	0.6427
D2*TIME	3.85E-05	3.73E-05	1.032785	0.3017
D3*TIME	6.97E-05	3.47E-05	2.006769	0.0448
D4*TIME	4.80E-05	3.58E-05	1.340912	0.1800
D5*TIME	-3.02E-05	3.48E-05	-0.866549	0.3862
D6*TIME	-2.03E-05	3.12E-05	-0.649754	0.5159
D8*TIME	6.62E-06	3.21E-05	0.206082	0.8367
D9*TIME	3.39E-05	4.19E-05	0.810868	0.4175
D10*TIME	-2.74E-05	4.23E-05	-0.647610	0.5172
D11*TIME	0.000110	4.18E-05	2.636724	0.0084
D12*TIME	8.02E-07	3.54E-05	0.022639	0.9819
DTR_CVG(-1)	0.319350	0.008912	35.83409	0.0000

R-squared	0.172113	Mean dependent var	19.65295
Adjusted R-squared	0.171174	S.D. dependent var	7.407178
S.E. of regression	6.743487	Akaike info criterion	6.656211
Sum squared resid	962197.4	Schwarz criterion	6.665606
Log likelihood	-70477.58	Hannan-Quinn criter.	6.659276
F-statistic	183.2846	Durbin-Watson stat	2.011761
Prob(F-statistic)	0.000000	Wald F-statistic	118.4390
Prob(Wald F-statistic)	0.000000		

CVG Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_CVG
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.01679	0.944392	12.72437	0.0000
TIME	-0.000153	6.89E-05	-2.221134	0.0264
D1	50.96373	5.223848	9.755975	0.0000
D2	48.40991	5.423664	8.925683	0.0000
D3	41.04935	3.606187	11.38304	0.0000
D4	30.98182	3.191382	9.707965	0.0000
D5	15.86392	2.381124	6.662366	0.0000
D6	7.398660	1.811721	4.083773	0.0000
D8	0.071797	1.522041	0.047171	0.9624
D9	10.74676	1.777760	6.045110	0.0000
D10	23.34223	2.435400	9.584555	0.0000
D11	31.74327	3.320407	9.560054	0.0000
D12	47.96885	4.063859	11.80377	0.0000
D1*TIME	0.000177	0.000410	0.431474	0.6661
D2*TIME	5.94E-05	0.000439	0.135446	0.8923
D3*TIME	0.000135	0.000290	0.464999	0.6419
D4*TIME	5.71E-05	0.000251	0.227959	0.8197
D5*TIME	-7.26E-05	0.000187	-0.388716	0.6975
D6*TIME	-0.000275	0.000126	-2.187412	0.0287
D8*TIME	-4.33E-06	0.000111	-0.039087	0.9688
D9*TIME	-0.000126	0.000133	-0.947807	0.3432
D10*TIME	-0.000149	0.000180	-0.827461	0.4080
D11*TIME	0.000327	0.000273	1.197181	0.2312
D12*TIME	-0.000390	0.000334	-1.169072	0.2424
E2_AVG_CVG(-1)	0.044256	0.009800	4.515712	0.0000

R-squared	0.103062	Mean dependent var	37.40048
Adjusted R-squared	0.102045	S.D. dependent var	61.54598
S.E. of regression	58.32129	Akaike info criterion	10.97099
Sum squared resid	71966243	Schwarz criterion	10.98039
Log likelihood	-116174.3	Hannan-Quinn criter.	10.97406
F-statistic	101.2977	Durbin-Watson stat	2.005939
Prob(F-statistic)	0.000000	Wald F-statistic	127.2446
Prob(Wald F-statistic)	0.000000		

CVG Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_CVG
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	25.23089	2.004959	12.58424	0.0000
TIME	-0.000281	0.000152	-1.845118	0.0650
D1	32.45761	4.975735	6.523179	0.0000
D2	34.20490	4.754066	7.194874	0.0000
D3	43.56364	4.444476	9.801749	0.0000
D4	36.14966	3.895899	9.278901	0.0000
D5	21.93777	3.785976	5.794481	0.0000
D6	4.122216	2.812186	1.465840	0.1427
D8	0.084758	2.922933	0.028998	0.9769
D9	17.10416	3.810780	4.488363	0.0000
D10	29.94829	3.811364	7.857629	0.0000
D11	29.72874	4.102293	7.246860	0.0000
D12	23.70356	4.155427	5.704241	0.0000
D1*TIME	7.56E-05	0.000376	0.201343	0.8404
D2*TIME	-0.000183	0.000345	-0.528823	0.5969
D3*TIME	-0.000378	0.000326	-1.160636	0.2458
D4*TIME	-0.000311	0.000284	-1.094739	0.2736
D5*TIME	-0.000217	0.000289	-0.751082	0.4526
D6*TIME	0.000159	0.000225	0.704410	0.4812
D8*TIME	8.15E-05	0.000223	0.365091	0.7150
D9*TIME	-0.000201	0.000282	-0.711595	0.4767
D10*TIME	-0.000318	0.000299	-1.065416	0.2867
D11*TIME	-0.000171	0.000305	-0.558695	0.5764
D12*TIME	0.000204	0.000348	0.585652	0.5581
E2_DTR_CVG(-1)	0.034954	0.011002	3.177057	0.0015

R-squared	0.045628	Mean dependent var	45.42284
Adjusted R-squared	0.044546	S.D. dependent var	64.54744
S.E. of regression	63.09340	Akaike info criterion	11.12829
Sum squared resid	84225288	Schwarz criterion	11.13768
Log likelihood	-117840.3	Hannan-Quinn criter.	11.13135
F-statistic	42.14846	Durbin-Watson stat	2.001734
Prob(F-statistic)	0.000000	Wald F-statistic	53.63302
Prob(Wald F-statistic)	0.000000		

DFW Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_DFW
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.60850	0.489067	48.27251	0.0000
TIME	2.95E-05	1.09E-05	2.690581	0.0071
D1	-11.86726	0.431701	-27.48956	0.0000
D2	-10.45895	0.414456	-25.23536	0.0000
D3	-7.988847	0.371546	-21.50163	0.0000
D4	-5.191779	0.283904	-18.28712	0.0000
D5	-3.262429	0.242930	-13.42949	0.0000
D6	-1.108213	0.206336	-5.370917	0.0000
D8	-0.399091	0.184321	-2.165193	0.0304
D9	-2.585552	0.268368	-9.634363	0.0000
D10	-5.144195	0.312852	-16.44293	0.0000
D11	-8.578026	0.359504	-23.86072	0.0000
D12	-10.74497	0.366911	-29.28493	0.0000
D1*TIME	5.08E-05	2.80E-05	1.812079	0.0700
D2*TIME	4.19E-05	3.12E-05	1.345583	0.1785
D3*TIME	2.76E-05	2.69E-05	1.025654	0.3051
D4*TIME	-1.70E-05	2.10E-05	-0.810297	0.4178
D5*TIME	5.69E-06	1.92E-05	0.296513	0.7668
D6*TIME	7.58E-06	1.61E-05	0.469456	0.6387
D8*TIME	2.19E-05	1.56E-05	1.402738	0.1607
D9*TIME	1.97E-05	2.02E-05	0.977705	0.3282
D10*TIME	-6.17E-06	2.36E-05	-0.262018	0.7933
D11*TIME	1.09E-05	2.60E-05	0.421661	0.6733
D12*TIME	-3.42E-06	2.55E-05	-0.133977	0.8934
AVG_DFW(-1)	0.720931	0.005548	129.9514	0.0000

R-squared	0.887748	Mean dependent var	66.19073
Adjusted R-squared	0.887621	S.D. dependent var	16.31214
S.E. of regression	5.468321	Akaike info criterion	6.237000
Sum squared resid	632707.8	Schwarz criterion	6.246395
Log likelihood	-66037.30	Hannan-Quinn criter.	6.240065
F-statistic	6972.363	Durbin-Watson stat	1.736926
Prob(F-statistic)	0.000000	Wald F-statistic	7977.419
Prob(Wald F-statistic)	0.000000		

DFW Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_DFW
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.09181	0.292565	44.74842	0.0000
TIME	-5.95E-05	1.72E-05	-3.458671	0.0005
D1	-0.602110	0.491848	-1.224179	0.2209
D2	0.361534	0.481548	0.750775	0.4528
D3	0.474541	0.425215	1.116001	0.2644
D4	-0.100201	0.404736	-0.247572	0.8045
D5	-0.696966	0.355645	-1.959724	0.0500
D6	-0.276270	0.315536	-0.875558	0.3813
D8	0.112590	0.324019	0.347480	0.7282
D9	-0.696780	0.405161	-1.719759	0.0855
D10	0.424459	0.491243	0.864050	0.3876
D11	-0.194554	0.457273	-0.425465	0.6705
D12	-0.533176	0.481900	-1.106404	0.2686
D1*TIME	6.06E-05	3.80E-05	1.594385	0.1109
D2*TIME	6.23E-06	3.75E-05	0.166259	0.8680
D3*TIME	7.98E-06	3.26E-05	0.244808	0.8066
D4*TIME	3.27E-05	3.01E-05	1.085403	0.2778
D5*TIME	1.46E-05	2.82E-05	0.518890	0.6038
D6*TIME	-4.68E-06	2.36E-05	-0.198288	0.8428
D8*TIME	6.62E-06	2.45E-05	0.269707	0.7874
D9*TIME	6.42E-05	3.00E-05	2.136006	0.0327
D10*TIME	2.96E-05	3.64E-05	0.811807	0.4169
D11*TIME	2.36E-05	3.49E-05	0.677387	0.4982
D12*TIME	2.74E-05	3.75E-05	0.731049	0.4648
DTR_DFW(-1)	0.404579	0.007879	51.35058	0.0000

R-squared	0.172454	Mean dependent var	21.08370
Adjusted R-squared	0.171515	S.D. dependent var	7.220368
S.E. of regression	6.572063	Akaike info criterion	6.604712
Sum squared resid	913899.8	Schwarz criterion	6.614107
Log likelihood	-69932.11	Hannan-Quinn criter.	6.607777
F-statistic	183.7230	Durbin-Watson stat	2.027764
Prob(F-statistic)	0.000000	Wald F-statistic	133.8050
Prob(Wald F-statistic)	0.000000		

DFW Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_DFW
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.344224	0.745442	7.169203	0.0000
TIME	3.41E-06	6.24E-05	0.054724	0.9564
D1	49.43505	4.519034	10.93930	0.0000
D2	40.19190	3.848754	10.44283	0.0000
D3	39.80782	3.504952	11.35759	0.0000
D4	21.05631	2.311871	9.107911	0.0000
D5	11.18306	1.720968	6.498122	0.0000
D6	2.899226	1.105014	2.623702	0.0087
D8	0.865943	1.048480	0.825903	0.4089
D9	10.25865	1.600603	6.409241	0.0000
D10	17.54943	2.233360	7.857859	0.0000
D11	33.83000	3.114937	10.86057	0.0000
D12	43.15118	3.844885	11.22301	0.0000
D1*TIME	-0.000397	0.000366	-1.084077	0.2783
D2*TIME	0.000152	0.000320	0.473139	0.6361
D3*TIME	-0.000369	0.000271	-1.362027	0.1732
D4*TIME	8.51E-05	0.000196	0.434284	0.6641
D5*TIME	-2.01E-05	0.000142	-0.140884	0.8880
D6*TIME	-7.73E-05	8.68E-05	-0.890914	0.3730
D8*TIME	3.56E-05	8.91E-05	0.399670	0.6894
D9*TIME	-9.42E-05	0.000130	-0.725623	0.4681
D10*TIME	0.000183	0.000179	1.023277	0.3062
D11*TIME	3.03E-05	0.000261	0.116060	0.9076
D12*TIME	-0.000166	0.000329	-0.505084	0.6135
E2_AVG_DFW(-1)	0.087784	0.010666	8.230030	0.0000

