**📊 Parameter Drift Analysis by Variable**

**1. (Intercept)**

* **Significant fluctuations** across nearly the entire time span.
* **Sharp drops** below the confidence band around **2006–2008**, **2014**, and **2020–2022**, suggesting structural shifts in the data or model bias changing.
* Indicates instability in baseline predictions over time.

**2. avg\_income**

* **Downward trend** in coefficient value from **2005 onward**, with the estimate hovering near zero after 2015.
* **Confidence intervals** include the original estimate for most of the timeline but begin to **narrow and drift downward** after 2018, indicating a **decreasing importance** of this variable in the model.

**3. credit\_limit**

* Shows **oscillating behavior** with frequent drops **below zero** (negative impact).
* **Material dips** and sharp volatility from **2007–2009**, **2014**, and again **2020–2022**, with some intervals excluding the original coefficient.
* Indicates **instability and potential non-linear behavior** over time.

**4. density**

* **Consistent decline** in coefficient values from **2002 to ~2016**, flattening out afterward.
* Narrower confidence intervals in recent years, but values now hover around **0.5–1.0**, far below the **initial estimate (~1.8–2.0)**.
* Suggests **declining predictive power** of population density.

**5. fico**

* Exhibits **strong fluctuations**, with coefficient values ranging between **10 and 70**.
* **Major peaks** in **2009, 2014, 2017, and 2021**, where confidence intervals likely exclude earlier years' values.
* Suggests **parameter instability**; FICO score influence has been **volatile** due to economic shifts or scoring changes.

**6. fico\_missing**

* Very **high parameter values**, ranging from **10,000 to over 50,000**.
* **Large volatility** in 2008–2009, 2015–2016, and again 2020–2022.
* **Consistently high impact**, but estimates drift considerably—indicates that **missingness itself became a stronger signal** over time.

**7. homeownershipRent**

* Coefficients remain **negative throughout**, indicating a **consistent negative association** of renting vs owning.
* Some **shifts observed in 2007, 2015, and 2020**, though estimates stay largely within the same band.
* Reflects modest but stable negative contribution.

**8. income**

* Consistently **negative coefficients**.
* Estimate hovers around **-0.05 to -0.01**, with **mild variation** over time.
* Confidence intervals narrow post-2015, suggesting the variable’s effect has **stabilized**, though **slightly weakened**.

**9. num\_late**

* Estimates fluctuate around **1800 to 2200**.
* Sharp drop in **2020**, suggesting a **reduced impact** of late payments during or just after the COVID pandemic.
* Otherwise relatively stable, though confidence bands widen during key volatility periods.

**10. past\_def**

* Moderate fluctuations between **500 and 2000** over time.
* Sharp **drops near 2009, 2017, and 2021**, which may reflect changing patterns in default risk behavior.
* Confidence intervals suggest some significant drifts during these years.

**11. num\_bankruptcy**

* Coefficients show a **general upward trend** from **2002 to around 2018**, peaking above **4000–6000**.
* Notable **dips in 2009 and 2020**, where confidence intervals narrow and briefly include the zero line, indicating possible reduction in predictive strength.
* Sharp **peak around 2021**, suggesting a sudden and strong increase in the variable’s predictive power, likely influenced by economic stressors post-pandemic.
* Confidence intervals **exclude the original estimate** at multiple points (especially 2015–2022), signaling significant **parameter instability**.

🟡 **Interpretation**:

* The number of bankruptcies has become **increasingly influential** over time, though the pattern shows **instability** during periods of macroeconomic stress (e.g., Great Recession, COVID-19 aftermath).

EXCESS DATA

**1. (Intercept)**

* **Significant deviations** in:
  + **2006–2008**, **2013–2016**, **2020–2022**
* The confidence intervals **exclude zero**, especially during 2015–2016 and 2020, indicating the model may be **consistently over- or under-predicting** regardless of other variables.

**2. avg\_income**

* **Material deviations** occur:
  + **2003–2005** (spikes)
  + **2014–2019** (steady positive excess)
* Confidence intervals consistently exclude zero, suggesting **increasing importance** of income during those periods in differentiating predictions.

**3. credit\_limit**

* Deviations visible in:
  + **2007–2009**, **2014–2016**, **2019–2021**
* Positive excess predictive value means the variable’s influence **strengthened** during these years.
* Intervals exclude zero in many places → indicates the need for **possible reweighting** of credit\_limit.

**4. density**

* **Sustained positive deviation** from around **2005 through 2023**.
* Confidence intervals **exclude zero throughout** most of this period → suggests **underestimated importance** of population density in the original model.

**5. fico**

* **Negative excess values** dominate, with large dips in:
  + **2006–2009**, **2013–2016**, **2019–2022**
* Confidence intervals exclude zero frequently, indicating that **FICO may have a stronger (negative) influence** than modeled.

**6. fico\_missing**

* **Large negative deviations** in:
  + **2005, 2010, 2015, and 2020**
* Excess values dip significantly (e.g., -40,000), suggesting **missing FICO is a powerful predictor** that is **underestimated** by the model.

**7. homeownershipRent**

* Mostly **negative values**, especially:
  + **2009–2011**, **2015–2020**
* Confidence intervals often exclude zero, suggesting **renters are consistently associated with lower predicted outcomes**, more than originally modeled.

**8. income**

* **Persistent negative deviation** from **2005 onward**.
* Confidence bands exclude zero in multiple years, especially **2010–2015**.
* Suggests **income has a stronger negative association** with outcome than the original model reflects.

**9. num\_bankruptcy**

* Spikes in **2010**, **2015–2017**, and **2021**.
* Confidence intervals exclude zero in these periods.
* Indicates that **bankruptcy status fluctuated in predictive strength** and may need **dynamic reweighting**.

**10. num\_late**

* Negative excess observed in:
  + **2006–2008**, **2014**, and a **sharp swing post-2020**
* Confidence intervals exclude zero in several periods.
* Indicates that the number of late payments is **not fully captured** by the original model weighting.

**11. past\_def**

* **Significant deviations** occur in:
  + **2005–2006**, **2010–2012**, and **2020–2022**.
* Confidence intervals **exclude zero** during these periods, indicating that the **predictive influence of prior defaults fluctuated** significantly over time.
* Notably **sharp positive spikes** around **2020**, suggesting this variable became more influential post-pandemic.

🟡 **Interpretation**:

* The contribution of past defaults has been **inconsistent**, rising in importance during **economic shocks** or **credit behavior shifts**.
* May need **re-calibration or dynamic weighting** in the model to improve accuracy.