Stability of preferences and personality: New evidence from developing and developed countries.

Buly Cardak (La Trobe), Edwin Ip (Monash), Nicolas Salamanca (Melbourne), Joe Vecci (Gothenburg)

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Introduction

What do we mean by stability?

- **Strict definition**: Preferences are stable over time (Schildberg-Hrisch, 2018, JEP)
- Assume we are interested in risk preferences
  - Implies that, in the absence of measurement error, one should observe the same willingness to take risks when measuring an individual’s risk preferences repeatedly over time.
- Conditional or unconditional stability: control for observable characteristics i.e. stability conditional on characteristics such as income?
A common assumption in economics (psychology, management and marketing) is that preferences are static primitives fixed over time

- Convenient for modeling (tractability)
  - Critical for welfare analysis (ceteris paribus) and policy
- Convenient for empirical work (no simultaneity)

However, preferences could change...

- ... due to events in people’s lives
- ... naturally over time
- ... or because they are measured with error (i.e., they only seem to change)
Introduction

- Despite the importance of this topic it is difficult to estimate the dynamic properties of preferences.
  - Difficult with observational data
  - Experimental data is limited
  - Requires panel data with measured preferences
  - Measurement error
Three main methods of analysing preference stability

1 Levels: \( preference_t = f(\text{characteristics}) \)

   e.g, Malmendier and Nagel 2011; Dohmen et al., 2011, 2012
   ▶ Method better suited to analysing heterogeneity of preferences
   ▶ Method is silent about stability
2 Changes: $\Delta preference_t = f(characteristics)$

- e.g., Cobb-Clark and Schurer, 2012, 2013; Carlsson et al, 2014; Guiso et al., (forthcoming)
  - Model examines the characteristics that impact change.
  - Not the same as stability especially in models with bad fit (e.g., $R^2 < 0.05$)
  - Cannot differentiate unexplained variance in preference from noise
  - Does not formally test stability
3 Test-retest (psychology): $preference_t = f(preference_{t-k})$

- e.g., Fraley and Roberts, 2005; Meier and Sprenger, 2015; Chuang and Schechter, 2015
  - Measures the amount preferences in the past explain current preferences.
  - Current models do not clearly define a null hypothesis to test against
  - Not able to separate changes due to measurement error
  - Results could reflect both measurement error and predictable changes due to background characteristics
  - Mostly small non-representative datasets measuring short term changes e.g, Meier and Sprenger, (2015) use data from 2007-2008
Measurement Error

- Meier and Sprenger, 2015 find "a high correlation at the individual level, (but) there remains instability....largely independent of demographics and situational changes, potentially attributable to error"

- Similarly, Chuang and Schechter, 2015 argue that variability in preferences maybe mostly due to noise- ‘data seems too noisy to estimate stability”

- Frederick, Loewenstein, and ODonoghue 2002 review the time preference literature

- Discount rates ranging from 0 percent to thousands of percent per annum.

  - They argue that differences may be due to measurement error.
What do we do?

We contribute to this literature in the following ways:

- We develop a model to test stability of preferences
- The model can
  - Formally test for the time stability of preferences
    - Empirically confirm or reject the stability assumption
  - Estimate the variance of idiosyncratic shocks
  - Estimate and account for measurement error
    - Can select measures with lowest measurement error
What do we do?

- Using this model we test risk and time preferences, the Big Five personality traits, trust and locus of control
- In Australia, Germany, Netherlands, United States, Thailand, Vietnam and Kyrgyzstan
  - Use nationally representative panel datasets
  - Over 140,000 individuals
  - Over 4-20 years
  - Most comprehensive analysis on the topic
What do we do?