R-squared	0.112559	Mean dependent var	29.86837
Adjusted R-squared	0.111553	S.D. dependent var	55.64610
S.E. of regression	52.45061	Akaike info criterion	10.75880
Sum squared resid	58207075	Schwarz criterion	10.76820
Log likelihood	-113926.8	Hannan-Quinn criter.	10.76187
F-statistic	111.8164	Durbin-Watson stat	2.005066
Prob(F-statistic)	0.000000	Wald F-statistic	125.8115
Prob(Wald F-statistic)	0.000000		

DFW Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_DFW
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.33893	1.484762	9.657391	0.0000
TIME	-0.000249	0.000111	-2.251440	0.0244
D1	61.11685	4.067130	15.02702	0.0000
D2	61.23381	4.813802	12.72047	0.0000
D3	48.99922	4.700404	10.42447	0.0000
D4	33.44867	3.337388	10.02241	0.0000
D5	14.14987	2.805166	5.044220	0.0000
D6	0.669062	2.009754	0.332907	0.7392
D8	0.096726	1.919723	0.050385	0.9598
D9	13.49462	2.689879	5.016814	0.0000
D10	29.96667	3.805248	7.875088	0.0000
D11	43.85100	3.922124	11.18042	0.0000
D12	52.71843	4.371013	12.06092	0.0000
D1*TIME	0.000200	0.000339	0.588791	0.5560
D2*TIME	-0.000173	0.000391	-0.443135	0.6577
D3*TIME	0.000102	0.000374	0.273888	0.7842
D4*TIME	-0.000202	0.000260	-0.774857	0.4384
D5*TIME	0.000175	0.000215	0.816319	0.4143
D6*TIME	0.000155	0.000152	1.022067	0.3068
D8*TIME	0.000164	0.000156	1.050147	0.2937
D9*TIME	-5.66E-05	0.000214	-0.264520	0.7914
D10*TIME	-4.33E-05	0.000299	-0.144574	0.8850
D11*TIME	-0.000165	0.000305	-0.541663	0.5881
D12*TIME	6.99E-05	0.000361	0.193690	0.8464
E2_DTR_DFW(-1)	0.032524	0.010284	3.162645	0.0016

R-squared	0.114659	Mean dependent var	43.14133
Adjusted R-squared	0.113655	S.D. dependent var	68.79992
S.E. of regression	64.77232	Akaike info criterion	11.18081
Sum squared resid	88767401	Schwarz criterion	11.19021
Log likelihood	-118396.6	Hannan-Quinn criter.	11.18388
F-statistic	114.1723	Durbin-Watson stat	2.003070
Prob(F-statistic)	0.000000	Wald F-statistic	137.7196
Prob(Wald F-statistic)	0.000000		

DSM Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_DSM
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.11835	0.394005	45.98513	0.0000
TIME	2.62E-05	1.33E-05	1.974676	0.0483
D1	-14.02385	0.507407	-27.63828	0.0000
D2	-12.19097	0.468022	-26.04783	0.0000
D3	-9.598972	0.450973	-21.28503	0.0000
D4	-5.930859	0.342748	-17.30386	0.0000
D5	-3.021425	0.300937	-10.04006	0.0000
D6	-0.858149	0.244130	-3.515135	0.0004
D8	-0.594196	0.240655	-2.469078	0.0136
D9	-3.117158	0.282356	-11.03981	0.0000
D10	-5.443745	0.354588	-15.35229	0.0000
D11	-9.526816	0.389285	-24.47258	0.0000
D12	-12.65989	0.444951	-28.45235	0.0000
D1*TIME	6.85E-05	3.44E-05	1.991393	0.0465
D2*TIME	2.30E-05	3.45E-05	0.667181	0.5047
D3*TIME	7.10E-05	3.34E-05	2.126822	0.0334
D4*TIME	1.08E-05	2.57E-05	0.418493	0.6756
D5*TIME	-9.79E-06	2.36E-05	-0.414652	0.6784
D6*TIME	-3.25E-06	1.95E-05	-0.166521	0.8677
D8*TIME	-5.95E-06	1.91E-05	-0.311707	0.7553
D9*TIME	2.18E-05	2.23E-05	0.977613	0.3283
D10*TIME	-3.65E-05	2.74E-05	-1.332199	0.1828
D11*TIME	1.96E-05	2.85E-05	0.690017	0.4902
D12*TIME	2.27E-05	3.29E-05	0.690612	0.4898
AVG_DSM(-1)	0.759245	0.004748	159.9024	0.0000

R-squared	0.912779	Mean dependent var	50.54673
Adjusted R-squared	0.912680	S.D. dependent var	21.57094
S.E. of regression	6.374205	Akaike info criterion	6.543575
Sum squared resid	859700.5	Schwarz criterion	6.552970
Log likelihood	-69284.55	Hannan-Quinn criter.	6.546640
F-statistic	9226.308	Durbin-Watson stat	1.778587
Prob(F-statistic)	0.000000	Wald F-statistic	10144.50
Prob(Wald F-statistic)	0.000000		

DSM Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_DSM
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.76511	0.308399	44.63413	0.0000
TIME	-4.59E-05	2.01E-05	-2.284795	0.0223
D1	-1.904842	0.465083	-4.095704	0.0000
D2	-1.746342	0.566342	-3.083547	0.0020
D3	-1.211129	0.537858	-2.251762	0.0243
D4	0.761969	0.450902	1.689876	0.0911
D5	0.718939	0.393141	1.828705	0.0675
D6	0.412967	0.376117	1.097977	0.2722
D8	0.375601	0.369866	1.015506	0.3099
D9	0.273584	0.428099	0.639068	0.5228
D10	1.009020	0.477435	2.113418	0.0346
D11	-1.947639	0.502966	-3.872308	0.0001
D12	-2.602893	0.464515	-5.603467	0.0000
D1*TIME	2.14E-05	3.90E-05	0.548147	0.5836
D2*TIME	4.60E-05	4.26E-05	1.079336	0.2805
D3*TIME	9.71E-05	4.19E-05	2.314491	0.0207
D4*TIME	3.69E-05	3.52E-05	1.048717	0.2943
D5*TIME	4.65E-06	3.07E-05	0.151558	0.8795
D6*TIME	-3.47E-06	2.99E-05	-0.115952	0.9077
D8*TIME	-2.22E-05	2.90E-05	-0.763428	0.4452
D9*TIME	7.86E-05	3.27E-05	2.405285	0.0162
D10*TIME	-1.58E-05	3.79E-05	-0.416607	0.6770
D11*TIME	8.22E-05	3.97E-05	2.069979	0.0385
D12*TIME	3.39E-05	3.61E-05	0.939031	0.3477
DTR_DSM(-1)	0.320748	0.007715	41.57329	0.0000

R-squared	0.145953	Mean dependent var	19.29975
Adjusted R-squared	0.144985	S.D. dependent var	7.553253
S.E. of regression	6.984269	Akaike info criterion	6.726377
Sum squared resid	1032136.	Schwarz criterion	6.735772
Log likelihood	-71220.79	Hannan-Quinn criter.	6.729442
F-statistic	150.6665	Durbin-Watson stat	2.026259
Prob(F-statistic)	0.000000	Wald F-statistic	102.9023
Prob(Wald F-statistic)	0.000000		

DSM Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_DSM
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.83574	1.068138	13.88935	0.0000
TIME	-6.13E-05	7.96E-05	-0.770054	0.4413
D1	55.40865	4.552928	12.16989	0.0000
D2	45.00290	5.338548	8.429802	0.0000
D3	33.44721	4.251177	7.867753	0.0000
D4	28.15180	3.652653	7.707220	0.0000
D5	13.86696	2.576145	5.382834	0.0000
D6	6.173084	2.050108	3.011101	0.0026
D8	5.838398	1.811526	3.222916	0.0013
D9	14.99249	2.521711	5.945367	0.0000
D10	24.78327	2.539874	9.757677	0.0000
D11	30.72825	3.963553	7.752703	0.0000
D12	49.15527	4.565341	10.76705	0.0000
D1*TIME	-0.000233	0.000389	-0.600420	0.5482
D2*TIME	-0.000116	0.000417	-0.276839	0.7819
D3*TIME	0.000258	0.000334	0.771238	0.4406
D4*TIME	0.000193	0.000298	0.647920	0.5170
D5*TIME	-6.29E-05	0.000209	-0.300575	0.7637
D6*TIME	-0.000235	0.000147	-1.596615	0.1104
D8*TIME	-0.000352	0.000130	-2.704065	0.0069
D9*TIME	-0.000125	0.000188	-0.665646	0.5056
D10*TIME	-9.99E-05	0.000204	-0.490488	0.6238
D11*TIME	0.000193	0.000317	0.607977	0.5432
D12*TIME	-0.000582	0.000349	-1.666043	0.0957
E2_AVG_DSM(-1)	0.046840	0.009453	4.954830	0.0000

R-squared	0.077881	Mean dependent var	40.58439
Adjusted R-squared	0.076835	S.D. dependent var	65.84207
S.E. of regression	63.26203	Akaike info criterion	11.13363
Sum squared resid	84676096	Schwarz criterion	11.14302
Log likelihood	-117896.8	Hannan-Quinn criter.	11.13669
F-statistic	74.45767	Durbin-Watson stat	2.005999
Prob(F-statistic)	0.000000	Wald F-statistic	90.52166
Prob(Wald F-statistic)	0.000000		

DSM Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_DSM
Method: Least Squares
Date: 07/01/19 Time: 10:22
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.19080	1.792788	12.93561	0.0000
TIME	-0.000299	0.000136	-2.195694	0.0281
D1	34.70647	4.762904	7.286831	0.0000
D2	40.39090	5.285366	7.642025	0.0000
D3	49.68880	4.867619	10.20803	0.0000
D4	51.43169	5.171040	9.946100	0.0000
D5	23.25545	3.543138	6.563518	0.0000
D6	5.748642	2.761889	2.081417	0.0374
D8	3.777678	2.766453	1.365532	0.1721
D9	19.99574	3.211388	6.226509	0.0000
D10	35.91203	3.963061	9.061691	0.0000
D11	36.30284	3.753960	9.670545	0.0000
D12	35.64458	4.880890	7.302885	0.0000
D1*TIME	0.000591	0.000426	1.388472	0.1650
D2*TIME	1.45E-05	0.000410	0.035459	0.9717
D3*TIME	1.43E-05	0.000383	0.037201	0.9703
D4*TIME	-0.000271	0.000410	-0.661101	0.5086
D5*TIME	2.60E-05	0.000278	0.093603	0.9254
D6*TIME	0.000146	0.000211	0.691774	0.4891
D8*TIME	2.87E-05	0.000210	0.137103	0.8910
D9*TIME	-0.000312	0.000252	-1.237749	0.2158
D10*TIME	-0.000155	0.000298	-0.519394	0.6035
D11*TIME	-6.66E-05	0.000305	-0.218575	0.8270
D12*TIME	5.90E-05	0.000389	0.151880	0.8793
E2_DTR_DSM(-1)	0.013418	0.009013	1.488826	0.1365

R-squared	0.055659	Mean dependent var	48.72412
Adjusted R-squared	0.054588	S.D. dependent var	72.41727
S.E. of regression	70.41299	Akaike info criterion	11.34781
Sum squared resid	1.05E+08	Schwarz criterion	11.35721
Log likelihood	-120165.4	Hannan-Quinn criter.	11.35088
F-statistic	51.95995	Durbin-Watson stat	2.001034
Prob(F-statistic)	0.000000	Wald F-statistic	75.48098
Prob(Wald F-statistic)	0.000000		

DTW Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_DTW
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.48781	0.372724	49.60184	0.0000
TIME	5.96E-05	1.33E-05	4.489180	0.0000
D1	-12.77763	0.440885	-28.98177	0.0000
D2	-11.78046	0.424776	-27.73335	0.0000
D3	-9.271638	0.378637	-24.48686	0.0000
D4	-5.999389	0.340776	-17.60509	0.0000
D5	-3.327635	0.311827	-10.67143	0.0000
D6	-0.777330	0.267662	-2.904151	0.0037
D8	-0.344618	0.226059	-1.524465	0.1274
D9	-2.441349	0.280814	-8.693834	0.0000
D10	-5.378439	0.333336	-16.13518	0.0000
D11	-8.595432	0.339567	-25.31292	0.0000
D12	-11.56781	0.395543	-29.24541	0.0000
D1*TIME	-5.27E-06	3.10E-05	-0.170254	0.8648
D2*TIME	-2.38E-05	3.13E-05	-0.759612	0.4475
D3*TIME	-1.18E-06	2.97E-05	-0.039906	0.9682
D4*TIME	-2.00E-05	2.57E-05	-0.781585	0.4345
D5*TIME	-1.73E-06	2.49E-05	-0.069338	0.9447
D6*TIME	-1.99E-05	2.11E-05	-0.941632	0.3464
D8*TIME	-1.69E-05	1.84E-05	-0.917849	0.3587
D9*TIME	-2.04E-05	2.27E-05	-0.899469	0.3684
D10*TIME	-3.03E-05	2.58E-05	-1.175061	0.2400
D11*TIME	-1.37E-05	2.50E-05	-0.549668	0.5826
D12*TIME	-3.92E-06	2.89E-05	-0.135926	0.8919
AVG_DTW(-1)	0.738322	0.004773	154.6826	0.0000

R-squared	0.908995	Mean dependent var	49.63121
Adjusted R-squared	0.908891	S.D. dependent var	19.18632
S.E. of regression	5.791238	Akaike info criterion	6.351749
Sum squared resid	709639.8	Schwarz criterion	6.361144
Log likelihood	-67252.72	Hannan-Quinn criter.	6.354814
F-statistic	8805.987	Durbin-Watson stat	1.763468
Prob(F-statistic)	0.000000	Wald F-statistic	10666.20
Prob(Wald F-statistic)	0.000000		

DTW Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_DTW
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.49672	0.352202	43.99957	0.0000
TIME	-0.000142	2.11E-05	-6.741022	0.0000
D1	-5.471803	0.407242	-13.43624	0.0000
D2	-4.792961	0.436509	-10.98022	0.0000
D3	-4.015636	0.509644	-7.879303	0.0000
D4	-1.485795	0.492920	-3.014275	0.0026
D5	0.090604	0.473261	0.191447	0.8482
D6	0.285696	0.434235	0.657930	0.5106
D8	-0.160112	0.423951	-0.377667	0.7057
D9	-0.488428	0.489095	-0.998636	0.3180
D10	-0.717476	0.527113	-1.361143	0.1735
D11	-4.902164	0.512248	-9.569895	0.0000
D12	-5.799630	0.437294	-13.26256	0.0000
D1*TIME	8.23E-05	3.10E-05	2.653189	0.0080
D2*TIME	9.20E-05	3.39E-05	2.715838	0.0066
D3*TIME	0.000166	3.72E-05	4.451500	0.0000
D4*TIME	0.000115	3.59E-05	3.202924	0.0014
D5*TIME	3.26E-05	3.41E-05	0.955111	0.3395
D6*TIME	-8.11E-06	3.16E-05	-0.256954	0.7972
D8*TIME	-2.80E-05	3.00E-05	-0.934235	0.3502
D9*TIME	2.06E-05	3.43E-05	0.601886	0.5473
D10*TIME	-2.03E-05	3.80E-05	-0.532971	0.5941
D11*TIME	0.000120	3.79E-05	3.170292	0.0015
D12*TIME	4.85E-05	3.05E-05	1.593032	0.1112
DTR_DTW(-1)	0.330141	0.007892	41.83005	0.0000

R-squared	0.268953	Mean dependent var	18.29565
Adjusted R-squared	0.268124	S.D. dependent var	7.368496
S.E. of regression	6.303729	Akaike info criterion	6.521339
Sum squared resid	840795.3	Schwarz criterion	6.530734
Log likelihood	-69049.03	Hannan-Quinn criter.	6.524405
F-statistic	324.3514	Durbin-Watson stat	2.019957
Prob(F-statistic)	0.000000	Wald F-statistic	240.0249
Prob(Wald F-statistic)	0.000000		

DTW Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_DTW
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.13935	1.236894	13.85677	0.0000
TIME	-0.000166	8.85E-05	-1.879221	0.0602
D1	30.96231	3.589463	8.625889	0.0000
D2	27.13271	4.283330	6.334490	0.0000
D3	22.82034	3.567825	6.396149	0.0000
D4	22.95490	3.284185	6.989529	0.0000
D5	15.04346	2.685523	5.601688	0.0000
D6	10.04190	2.262213	4.438972	0.0000
D8	1.574000	1.889776	0.832903	0.4049
D9	12.21849	2.352779	5.193217	0.0000
D10	17.92425	2.580795	6.945245	0.0000
D11	19.51285	2.966636	6.577433	0.0000
D12	27.72867	3.182770	8.712118	0.0000
D1*TIME	0.000113	0.000299	0.377929	0.7055
D2*TIME	-1.36E-05	0.000339	-0.040192	0.9679
D3*TIME	0.000477	0.000299	1.596391	0.1104
D4*TIME	8.71E-05	0.000255	0.341275	0.7329
D5*TIME	5.53E-05	0.000216	0.255832	0.7981
D6*TIME	-0.000303	0.000170	-1.778242	0.0754
D8*TIME	-0.000228	0.000133	-1.711832	0.0869
D9*TIME	-0.000336	0.000176	-1.910644	0.0561
D10*TIME	-0.000301	0.000198	-1.521576	0.1281
D11*TIME	0.000166	0.000229	0.726590	0.4675
D12*TIME	-0.000462	0.000239	-1.932592	0.0533
E2_AVG_DTW(-1)	0.045653	0.008088	5.644486	0.0000

R-squared	0.049447	Mean dependent var	33.49578
Adjusted R-squared	0.048369	S.D. dependent var	51.83723
S.E. of regression	50.56803	Akaike info criterion	10.68570
Sum squared resid	54103674	Schwarz criterion	10.69509
Log likelihood	-113152.5	Hannan-Quinn criter.	10.68876
F-statistic	45.85933	Durbin-Watson stat	2.005524
Prob(F-statistic)	0.000000	Wald F-statistic	63.43385
Prob(Wald F-statistic)	0.000000		

DTW Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_DTW
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	31.69680	2.022188	15.67451	0.0000
TIME	-0.000730	0.000141	-5.166134	0.0000
D1	6.642673	3.366686	1.973060	0.0485
D2	6.275582	3.250428	1.930694	0.0535
D3	20.13056	4.088955	4.923156	0.0000
D4	21.51179	3.808366	5.648561	0.0000
D5	18.41616	3.546144	5.193291	0.0000
D6	5.996661	3.342032	1.794316	0.0728
D8	2.078889	3.178596	0.654028	0.5131
D9	16.37766	3.774804	4.338679	0.0000
D10	24.34889	4.129747	5.895975	0.0000
D11	16.23148	3.595068	4.514929	0.0000
D12	10.37129	3.714145	2.792377	0.0052
D1*TIME	0.000511	0.000260	1.962633	0.0497
D2*TIME	0.000497	0.000251	1.984643	0.0472
D3*TIME	0.000434	0.000330	1.312930	0.1892
D4*TIME	0.000853	0.000300	2.843681	0.0045
D5*TIME	7.73E-05	0.000256	0.302127	0.7626
D6*TIME	5.34E-05	0.000233	0.229464	0.8185
D8*TIME	-4.36E-05	0.000220	-0.197708	0.8433
D9*TIME	-0.000515	0.000256	-2.007368	0.0447
D10*TIME	-0.000374	0.000300	-1.247674	0.2122
D11*TIME	0.000118	0.000266	0.442503	0.6581
D12*TIME	-5.01E-05	0.000268	-0.186995	0.8517
E2_DTR_DTW(-1)	0.051019	0.009683	5.268815	0.0000

R-squared	0.034092	Mean dependent var	39.69082
Adjusted R-squared	0.032997	S.D. dependent var	57.77389
S.E. of regression	56.81272	Akaike info criterion	10.91858
Sum squared resid	68291366	Schwarz criterion	10.92797
Log likelihood	-115619.1	Hannan-Quinn criter.	10.92164
F-statistic	31.11603	Durbin-Watson stat	2.001393
Prob(F-statistic)	0.000000	Wald F-statistic	36.53713
Prob(Wald F-statistic)	0.000000		

LAS Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_LAS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.76471	0.352583	44.71200	0.0000
TIME	2.69E-05	8.97E-06	2.999767	0.0027
D1	-8.047329	0.258971	-31.07419	0.0000
D2	-7.007528	0.250391	-27.98630	0.0000
D3	-6.103003	0.253282	-24.09564	0.0000
D4	-4.652306	0.252612	-18.41677	0.0000
D5	-2.824805	0.224039	-12.60857	0.0000
D6	-1.173883	0.207709	-5.651566	0.0000
D8	-0.663182	0.165249	-4.013226	0.0001
D9	-2.303367	0.193193	-11.92263	0.0000
D10	-4.626580	0.225820	-20.48795	0.0000
D11	-6.778051	0.241343	-28.08474	0.0000
D12	-8.293696	0.245602	-33.76882	0.0000
D1*TIME	3.12E-05	1.54E-05	2.020078	0.0434
D2*TIME	1.61E-05	1.64E-05	0.985576	0.3244
D3*TIME	4.62E-05	1.73E-05	2.672912	0.0075
D4*TIME	2.69E-05	1.85E-05	1.456533	0.1453
D5*TIME	2.48E-05	1.82E-05	1.361534	0.1734
D6*TIME	3.40E-05	1.70E-05	1.994436	0.0461
D8*TIME	1.46E-05	1.38E-05	1.059387	0.2894
D9*TIME	1.93E-05	1.53E-05	1.260483	0.2075
D10*TIME	1.66E-05	1.64E-05	1.014396	0.3104
D11*TIME	9.65E-06	1.65E-05	0.585038	0.5585
D12*TIME	2.10E-05	1.47E-05	1.435333	0.1512
AVG_LAS(-1)	0.824930	0.003771	218.7504	0.0000

R-squared	0.955411	Mean dependent var	68.07990
Adjusted R-squared	0.955361	S.D. dependent var	17.14269
S.E. of regression	3.621913	Akaike info criterion	5.413061
Sum squared resid	277569.2	Schwarz criterion	5.422456
Log likelihood	-57310.15	Hannan-Quinn criter.	5.416127
F-statistic	18890.72	Durbin-Watson stat	1.710895
Prob(F-statistic)	0.000000	Wald F-statistic	29326.08
Prob(Wald F-statistic)	0.000000		

LAS Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_LAS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.01105	0.305975	52.32804	0.0000
TIME	-0.000206	1.58E-05	-13.02875	0.0000
D1	-2.996023	0.380146	-7.881236	0.0000
D2	-2.416126	0.393892	-6.133978	0.0000
D3	-1.748393	0.345249	-5.064150	0.0000
D4	-0.694242	0.358196	-1.938161	0.0526
D5	-0.128939	0.301154	-0.428150	0.6685
D6	0.590602	0.283976	2.079759	0.0376
D8	-0.438927	0.287098	-1.528840	0.1263
D9	-0.103269	0.316026	-0.326774	0.7438
D10	-0.519505	0.378675	-1.371900	0.1701
D11	-2.632244	0.368699	-7.139279	0.0000
D12	-3.116124	0.400760	-7.775528	0.0000
D1*TIME	4.58E-05	2.84E-05	1.613267	0.1067
D2*TIME	4.15E-05	3.07E-05	1.354751	0.1755
D3*TIME	6.01E-05	2.54E-05	2.362585	0.0182
D4*TIME	2.28E-05	2.55E-05	0.892447	0.3722
D5*TIME	1.22E-05	2.18E-05	0.559573	0.5758
D6*TIME	1.08E-05	2.14E-05	0.507643	0.6117
D8*TIME	2.14E-05	2.10E-05	1.021642	0.3070
D9*TIME	6.17E-06	2.32E-05	0.265505	0.7906
D10*TIME	8.16E-07	2.80E-05	0.029157	0.9767
D11*TIME	7.55E-05	2.64E-05	2.855830	0.0043
D12*TIME	3.54E-05	2.84E-05	1.244736	0.2132
DTR_LAS(-1)	0.463022	0.007452	62.13569	0.0000

R-squared	0.374424	Mean dependent var	24.10475
Adjusted R-squared	0.373714	S.D. dependent var	6.333985
S.E. of regression	5.012604	Akaike info criterion	6.062967
Sum squared resid	531645.2	Schwarz criterion	6.072363
Log likelihood	-64193.95	Hannan-Quinn criter.	6.066033
F-statistic	527.6754	Durbin-Watson stat	2.026025
Prob(F-statistic)	0.000000	Wald F-statistic	454.0503
Prob(Wald F-statistic)	0.000000		

LAS Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_LAS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.413402	0.877209	8.451126	0.0000
TIME	7.68E-05	8.13E-05	0.944738	0.3448
D1	6.461432	1.812903	3.564135	0.0004
D2	4.672393	1.391986	3.356638	0.0008
D3	8.413116	1.472686	5.712770	0.0000
D4	12.09210	1.792485	6.745997	0.0000
D5	7.469101	1.724752	4.330536	0.0000
D6	3.922707	1.335292	2.937714	0.0033
D8	-0.417730	1.294586	-0.322674	0.7469
D9	4.106002	1.339488	3.065352	0.0022
D10	4.657779	1.580711	2.946635	0.0032
D11	4.013625	1.381006	2.906305	0.0037
D12	2.388541	1.422987	1.678540	0.0933
D1*TIME	-0.000302	0.000146	-2.061534	0.0393
D2*TIME	-0.000108	0.000119	-0.908309	0.3637
D3*TIME	-0.000157	0.000128	-1.229967	0.2187
D4*TIME	-0.000126	0.000149	-0.848326	0.3963
D5*TIME	8.54E-05	0.000155	0.549366	0.5828
D6*TIME	-8.56E-05	0.000116	-0.734923	0.4624
D8*TIME	2.19E-05	0.000115	0.190081	0.8492
D9*TIME	-0.000210	0.000115	-1.837209	0.0662
D10*TIME	-0.000134	0.000129	-1.038182	0.2992
D11*TIME	-7.92E-05	0.000113	-0.702013	0.4827
D12*TIME	-3.00E-05	0.000120	-0.249604	0.8029
E2_AVG_LAS(-1)	0.080679	0.008424	9.577281	0.0000

R-squared	0.026192	Mean dependent var	13.10182
Adjusted R-squared	0.025087	S.D. dependent var	24.62439
S.E. of regression	24.31355	Akaike info criterion	9.221124
Sum squared resid	12507527	Schwarz criterion	9.230520
Log likelihood	-97640.54	Hannan-Quinn criter.	9.224190
F-statistic	23.71130	Durbin-Watson stat	2.000977
Prob(F-statistic)	0.000000	Wald F-statistic	20.22720
Prob(Wald F-statistic)	0.000000		

LAS Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_LAS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	24.41107	1.752355	13.93044	0.0000
TIME	-0.000557	0.000122	-4.582464	0.0000
D1	0.642535	2.365015	0.271683	0.7859
D2	11.86717	3.126209	3.796025	0.0001
D3	19.48070	3.056954	6.372584	0.0000
D4	20.56430	2.937047	7.001691	0.0000
D5	8.100942	2.485299	3.259544	0.0011
D6	-0.045375	2.212152	-0.020512	0.9836
D8	-6.546613	2.090030	-3.132306	0.0017
D9	3.260355	2.668820	1.221646	0.2219
D10	5.417193	2.778069	1.949985	0.0512
D11	3.846546	2.438146	1.577652	0.1147
D12	0.684468	2.635948	0.259667	0.7951
D1*TIME	0.000385	0.000170	2.262389	0.0237
D2*TIME	-0.000107	0.000223	-0.479823	0.6314
D3*TIME	-0.000361	0.000215	-1.681111	0.0928
D4*TIME	-0.000425	0.000214	-1.982640	0.0474
D5*TIME	-0.000168	0.000176	-0.952687	0.3408
D6*TIME	4.60E-05	0.000160	0.287889	0.7734
D8*TIME	0.000371	0.000153	2.420558	0.0155
D9*TIME	-0.000118	0.000188	-0.626569	0.5309
D10*TIME	7.16E-05	0.000195	0.366472	0.7140
D11*TIME	2.87E-05	0.000177	0.161941	0.8714
D12*TIME	0.000249	0.000184	1.354634	0.1755
E2_DTR_LAS(-1)	0.041381	0.008144	5.081460	0.0000

R-squared	0.038660	Mean dependent var	25.09764
Adjusted R-squared	0.037569	S.D. dependent var	36.91184
S.E. of regression	36.21182	Akaike info criterion	10.01783
Sum squared resid	27744406	Schwarz criterion	10.02722
Log likelihood	-106078.8	Hannan-Quinn criter.	10.02089
F-statistic	35.45239	Durbin-Watson stat	2.000915
Prob(F-statistic)	0.000000	Wald F-statistic	29.76471
Prob(Wald F-statistic)	0.000000		

MSP Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_MSP
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.30247	0.367166	44.40079	0.0000
TIME	4.33E-05	1.31E-05	3.319611	0.0009
D1	-14.31668	0.502355	-28.49914	0.0000
D2	-12.22808	0.483393	-25.29636	0.0000
D3	-9.556968	0.431685	-22.13876	0.0000
D4	-5.775969	0.336872	-17.14587	0.0000
D5	-2.932429	0.296810	-9.879813	0.0000
D6	-0.842701	0.268730	-3.135863	0.0017
D8	-0.603024	0.245993	-2.451391	0.0142
D9	-3.368409	0.298090	-11.29998	0.0000
D10	-5.422668	0.336155	-16.13143	0.0000
D11	-9.631104	0.382383	-25.18706	0.0000
D12	-12.70635	0.444381	-28.59336	0.0000
D1*TIME	6.40E-05	3.38E-05	1.891801	0.0585
D2*TIME	3.76E-06	3.33E-05	0.113168	0.9099
D3*TIME	3.68E-05	3.20E-05	1.149755	0.2503
D4*TIME	-8.12E-06	2.54E-05	-0.319875	0.7491
D5*TIME	-1.66E-05	2.30E-05	-0.722070	0.4703
D6*TIME	-1.40E-05	2.09E-05	-0.670495	0.5025
D8*TIME	-1.81E-05	1.91E-05	-0.945791	0.3443
D9*TIME	2.91E-05	2.29E-05	1.271606	0.2035
D10*TIME	-4.62E-05	2.57E-05	-1.798502	0.0721
D11*TIME	1.03E-05	2.83E-05	0.362195	0.7172
D12*TIME	6.64E-06	3.19E-05	0.208357	0.8350
AVG_MSP(-1)	0.772968	0.004506	171.5487	0.0000

R-squared	0.925989	Mean dependent var	45.72880
Adjusted R-squared	0.925905	S.D. dependent var	22.97425
S.E. of regression	6.253687	Akaike info criterion	6.505399
Sum squared resid	827498.9	Schwarz criterion	6.514794
Log likelihood	-68880.18	Hannan-Quinn criter.	6.508464
F-statistic	11030.42	Durbin-Watson stat	1.781734
Prob(F-statistic)	0.000000	Wald F-statistic	12756.28
Prob(Wald F-statistic)	0.000000		

MSP Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_MSP
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.99778	0.312647	47.97029	0.0000
TIME	-0.000119	1.86E-05	-6.393857	0.0000
D1	-1.785039	0.405960	-4.397084	0.0000
D2	-2.297775	0.458057	-5.016358	0.0000
D3	-3.197336	0.465514	-6.868397	0.0000
D4	-0.506525	0.526474	-0.962107	0.3360
D5	0.521668	0.441756	1.180894	0.2377
D6	0.343277	0.418608	0.820046	0.4122
D8	0.088788	0.378781	0.234406	0.8147
D9	-0.501589	0.446093	-1.124405	0.2609
D10	-0.273325	0.465362	-0.587340	0.5570
D11	-3.908240	0.468492	-8.342178	0.0000
D12	-3.616272	0.447688	-8.077656	0.0000
D1*TIME	-3.68E-05	3.30E-05	-1.115742	0.2645
D2*TIME	1.49E-05	3.38E-05	0.440263	0.6598
D3*TIME	0.000115	3.43E-05	3.364982	0.0008
D4*TIME	6.21E-05	3.87E-05	1.605379	0.1084
D5*TIME	1.03E-05	3.39E-05	0.304229	0.7610
D6*TIME	-7.56E-06	3.04E-05	-0.248976	0.8034
D8*TIME	-3.08E-05	2.73E-05	-1.130956	0.2581
D9*TIME	4.95E-05	3.31E-05	1.496962	0.1344
D10*TIME	-3.31E-05	3.62E-05	-0.913314	0.3611
D11*TIME	7.72E-05	3.60E-05	2.140895	0.0323
D12*TIME	1.30E-05	3.43E-05	0.378411	0.7051
DTR_MSP(-1)	0.309669	0.008087	38.29054	0.0000

R-squared	0.176345	Mean dependent var	18.37632
Adjusted R-squared	0.175410	S.D. dependent var	7.408062
S.E. of regression	6.727033	Akaike info criterion	6.651325
Sum squared resid	957507.6	Schwarz criterion	6.660720
Log likelihood	-70425.83	Hannan-Quinn criter.	6.654390
F-statistic	188.7559	Durbin-Watson stat	2.029915
Prob(F-statistic)	0.000000	Wald F-statistic	130.9556
Prob(Wald F-statistic)	0.000000		

MSP Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_MSP
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.34472	1.282400	14.30499	0.0000
TIME	-0.000167	9.57E-05	-1.747690	0.0805
D1	62.89960	5.881628	10.69425	0.0000
D2	48.85086	6.102162	8.005500	0.0000
D3	24.87085	3.829764	6.494094	0.0000
D4	18.42077	3.231991	5.699511	0.0000
D5	14.24197	2.941141	4.842328	0.0000
D6	7.428000	2.364535	3.141421	0.0017
D8	6.175422	2.009015	3.073855	0.0021
D9	14.07551	2.489625	5.653669	0.0000
D10	23.45247	2.804798	8.361554	0.0000
D11	20.01968	3.479940	5.752880	0.0000
D12	49.52776	4.437583	11.16098	0.0000
D1*TIME	-0.000957	0.000456	-2.098595	0.0359
D2*TIME	-0.000921	0.000441	-2.090556	0.0366
D3*TIME	0.000154	0.000314	0.490909	0.6235
D4*TIME	0.000132	0.000261	0.503949	0.6143
D5*TIME	-6.52E-06	0.000246	-0.026527	0.9788
D6*TIME	-0.000147	0.000176	-0.838415	0.4018
D8*TIME	-0.000461	0.000145	-3.179657	0.0015
D9*TIME	-0.000106	0.000189	-0.560101	0.5754
D10*TIME	-0.000313	0.000218	-1.438058	0.1504
D11*TIME	0.000270	0.000282	0.955626	0.3393
D12*TIME	-0.001032	0.000344	-3.005297	0.0027
E2_AVG_MSP(-1)	0.035603	0.009047	3.935163	0.0001

R-squared	0.070375	Mean dependent var	39.06429
Adjusted R-squared	0.069321	S.D. dependent var	62.85326
S.E. of regression	60.63563	Akaike info criterion	11.04882
Sum squared resid	77791178	Schwarz criterion	11.05822
Log likelihood	-116998.6	Hannan-Quinn criter.	11.05189
F-statistic	66.73827	Durbin-Watson stat	2.004625
Prob(F-statistic)	0.000000	Wald F-statistic	68.33802
Prob(Wald F-statistic)	0.000000		

MSP Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_MSP
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	34.06098	2.015655	16.89822	0.0000
TIME	-0.000948	0.000146	-6.475538	0.0000
D1	27.58147	5.745840	4.800250	0.0000
D2	25.40171	4.466650	5.686970	0.0000
D3	18.16609	4.635618	3.918806	0.0001
D4	30.83892	3.951513	7.804332	0.0000
D5	22.39459	3.737882	5.991252	0.0000
D6	4.664294	3.174541	1.469281	0.1418
D8	3.118522	3.123541	0.998393	0.3181
D9	20.13052	3.783947	5.319978	0.0000
D10	26.11742	3.334005	7.833650	0.0000
D11	13.11547	3.981011	3.294507	0.0010
D12	23.81933	4.880008	4.881002	0.0000
D1*TIME	0.000106	0.000441	0.239832	0.8105
D2*TIME	-0.000319	0.000329	-0.969740	0.3322
D3*TIME	0.000395	0.000345	1.144918	0.2523
D4*TIME	0.000214	0.000295	0.724692	0.4686
D5*TIME	0.000457	0.000303	1.507234	0.1318
D6*TIME	0.000328	0.000236	1.390517	0.1644
D8*TIME	-2.91E-05	0.000225	-0.129454	0.8970
D9*TIME	-0.000274	0.000268	-1.023011	0.3063
D10*TIME	0.000150	0.000255	0.586688	0.5574
D11*TIME	0.000499	0.000290	1.724101	0.0847
D12*TIME	-0.000126	0.000367	-0.342688	0.7318
E2_DTR_MSP(-1)	0.044904	0.008500	5.282587	0.0000

R-squared	0.034730	Mean dependent var	45.20123
Adjusted R-squared	0.033635	S.D. dependent var	66.11566
S.E. of regression	64.99425	Akaike info criterion	11.18765
Sum squared resid	89376748	Schwarz criterion	11.19705
Log likelihood	-118469.0	Hannan-Quinn criter.	11.19072
F-statistic	31.71876	Durbin-Watson stat	2.002315
Prob(F-statistic)	0.000000	Wald F-statistic	50.89090
Prob(Wald F-statistic)	0.000000		

LGA Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_LGA
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.84165	0.401929	54.34208	0.0000
TIME	5.65E-05	1.23E-05	4.606160	0.0000
D1	-13.10569	0.391275	-33.49479	0.0000
D2	-12.22641	0.394081	-31.02509	0.0000
D3	-9.987085	0.340507	-29.33005	0.0000
D4	-6.933892	0.291662	-23.77374	0.0000
D5	-3.905720	0.280320	-13.93310	0.0000
D6	-1.159457	0.237671	-4.878407	0.0000
D8	-0.320957	0.205906	-1.558758	0.1191
D9	-2.634650	0.264624	-9.956212	0.0000
D10	-5.632880	0.299697	-18.79527	0.0000
D11	-8.612829	0.323178	-26.65040	0.0000
D12	-11.88537	0.363446	-32.70186	0.0000
D1*TIME	7.27E-06	2.79E-05	0.260654	0.7944
D2*TIME	-9.18E-06	2.82E-05	-0.325717	0.7446
D3*TIME	-6.65E-06	2.55E-05	-0.260473	0.7945
D4*TIME	-6.40E-06	2.20E-05	-0.290532	0.7714
D5*TIME	-1.25E-05	2.25E-05	-0.554599	0.5792
D6*TIME	-2.56E-05	2.03E-05	-1.262341	0.2068
D8*TIME	-7.86E-06	1.75E-05	-0.449669	0.6530
D9*TIME	-5.04E-06	2.10E-05	-0.240707	0.8098
D10*TIME	-1.30E-05	2.35E-05	-0.552102	0.5809
D11*TIME	-1.22E-05	2.36E-05	-0.515302	0.6063
D12*TIME	2.22E-05	2.65E-05	0.836912	0.4027
AVG_LGA(-1)	0.710160	0.005007	141.8410	0.0000

R-squared	0.908353	Mean dependent var	55.34663
Adjusted R-squared	0.908249	S.D. dependent var	17.37212
S.E. of regression	5.262079	Akaike info criterion	6.160109
Sum squared resid	585881.6	Schwarz criterion	6.169504
Log likelihood	-65222.87	Hannan-Quinn criter.	6.163174
F-statistic	8738.200	Durbin-Watson stat	1.765296
Prob(F-statistic)	0.000000	Wald F-statistic	10318.84
Prob(Wald F-statistic)	0.000000		

LGA Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_LGA
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.55812	0.230796	50.07936	0.0000
TIME	-1.65E-05	1.53E-05	-1.076188	0.2819
D1	-2.856915	0.320207	-8.922086	0.0000
D2	-2.298310	0.395126	-5.816648	0.0000
D3	-1.452668	0.337296	-4.306805	0.0000
D4	0.270352	0.411711	0.656655	0.5114
D5	0.846084	0.354322	2.387893	0.0170
D6	0.554696	0.313629	1.768640	0.0770
D8	-0.569518	0.252036	-2.259675	0.0239
D9	-0.848890	0.300534	-2.824605	0.0047
D10	-0.785592	0.303583	-2.587735	0.0097
D11	-2.763709	0.315937	-8.747646	0.0000
D12	-3.162624	0.350785	-9.015838	0.0000
D1*TIME	3.73E-05	2.62E-05	1.424563	0.1543
D2*TIME	6.09E-05	3.16E-05	1.926419	0.0541
D3*TIME	7.58E-05	2.65E-05	2.864131	0.0042
D4*TIME	3.38E-05	3.16E-05	1.069776	0.2847
D5*TIME	1.36E-05	2.85E-05	0.476467	0.6337
D6*TIME	3.18E-07	2.43E-05	0.013085	0.9896
D8*TIME	-1.51E-05	1.96E-05	-0.768401	0.4423
D9*TIME	-1.71E-05	2.28E-05	-0.751907	0.4521
D10*TIME	-3.45E-05	2.38E-05	-1.451063	0.1468
D11*TIME	4.24E-05	2.46E-05	1.721686	0.0851
D12*TIME	2.76E-05	2.63E-05	1.048947	0.2942
DTR_LGA(-1)	0.233524	0.007663	30.47499	0.0000

R-squared	0.142397	Mean dependent var	13.69052
Adjusted R-squared	0.141424	S.D. dependent var	5.302051
S.E. of regression	4.912846	Akaike info criterion	6.022763
Sum squared resid	510694.9	Schwarz criterion	6.032159
Log likelihood	-63768.11	Hannan-Quinn criter.	6.025829
F-statistic	146.3857	Durbin-Watson stat	2.023592
Prob(F-statistic)	0.000000	Wald F-statistic	106.4927
Prob(Wald F-statistic)	0.000000		

LGA Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_LGA
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.83078	0.954187	14.49483	0.0000
TIME	-4.57E-05	7.59E-05	-0.601840	0.5473
D1	23.96028	2.915526	8.218166	0.0000
D2	22.74854	3.556921	6.395570	0.0000
D3	13.57759	3.074610	4.416038	0.0000
D4	14.70871	2.672776	5.503158	0.0000
D5	10.29451	2.127996	4.837656	0.0000
D6	5.498152	1.603130	3.429636	0.0006
D8	-0.190390	1.358796	-0.140117	0.8886
D9	6.470735	1.638657	3.948803	0.0001
D10	10.45443	1.656723	6.310310	0.0000
D11	14.52025	2.313759	6.275609	0.0000
D12	22.54816	2.955273	7.629806	0.0000
D1*TIME	0.000152	0.000251	0.607199	0.5437
D2*TIME	0.000103	0.000293	0.351207	0.7254
D3*TIME	0.000583	0.000268	2.175156	0.0296
D4*TIME	3.21E-05	0.000212	0.151426	0.8796
D5*TIME	5.96E-05	0.000172	0.346985	0.7286
D6*TIME	7.37E-05	0.000140	0.526354	0.5986
D8*TIME	-6.84E-05	0.000104	-0.657213	0.5111
D9*TIME	-0.000152	0.000124	-1.226277	0.2201
D10*TIME	-5.02E-05	0.000139	-0.362140	0.7173
D11*TIME	6.32E-05	0.000194	0.325966	0.7445
D12*TIME	-0.000165	0.000228	-0.721813	0.4704
E2_AVG_LGA(-1)	0.064252	0.009048	7.101484	0.0000

R-squared	0.051333	Mean dependent var	27.65724
Adjusted R-squared	0.050257	S.D. dependent var	42.33102
S.E. of regression	41.25360	Akaike info criterion	10.27853
Sum squared resid	36007944	Schwarz criterion	10.28793
Log likelihood	-108840.1	Hannan-Quinn criter.	10.28160
F-statistic	47.70280	Durbin-Watson stat	2.008103
Prob(F-statistic)	0.000000	Wald F-statistic	53.92404
Prob(Wald F-statistic)	0.000000		

LGA Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_LGA
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.38214	1.076745	13.35705	0.0000
TIME	-3.18E-05	8.33E-05	-0.381391	0.7029
D1	11.44228	2.830989	4.041794	0.0001
D2	13.93449	2.762289	5.044543	0.0000
D3	16.34940	2.754528	5.935465	0.0000
D4	23.77409	3.263431	7.285000	0.0000
D5	18.50027	2.339504	7.907772	0.0000
D6	10.56058	1.903918	5.546762	0.0000
D8	-1.151124	1.364576	-0.843576	0.3989
D9	6.116814	1.760952	3.473584	0.0005
D10	6.471731	1.772247	3.651709	0.0003
D11	5.545100	1.831961	3.026866	0.0025
D12	13.58109	2.474101	5.489303	0.0000
D1*TIME	3.57E-05	0.000222	0.160676	0.8724
D2*TIME	-0.000230	0.000214	-1.077654	0.2812
D3*TIME	-8.31E-05	0.000199	-0.416721	0.6769
D4*TIME	-0.000323	0.000255	-1.268317	0.2047
D5*TIME	-6.45E-05	0.000185	-0.349033	0.7271
D6*TIME	-0.000295	0.000155	-1.906884	0.0565
D8*TIME	-9.78E-05	0.000105	-0.927766	0.3535
D9*TIME	-0.000391	0.000128	-3.041925	0.0024
D10*TIME	-0.000225	0.000130	-1.722371	0.0850
D11*TIME	3.67E-06	0.000138	0.026653	0.9787
D12*TIME	-0.000248	0.000185	-1.339157	0.1805
E2_DTR_LGA(-1)	0.056094	0.009390	5.973708	0.0000

R-squared	0.034605	Mean dependent var	24.10622
Adjusted R-squared	0.033510	S.D. dependent var	41.76461
S.E. of regression	41.05888	Akaike info criterion	10.26907
Sum squared resid	35668821	Schwarz criterion	10.27847
Log likelihood	-108739.9	Hannan-Quinn criter.	10.27214
F-statistic	31.60111	Durbin-Watson stat	2.003345
Prob(F-statistic)	0.000000	Wald F-statistic	39.29319
Prob(Wald F-statistic)	0.000000		

PDX Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_PDX
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.22612	0.372319	43.58121	0.0000
TIME	2.86E-05	1.17E-05	2.454941	0.0141
D1	-6.891863	0.282434	-24.40163	0.0000
D2	-5.706058	0.250725	-22.75824	0.0000
D3	-5.030027	0.225616	-22.29460	0.0000
D4	-4.218947	0.227240	-18.56607	0.0000
D5	-2.749549	0.223884	-12.28112	0.0000
D6	-1.178001	0.217068	-5.426875	0.0000
D8	-0.286170	0.210542	-1.359202	0.1741
D9	-1.553650	0.212103	-7.324963	0.0000
D10	-3.606323	0.221871	-16.25417	0.0000
D11	-5.515805	0.242701	-22.72674	0.0000
D12	-6.725799	0.272153	-24.71326	0.0000
D1*TIME	5.16E-06	2.03E-05	0.254107	0.7994
D2*TIME	-2.67E-05	1.83E-05	-1.456612	0.1452
D3*TIME	-3.09E-06	1.62E-05	-0.190854	0.8486
D4*TIME	1.15E-05	1.70E-05	0.678988	0.4972
D5*TIME	1.65E-05	1.77E-05	0.934818	0.3499
D6*TIME	-7.92E-06	1.83E-05	-0.432922	0.6651
D8*TIME	1.75E-05	1.64E-05	1.067908	0.2856
D9*TIME	1.31E-05	1.72E-05	0.761435	0.4464
D10*TIME	-8.18E-06	1.69E-05	-0.485196	0.6275
D11*TIME	-1.27E-05	1.82E-05	-0.697042	0.4858
D12*TIME	-2.46E-05	2.01E-05	-1.221322	0.2220
AVG_PDX(-1)	0.761458	0.005104	149.2000	0.0000

R-squared	0.903683	Mean dependent var	54.08539
Adjusted R-squared	0.903574	S.D. dependent var	11.63708
S.E. of regression	3.613615	Akaike info criterion	5.408474
Sum squared resid	276298.8	Schwarz criterion	5.417869
Log likelihood	-57261.56	Hannan-Quinn criter.	5.411539
F-statistic	8271.729	Durbin-Watson stat	1.825089
Prob(F-statistic)	0.000000	Wald F-statistic	8223.034
Prob(Wald F-statistic)	0.000000		

PDX Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_PDX
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.93898	0.360232	33.14244	0.0000
TIME	-3.16E-05	2.54E-05	-1.243375	0.2137
D1	-6.204347	0.390582	-15.88487	0.0000
D2	-4.288179	0.429911	-9.974563	0.0000
D3	-2.859266	0.489168	-5.845159	0.0000
D4	-2.290199	0.439258	-5.213791	0.0000
D5	-1.679966	0.479514	-3.503473	0.0005
D6	-1.101349	0.447077	-2.463442	0.0138
D8	-0.341349	0.493907	-0.691120	0.4895
D9	-0.263635	0.491605	-0.536274	0.5918
D10	-2.045587	0.473712	-4.318205	0.0000
D11	-5.201727	0.415131	-12.53032	0.0000
D12	-6.363653	0.368959	-17.24761	0.0000
D1*TIME	1.94E-05	2.96E-05	0.657805	0.5107
D2*TIME	2.60E-06	3.39E-05	0.076885	0.9387
D3*TIME	-2.02E-05	3.75E-05	-0.538312	0.5904
D4*TIME	-2.05E-06	3.43E-05	-0.059740	0.9524
D5*TIME	-9.52E-06	3.85E-05	-0.247206	0.8048
D6*TIME	-3.00E-05	3.62E-05	-0.827529	0.4079
D8*TIME	1.97E-05	3.67E-05	0.536587	0.5916
D9*TIME	-8.50E-06	3.80E-05	-0.223443	0.8232
D10*TIME	-5.61E-05	3.75E-05	-1.494891	0.1350
D11*TIME	-1.39E-05	3.17E-05	-0.437726	0.6616
D12*TIME	1.76E-06	2.83E-05	0.062211	0.9504
DTR_PDX(-1)	0.501533	0.006566	76.38458	0.0000

R-squared	0.452603	Mean dependent var	17.66286
Adjusted R-squared	0.451982	S.D. dependent var	8.428349
S.E. of regression	6.239358	Akaike info criterion	6.500811
Sum squared resid	823711.1	Schwarz criterion	6.510206
Log likelihood	-68831.59	Hannan-Quinn criter.	6.503876
F-statistic	728.9518	Durbin-Watson stat	1.953363
Prob(F-statistic)	0.000000	Wald F-statistic	850.4366
Prob(Wald F-statistic)	0.000000		

PDX Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_PDX
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.69828	0.898321	13.02239	0.0000
TIME	6.25E-06	6.83E-05	0.091557	0.9271
D1	3.120547	1.440132	2.166848	0.0303
D2	-1.038655	1.236837	-0.839767	0.4010
D3	-3.067994	1.139644	-2.692062	0.0071
D4	1.321539	1.362147	0.970188	0.3320
D5	0.103694	1.399651	0.074086	0.9409
D6	0.574316	1.214096	0.473040	0.6362
D8	-1.066115	1.160195	-0.918910	0.3582
D9	-1.487095	1.137078	-1.307822	0.1909
D10	-0.433850	1.260019	-0.344320	0.7306
D11	-0.050384	1.349859	-0.037325	0.9702
D12	3.157573	1.693347	1.864694	0.0622
D1*TIME	-0.000192	0.000116	-1.655629	0.0978
D2*TIME	-8.92E-06	9.82E-05	-0.090876	0.9276
D3*TIME	7.67E-05	9.60E-05	0.798990	0.4243
D4*TIME	-8.94E-05	0.000110	-0.812495	0.4165
D5*TIME	0.000144	0.000119	1.205925	0.2279
D6*TIME	4.11E-05	0.000102	0.404415	0.6859
D8*TIME	3.35E-05	9.49E-05	0.353117	0.7240
D9*TIME	1.33E-05	8.95E-05	0.149042	0.8815
D10*TIME	-0.000111	9.79E-05	-1.137431	0.2554
D11*TIME	2.19E-05	0.000107	0.204407	0.8380
D12*TIME	-0.000111	0.000126	-0.880555	0.3786
E2_AVG_PDX(-1)	0.102696	0.013395	7.666837	0.0000

R-squared	0.016997	Mean dependent var	13.04332
Adjusted R-squared	0.015882	S.D. dependent var	19.56938
S.E. of regression	19.41335	Akaike info criterion	8.770979
Sum squared resid	7973990.	Schwarz criterion	8.780374
Log likelihood	-92872.82	Hannan-Quinn criter.	8.774044
F-statistic	15.24364	Durbin-Watson stat	2.006586
Prob(F-statistic)	0.000000	Wald F-statistic	7.632166
Prob(Wald F-statistic)	0.000000		

PDX Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_PDX
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	45.93065	2.845982	16.13877	0.0000
TIME	-0.000380	0.000214	-1.780444	0.0750
D1	-23.11930	3.297534	-7.011087	0.0000
D2	-15.98568	3.597986	-4.442953	0.0000
D3	-1.105747	4.093888	-0.270097	0.7871
D4	13.61799	4.317103	3.154428	0.0016
D5	7.995152	4.445505	1.798480	0.0721
D6	4.102592	4.244723	0.966516	0.3338
D8	10.34431	4.058045	2.549088	0.0108
D9	22.04047	4.651570	4.738286	0.0000
D10	1.268554	4.240811	0.299130	0.7648
D11	-17.31091	3.400451	-5.090769	0.0000
D12	-22.71134	3.266676	-6.952430	0.0000
D1*TIME	0.000275	0.000247	1.113576	0.2655
D2*TIME	0.000244	0.000281	0.866403	0.3863
D3*TIME	-8.12E-06	0.000318	-0.025502	0.9797
D4*TIME	-0.000501	0.000335	-1.493898	0.1352
D5*TIME	0.000124	0.000352	0.352419	0.7245
D6*TIME	3.74E-06	0.000320	0.011675	0.9907
D8*TIME	-0.000527	0.000301	-1.748820	0.0803
D9*TIME	-0.000698	0.000348	-2.005444	0.0449
D10*TIME	-0.000183	0.000319	-0.572764	0.5668
D11*TIME	-2.81E-05	0.000262	-0.107283	0.9146
D12*TIME	0.000126	0.000248	0.506126	0.6128
E2_DTR_PDX(-1)	-0.006629	0.007562	-0.876635	0.3807

R-squared	0.048945	Mean dependent var	38.88534
Adjusted R-squared	0.047866	S.D. dependent var	55.27324
S.E. of regression	53.93417	Akaike info criterion	10.81459
Sum squared resid	61546403	Schwarz criterion	10.82398
Log likelihood	-114517.7	Hannan-Quinn criter.	10.81765
F-statistic	45.36935	Durbin-Watson stat	2.000808
Prob(F-statistic)	0.000000	Wald F-statistic	54.21619
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	21.20203	0.406242	52.19058	0.0000
TIME	6.68E-05	1.13E-05	5.890710	0.0000
D1	-13.00377	0.398518	-32.63032	0.0000
D2	-12.01654	0.399985	-30.04244	0.0000
D3	-9.477612	0.366252	-25.87730	0.0000
D4	-6.497795	0.316712	-20.51640	0.0000
D5	-3.590633	0.271226	-13.23852	0.0000
D6	-1.031422	0.224911	-4.585914	0.0000
D8	-0.281529	0.207881	-1.354279	0.1757
D9	-2.623407	0.270530	-9.697284	0.0000
D10	-5.887328	0.305137	-19.29406	0.0000
D11	-8.778265	0.325337	-26.98210	0.0000
D12	-11.86465	0.382181	-31.04459	0.0000
D1*TIME	7.51E-06	2.78E-05	0.270704	0.7866
D2*TIME	-5.17E-06	2.81E-05	-0.183774	0.8542
D3*TIME	-7.90E-06	2.69E-05	-0.293868	0.7689
D4*TIME	-6.22E-06	2.30E-05	-0.270271	0.7870
D5*TIME	-1.02E-05	2.24E-05	-0.455154	0.6490
D6*TIME	-2.41E-05	1.84E-05	-1.313423	0.1891
D8*TIME	-2.11E-05	1.68E-05	-1.254882	0.2095
D9*TIME	-1.35E-05	2.12E-05	-0.637214	0.5240
D10*TIME	-1.09E-05	2.32E-05	-0.470157	0.6382
D11*TIME	-1.16E-05	2.26E-05	-0.515052	0.6065
D12*TIME	1.82E-05	2.72E-05	0.668393	0.5039
AVG_PHL(-1)	0.718329	0.005105	140.7124	0.0000

R-squared	0.908718	Mean dependent var	55.41201
Adjusted R-squared	0.908614	S.D. dependent var	17.71637
S.E. of regression	5.355669	Akaike info criterion	6.195368
Sum squared resid	606907.6	Schwarz criterion	6.204763
Log likelihood	-65596.33	Hannan-Quinn criter.	6.198433
F-statistic	8776.620	Durbin-Watson stat	1.782252
Prob(F-statistic)	0.000000	Wald F-statistic	10401.85
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.95271	0.302723	42.78740	0.0000
TIME	-8.61E-05	1.93E-05	-4.453194	0.0000
D1	-2.922818	0.369270	-7.915131	0.0000
D2	-2.173920	0.412045	-5.275928	0.0000
D3	-1.035858	0.441871	-2.344253	0.0191
D4	0.964259	0.481586	2.002259	0.0453
D5	0.990373	0.408136	2.426577	0.0153
D6	0.804887	0.403563	1.994453	0.0461
D8	-0.301248	0.360100	-0.836567	0.4028
D9	-0.093547	0.418681	-0.223433	0.8232
D10	1.209749	0.443337	2.728733	0.0064
D11	-1.082676	0.440556	-2.457523	0.0140
D12	-2.615967	0.393432	-6.649102	0.0000
D1*TIME	6.07E-05	2.91E-05	2.088017	0.0368
D2*TIME	7.69E-05	3.20E-05	2.406160	0.0161
D3*TIME	9.12E-05	3.15E-05	2.895508	0.0038
D4*TIME	3.91E-05	3.56E-05	1.097937	0.2722
D5*TIME	1.26E-05	3.16E-05	0.398334	0.6904
D6*TIME	-9.59E-06	2.88E-05	-0.333302	0.7389
D8*TIME	-1.36E-06	2.63E-05	-0.051623	0.9588
D9*TIME	-2.09E-06	3.02E-05	-0.069050	0.9450
D10*TIME	-8.02E-05	3.22E-05	-2.489722	0.0128
D11*TIME	2.43E-05	3.23E-05	0.753026	0.4514
D12*TIME	3.13E-05	2.92E-05	1.070849	0.2842
DTR_PHL(-1)	0.339047	0.007669	44.20912	0.0000

R-squared	0.190049	Mean dependent var	17.75151
Adjusted R-squared	0.189130	S.D. dependent var	6.461226
S.E. of regression	5.818225	Akaike info criterion	6.361047
Sum squared resid	716268.9	Schwarz criterion	6.370442
Log likelihood	-67351.21	Hannan-Quinn criter.	6.364112
F-statistic	206.8665	Durbin-Watson stat	1.997036
Prob(F-statistic)	0.000000	Wald F-statistic	149.6270
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.53425	0.856703	14.63081	0.0000
TIME	-8.55E-05	6.71E-05	-1.274025	0.2027
D1	27.95462	3.314398	8.434298	0.0000
D2	27.40326	3.694701	7.416908	0.0000
D3	19.65243	3.217091	6.108760	0.0000
D4	16.33077	2.814383	5.802609	0.0000
D5	15.64959	2.275583	6.877178	0.0000
D6	7.851489	1.614614	4.862766	0.0000
D8	1.684095	1.451363	1.160355	0.2459
D9	10.15016	1.696774	5.982032	0.0000
D10	15.41559	1.868326	8.251017	0.0000
D11	21.81678	2.580458	8.454616	0.0000
D12	25.32869	2.912196	8.697454	0.0000
D1*TIME	0.000147	0.000289	0.508400	0.6112
D2*TIME	2.29E-05	0.000311	0.073498	0.9414
D3*TIME	0.000468	0.000278	1.683618	0.0923
D4*TIME	0.000376	0.000229	1.646811	0.0996
D5*TIME	-0.000170	0.000170	-1.000579	0.3170
D6*TIME	-0.000154	0.000129	-1.191914	0.2333
D8*TIME	-0.000147	0.000104	-1.409849	0.1586
D9*TIME	-0.000204	0.000130	-1.572636	0.1158
D10*TIME	-0.000131	0.000150	-0.870783	0.3839
D11*TIME	-5.66E-05	0.000223	-0.253438	0.7999
D12*TIME	-0.000102	0.000226	-0.449544	0.6530
E2_AVG_PHL(-1)	0.045064	0.008634	5.219394	0.0000

R-squared	0.056834	Mean dependent var	28.65058
Adjusted R-squared	0.055765	S.D. dependent var	44.80583
S.E. of regression	43.53862	Akaike info criterion	10.38635
Sum squared resid	40107347	Schwarz criterion	10.39575
Log likelihood	-109982.1	Hannan-Quinn criter.	10.38942
F-statistic	53.12346	Durbin-Watson stat	2.002735
Prob(F-statistic)	0.000000	Wald F-statistic	71.11827
Prob(Wald F-statistic)	0.000000		

PHL Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_PHL
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.37441	2.025807	11.04469	0.0000
TIME	-0.000393	0.000143	-2.754483	0.0059
D1	10.66203	3.499646	3.046602	0.0023
D2	15.43329	3.251396	4.746665	0.0000
D3	23.89886	3.584542	6.667200	0.0000
D4	27.07562	3.612763	7.494436	0.0000
D5	23.21550	3.713078	6.252359	0.0000
D6	10.56819	2.869652	3.682741	0.0002
D8	-0.077822	2.467053	-0.031545	0.9748
D9	11.83351	3.131250	3.779164	0.0002
D10	15.76030	3.429174	4.595946	0.0000
D11	12.79291	3.141156	4.072675	0.0000
D12	11.53788	2.921364	3.949484	0.0001
D1*TIME	0.000435	0.000282	1.542890	0.1229
D2*TIME	0.000121	0.000256	0.471372	0.6374
D3*TIME	0.000287	0.000279	1.029384	0.3033
D4*TIME	0.000150	0.000283	0.531146	0.5953
D5*TIME	-0.000227	0.000269	-0.845246	0.3980
D6*TIME	-0.000307	0.000211	-1.455570	0.1455
D8*TIME	-9.88E-05	0.000176	-0.560119	0.5754
D9*TIME	-0.000565	0.000219	-2.586589	0.0097
D10*TIME	-0.000220	0.000244	-0.898320	0.3690
D11*TIME	0.000126	0.000236	0.535258	0.5925
D12*TIME	6.74E-05	0.000211	0.319497	0.7494
E2_DTR_PHL(-1)	0.067617	0.011837	5.712522	0.0000

R-squared	0.046411	Mean dependent var	33.80817
Adjusted R-squared	0.045329	S.D. dependent var	49.85206
S.E. of regression	48.70908	Akaike info criterion	10.61079
Sum squared resid	50198927	Schwarz criterion	10.62018
Log likelihood	-112359.2	Hannan-Quinn criter.	10.61385
F-statistic	42.90654	Durbin-Watson stat	2.001013
Prob(F-statistic)	0.000000	Wald F-statistic	56.51759
Prob(Wald F-statistic)	0.000000		

SLC Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_SLC
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.40525	0.365879	47.57111	0.0000
TIME	4.33E-05	1.17E-05	3.709801	0.0002
D1	-11.15687	0.386837	-28.84125	0.0000
D2	-9.747044	0.360998	-27.00029	0.0000
D3	-8.171221	0.313948	-26.02733	0.0000
D4	-6.296421	0.281758	-22.34691	0.0000
D5	-4.046906	0.272162	-14.86948	0.0000
D6	-1.974981	0.279877	-7.056612	0.0000
D8	-0.867376	0.225234	-3.850993	0.0001
D9	-3.388646	0.277781	-12.19901	0.0000
D10	-6.090795	0.285682	-21.32017	0.0000
D11	-8.646089	0.314690	-27.47491	0.0000
D12	-11.05492	0.337219	-32.78261	0.0000
D1*TIME	-8.64E-06	2.53E-05	-0.341156	0.7330
D2*TIME	-8.82E-06	2.54E-05	-0.346976	0.7286
D3*TIME	2.77E-05	2.25E-05	1.234045	0.2172
D4*TIME	-1.31E-05	2.05E-05	-0.640150	0.5221
D5*TIME	-1.19E-05	2.20E-05	-0.542624	0.5874
D6*TIME	1.26E-05	2.38E-05	0.531943	0.5948
D8*TIME	9.22E-06	1.81E-05	0.508450	0.6111
D9*TIME	1.21E-05	2.22E-05	0.543139	0.5870
D10*TIME	-1.43E-05	2.12E-05	-0.675025	0.4997
D11*TIME	-3.09E-05	2.31E-05	-1.335244	0.1818
D12*TIME	-1.98E-05	2.32E-05	-0.851345	0.3946
AVG_SLC(-1)	0.774605	0.004468	173.3575	0.0000

R-squared	0.929073	Mean dependent var	52.74790
Adjusted R-squared	0.928993	S.D. dependent var	18.66817
S.E. of regression	4.974534	Akaike info criterion	6.047720
Sum squared resid	523600.5	Schwarz criterion	6.057115
Log likelihood	-64032.45	Hannan-Quinn criter.	6.050785
F-statistic	11548.48	Durbin-Watson stat	1.737992
Prob(F-statistic)	0.000000	Wald F-statistic	14968.50
Prob(Wald F-statistic)	0.000000		

SLC Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_SLC
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.87325	0.342115	52.24339	0.0000
TIME	-0.000178	1.77E-05	-10.01339	0.0000
D1	-7.688052	0.453260	-16.96169	0.0000
D2	-6.797434	0.385310	-17.64149	0.0000
D3	-5.776288	0.426163	-13.55418	0.0000
D4	-4.240485	0.407060	-10.41734	0.0000
D5	-2.130001	0.396504	-5.371948	0.0000
D6	-0.946553	0.397036	-2.384048	0.0171
D8	-0.435885	0.385472	-1.130780	0.2582
D9	-1.052899	0.397303	-2.650118	0.0081
D10	-2.634868	0.473530	-5.564314	0.0000
D11	-6.656500	0.439406	-15.14886	0.0000
D12	-8.411048	0.398709	-21.09569	0.0000
D1*TIME	8.57E-05	3.33E-05	2.576065	0.0100
D2*TIME	0.000104	2.87E-05	3.611030	0.0003
D3*TIME	0.000133	3.13E-05	4.229692	0.0000
D4*TIME	8.29E-05	3.03E-05	2.740054	0.0061
D5*TIME	2.06E-05	3.03E-05	0.679808	0.4966
D6*TIME	5.08E-05	3.04E-05	1.673313	0.0943
D8*TIME	3.76E-06	2.81E-05	0.133721	0.8936
D9*TIME	1.49E-05	3.05E-05	0.488764	0.6250
D10*TIME	2.99E-05	3.47E-05	0.862010	0.3887
D11*TIME	0.000144	3.20E-05	4.495262	0.0000
D12*TIME	0.000122	2.73E-05	4.455612	0.0000
DTR_SLC(-1)	0.442952	0.007672	57.73460	0.0000

R-squared	0.470649	Mean dependent var	22.98353
Adjusted R-squared	0.470049	S.D. dependent var	7.940032
S.E. of regression	5.780166	Akaike info criterion	6.347921
Sum squared resid	706928.8	Schwarz criterion	6.357316
Log likelihood	-67212.18	Hannan-Quinn criter.	6.350986
F-statistic	783.8577	Durbin-Watson stat	2.041071
Prob(F-statistic)	0.000000	Wald F-statistic	688.8892
Prob(Wald F-statistic)	0.000000		

SLC Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_SLC
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.60867	1.295957	10.50087	0.0000
TIME	-8.28E-05	9.58E-05	-0.864800	0.3872
D1	18.09822	3.382826	5.350028	0.0000
D2	10.14726	2.162444	4.692493	0.0000
D3	12.58087	2.410701	5.218760	0.0000
D4	14.67685	2.383260	6.158310	0.0000
D5	11.38431	2.496044	4.560941	0.0000
D6	5.560412	2.188839	2.540348	0.0111
D8	3.666125	2.457180	1.492005	0.1357
D9	11.61027	2.587468	4.487115	0.0000
D10	8.721948	2.577652	3.383679	0.0007
D11	7.392774	2.212941	3.340701	0.0008
D12	12.13896	3.041847	3.990652	0.0001
D1*TIME	-0.000537	0.000278	-1.932680	0.0533
D2*TIME	-0.000114	0.000169	-0.676151	0.4990
D3*TIME	-2.40E-05	0.000188	-0.127530	0.8985
D4*TIME	0.000261	0.000216	1.207461	0.2273
D5*TIME	0.000227	0.000191	1.191765	0.2334
D6*TIME	0.000511	0.000190	2.682730	0.0073
D8*TIME	-0.000128	0.000189	-0.678551	0.4974
D9*TIME	-7.97E-05	0.000212	-0.375631	0.7072
D10*TIME	4.66E-05	0.000199	0.234444	0.8146
D11*TIME	0.000271	0.000182	1.487802	0.1368
D12*TIME	-3.67E-05	0.000226	-0.162452	0.8710
E2_AVG_SLC(-1)	0.079979	0.008473	9.438963	0.0000

R-squared	0.022544	Mean dependent var	24.71221
Adjusted R-squared	0.021436	S.D. dependent var	41.21924
S.E. of regression	40.77507	Akaike info criterion	10.25520
Sum squared resid	35177423	Schwarz criterion	10.26459
Log likelihood	-108592.9	Hannan-Quinn criter.	10.25826
F-statistic	20.33310	Durbin-Watson stat	2.006258
Prob(F-statistic)	0.000000	Wald F-statistic	21.37933
Prob(Wald F-statistic)	0.000000		

SLC Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_SLC
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	34.79991	2.049202	16.98217	0.0000
TIME	-0.000708	0.000147	-4.810128	0.0000
D1	0.332732	3.619821	0.091920	0.9268
D2	-9.222315	2.806631	-3.285902	0.0010
D3	0.861812	3.058442	0.281782	0.7781
D4	13.28118	3.948518	3.363587	0.0008
D5	8.360817	3.409282	2.452369	0.0142
D6	3.640954	3.137571	1.160437	0.2459
D8	-2.224634	2.882226	-0.771846	0.4402
D9	1.429747	3.157547	0.452803	0.6507
D10	4.920049	3.522847	1.396611	0.1625
D11	-4.335200	3.147759	-1.377234	0.1685
D12	-5.596291	2.800700	-1.998176	0.0457
D1*TIME	1.88E-05	0.000265	0.071037	0.9434
D2*TIME	0.000751	0.000216	3.473086	0.0005
D3*TIME	0.000613	0.000231	2.656762	0.0079
D4*TIME	0.000293	0.000324	0.905512	0.3652
D5*TIME	0.000284	0.000245	1.160657	0.2458
D6*TIME	0.000379	0.000234	1.617812	0.1057
D8*TIME	6.23E-05	0.000210	0.297198	0.7663
D9*TIME	0.000381	0.000234	1.630166	0.1031
D10*TIME	0.000138	0.000262	0.526679	0.5984
D11*TIME	0.000616	0.000241	2.558941	0.0105
D12*TIME	0.000356	0.000210	1.697554	0.0896
E2_DTR_SLC(-1)	0.050174	0.009228	5.437107	0.0000

R-squared	0.020534	Mean dependent var	33.36957
Adjusted R-squared	0.019423	S.D. dependent var	48.19653
S.E. of regression	47.72618	Akaike info criterion	10.57002
Sum squared resid	48193440	Schwarz criterion	10.57941
Log likelihood	-111927.3	Hannan-Quinn criter.	10.57308
F-statistic	18.48197	Durbin-Watson stat	2.000356
Prob(F-statistic)	0.000000	Wald F-statistic	17.29141
Prob(Wald F-statistic)	0.000000		

TUS Joint Conditional Mean Regression, AVG

Dependent Variable: AVG_TUS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.69234	0.353937	49.98722	0.0000
TIME	2.76E-05	9.02E-06	3.062295	0.0022
D1	-7.163316	0.244219	-29.33158	0.0000
D2	-6.577785	0.259276	-25.36983	0.0000
D3	-5.848010	0.254256	-23.00052	0.0000
D4	-4.265228	0.230099	-18.53651	0.0000
D5	-2.441623	0.202736	-12.04334	0.0000
D6	-0.528472	0.182280	-2.899234	0.0037
D8	-0.455494	0.138481	-3.289222	0.0010
D9	-1.513788	0.169661	-8.922451	0.0000
D10	-3.808057	0.221808	-17.16823	0.0000
D11	-5.886261	0.243572	-24.16639	0.0000
D12	-7.251388	0.245628	-29.52182	0.0000
D1*TIME	9.02E-06	1.66E-05	0.543717	0.5866
D2*TIME	1.55E-05	1.93E-05	0.805221	0.4207
D3*TIME	4.64E-05	1.79E-05	2.591164	0.0096
D4*TIME	2.68E-05	1.71E-05	1.570292	0.1164
D5*TIME	2.72E-05	1.63E-05	1.662988	0.0963
D6*TIME	3.25E-05	1.49E-05	2.181916	0.0291
D8*TIME	1.51E-05	1.21E-05	1.252079	0.2106
D9*TIME	1.87E-05	1.36E-05	1.370308	0.1706
D10*TIME	2.30E-05	1.71E-05	1.349064	0.1773
D11*TIME	8.14E-06	1.85E-05	0.439507	0.6603
D12*TIME	1.68E-06	1.72E-05	0.097500	0.9223
AVG_TUS(-1)	0.792316	0.003967	199.7301	0.0000

R-squared	0.933449	Mean dependent var	69.25057
Adjusted R-squared	0.933374	S.D. dependent var	14.12647
S.E. of regression	3.646332	Akaike info criterion	5.426500
Sum squared resid	281324.5	Schwarz criterion	5.435895
Log likelihood	-57452.49	Hannan-Quinn criter.	5.429565
F-statistic	12365.79	Durbin-Watson stat	1.689406
Prob(F-statistic)	0.000000	Wald F-statistic	18357.55
Prob(Wald F-statistic)	0.000000		

TUS Joint Conditional Mean Regression, DTR

Dependent Variable: DTR_TUS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/02/1960 12/31/2017
Included observations: 21184 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.43571	0.255499	48.67220	0.0000
TIME	-1.44E-05	1.61E-05	-0.889374	0.3738
D1	0.002906	0.405695	0.007163	0.9943
D2	0.774042	0.374876	2.064794	0.0390
D3	1.241534	0.358866	3.459605	0.0005
D4	2.809394	0.317329	8.853256	0.0000
D5	3.309705	0.279960	11.82208	0.0000
D6	3.161722	0.307328	10.28777	0.0000
D8	-0.421190	0.270384	-1.557750	0.1193
D9	0.107870	0.333325	0.323619	0.7462
D10	0.822989	0.349958	2.351678	0.0187
D11	0.472137	0.345159	1.367881	0.1714
D12	-0.043929	0.413605	-0.106211	0.9154
D1*TIME	5.26E-05	3.32E-05	1.584369	0.1131
D2*TIME	3.17E-05	3.23E-05	0.981525	0.3263
D3*TIME	5.28E-05	2.79E-05	1.895662	0.0580
D4*TIME	-2.06E-06	2.47E-05	-0.083396	0.9335
D5*TIME	-1.48E-05	2.23E-05	-0.661037	0.5086
D6*TIME	-8.69E-06	2.43E-05	-0.357886	0.7204
D8*TIME	1.41E-05	2.18E-05	0.647245	0.5175
D9*TIME	2.61E-05	2.67E-05	0.979468	0.3274
D10*TIME	5.16E-05	2.74E-05	1.884351	0.0595
D11*TIME	6.99E-05	2.80E-05	2.500878	0.0124
D12*TIME	4.36E-05	3.21E-05	1.354749	0.1755
DTR_TUS(-1)	0.508269	0.006638	76.57422	0.0000

R-squared	0.345670	Mean dependent var	27.61358
Adjusted R-squared	0.344928	S.D. dependent var	6.822445
S.E. of regression	5.521851	Akaike info criterion	6.256483
Sum squared resid	645155.7	Schwarz criterion	6.265878
Log likelihood	-66243.67	Hannan-Quinn criter.	6.259548
F-statistic	465.7450	Durbin-Watson stat	1.997514
Prob(F-statistic)	0.000000	Wald F-statistic	462.6501
Prob(Wald F-statistic)	0.000000		

TUS Joint Conditional Variance Regression, AVG

Dependent Variable: E2_AVG_TUS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.215543	0.537294	13.42941	0.0000
TIME	3.73E-05	4.40E-05	0.847733	0.3966
D1	9.252778	1.453033	6.367905	0.0000
D2	8.079570	1.323707	6.103743	0.0000
D3	11.89912	1.342194	8.865429	0.0000
D4	11.04992	1.693287	6.525721	0.0000
D5	5.279525	1.318872	4.003060	0.0001
D6	0.215097	0.851602	0.252579	0.8006
D8	-2.746006	0.693506	-3.959600	0.0001
D9	0.272095	1.002688	0.271365	0.7861
D10	6.450070	1.574218	4.097318	0.0000
D11	9.728652	1.400171	6.948189	0.0000
D12	7.544556	1.570071	4.805232	0.0000
D1*TIME	-0.000163	0.000121	-1.349179	0.1773
D2*TIME	7.65E-05	0.000123	0.619566	0.5356
D3*TIME	-0.000172	0.000110	-1.563390	0.1180
D4*TIME	6.68E-06	0.000142	0.047101	0.9624
D5*TIME	-5.55E-05	0.000106	-0.522671	0.6012
D6*TIME	-7.65E-05	6.66E-05	-1.147634	0.2511
D8*TIME	0.000139	6.44E-05	2.165271	0.0304
D9*TIME	-7.61E-05	7.55E-05	-1.008414	0.3133
D10*TIME	-0.000103	0.000119	-0.865315	0.3869
D11*TIME	-8.59E-05	0.000111	-0.774750	0.4385
D12*TIME	0.000149	0.000119	1.245371	0.2130
E2_AVG_TUS(-1)	0.031655	0.007785	4.066037	0.0000

R-squared	0.035940	Mean dependent var	13.28001
Adjusted R-squared	0.034847	S.D. dependent var	25.01946
S.E. of regression	24.57967	Akaike info criterion	9.242896
Sum squared resid	12782822	Schwarz criterion	9.252291
Log likelihood	-97871.13	Hannan-Quinn criter.	9.245961
F-statistic	32.86534	Durbin-Watson stat	2.001103
Prob(F-statistic)	0.000000	Wald F-statistic	48.44055
Prob(Wald F-statistic)	0.000000		

TUS Joint Conditional Variance Regression, DTR

Dependent Variable: E2_DTR_TUS
Method: Least Squares
Date: 07/01/19 Time: 10:23
Sample (adjusted): 1/03/1960 12/31/2017
Included observations: 21183 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 14.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.35789	1.552208	11.82695	0.0000
TIME	-1.90E-05	0.000119	-0.159701	0.8731
D1	22.93794	3.217431	7.129274	0.0000
D2	20.63349	3.284464	6.282146	0.0000
D3	24.84630	3.010642	8.252824	0.0000
D4	18.38531	3.202845	5.740305	0.0000
D5	5.568027	2.437143	2.284653	0.0223
D6	-0.259775	2.286819	-0.113597	0.9096
D8	-4.621723	1.867100	-2.475349	0.0133
D9	0.115488	2.239157	0.051576	0.9589
D10	8.625928	2.467382	3.495984	0.0005
D11	13.20993	2.799227	4.719135	0.0000
D12	20.30402	3.071102	6.611315	0.0000
D1*TIME	4.86E-05	0.000259	0.187195	0.8515
D2*TIME	0.000371	0.000276	1.342759	0.1794
D3*TIME	-9.15E-05	0.000250	-0.365404	0.7148
D4*TIME	3.76E-05	0.000248	0.151537	0.8796
D5*TIME	0.000134	0.000199	0.674674	0.4999
D6*TIME	0.000106	0.000183	0.580634	0.5615
D8*TIME	0.000301	0.000154	1.953836	0.0507
D9*TIME	0.000303	0.000184	1.650888	0.0988
D10*TIME	2.66E-06	0.000189	0.014097	0.9888
D11*TIME	0.000161	0.000224	0.721540	0.4706
D12*TIME	0.000204	0.000240	0.849063	0.3959
E2_DTR_TUS(-1)	0.005100	0.006915	0.737508	0.4608

R-squared	0.042034	Mean dependent var	30.45625
Adjusted R-squared	0.040948	S.D. dependent var	48.32506
S.E. of regression	47.32532	Akaike info criterion	10.55315
Sum squared resid	47387270	Schwarz criterion	10.56254
Log likelihood	-111748.7	Hannan-Quinn criter.	10.55621
F-statistic	38.68292	Durbin-Watson stat	2.000578
Prob(F-statistic)	0.000000	Wald F-statistic	47.27854
Prob(Wald F-statistic)	0.000000		