- Important contribution is the analysis of both developed and developing countries
  - Stability could differ between these two groups for a number of reasons- more shocks in developing countries
  - Many program in developing countries attempt to change preferences (either explicitly or implicitly)
  - Its important to understand the malleability of preferences
The Model
Model

\[ P_{it} = P_{it}^* + \varepsilon_{it} \quad (1) \]

\[ P_{it}^* = \alpha P_{i,t-1}^* + g(X_{it}) + \eta_{it} \quad (2) \]

where

- \( P_{it} \equiv \) person \( i \)'s measured level of preference at time \( t \)
- \( P_{it}^* \equiv \) latent preferences
- \( g(X_{it}) \equiv \) observable characteristics
- \( \eta_{it} \equiv \) idiosyncratic shocks to preferences
- \( \varepsilon_{it} \equiv \) measurement error

Eq 2 defines the evolution of latent preferences \( P_{it}^* \) as an AR(1) autoregressive process with a drift \( g(X_{it}) \).
First, replace (2) into (1)

\[ P_{it} = \alpha P_{i,t-1} + g(X_{it}) + \{\eta_{it} + \varepsilon_{it} - \alpha \varepsilon_{i,t-1}\} \] (3)

All elements are observable.

1. The autoregressive parameter \( \alpha \) shows the intra-individual stability of \( P_{it} \), i.e., past to present.

2. \( g(X_{it}) \) (drift) allows preferences to tend towards a conditional mean level determined by observables.
   - Think of this as the level to which preferences tend to once autocorrelation has been accounted.
First, replace (2) into (1)

\[ P_{it} = \alpha P_{i,t-1} + g(X_{it}) + \{\eta_{it} + \varepsilon_{it} - \alpha \varepsilon_{i,t-1}\} \]  (3)

- \( X_{it} \) will capture factors that impact the conditional level to which preferences tend

3 \( \eta_{it} \) are the idiosyncratic shocks i.e the importance of conditional variation in latent preferences

4 \( \varepsilon_{it} \) will quantify the measurement error
To find variance of idiosyncratic shocks ($\sigma^2_\eta$), and of measurement error ($\sigma^2_\epsilon$):

1. It is easier to work with $\tilde{P}_{it}$, which is $P^*_{it}$ net of $g(X_{it})$.
2. With some algebra

\[
\text{Var}(\tilde{P}_{i,t+k} - (\hat{\alpha}^k)\tilde{P}_{it} | \tilde{X}_i, t+k) = \sigma^2_\eta \sum_{j=0}^{k} \hat{\alpha}^{2j} + \sigma^2_\epsilon (\hat{\alpha}^{2k}+1); \ k = 1, ..., K
\]  

(4)

▶ Working

3. Then solve a 2-unknown, $K \geq$ equation system
Estimation

Estimation in a two-step process:

1. GMM IV: \[ P_{it} = \alpha P_{i,t-1} + g(X_{it}) + e_{it} \]
   - **OLS is biased** since \( P_{i,t-1} \) and \( e_{i,t-1} \) are correlated
   - To obtain consistent estimates of the parameters we use the moment conditions implied in a Generalised Method of Moments (GMM) IV approach
   - \( P_{i,t-1} \) is instrumented by further lags
   - Similar to a test retest correlation, but is not attenuated by measurement error and nets out predictable variation due to observable characteristics
   - Standardise all measures
Test whether $\alpha = 1$ i.e stability

Interpretation of $\alpha = 1$

- If compared to a test-retest correlation $\alpha = 1$ would imply perfect correlation over time and full stability.
To estimate the variance of the errors:

2 Non-linear regression:

\[
\text{Var}(\tilde{P}_{i,t+k} - (\hat{\alpha}^k)\tilde{P}_{it}|X_i, t+k) = e^{\ln(\sigma^2_\eta)} \sum_{j=0}^{k} \hat{\alpha}^{2j} + e^{\ln(\sigma^2_\varepsilon)} (\hat{\alpha}^{2k} + 1) + v_k;
\]

\[k = 1, ..., K\]

with nonparametric bootstrap standard errors
We also estimate a noise to signal ratio following Cameron and Trivedi, 2005, p903.

- A comparable metric of the amount of measurement error in preferences across models
- Since $P_{it}$ can be standardised to have unit variance we can estimate

$$s = \frac{\sigma^2_\varepsilon}{(1 - \sigma^2_\varepsilon)} \quad (6)$$
1 Household, Income and Labour Dynamics in Australia (HILDA)

- Unbalanced yearly representative panel of Australian households
- Use data from 2001 to 2016. Approx 5,000 individuals per wave.
- Risk
  - Question on financial risk.
    - Risk elicited 13 times
2 Dutch National Bank Household Survey
   ▶ Unbalanced representative yearly panel of Dutch households since 1993
   ▶ Risk aversion index
      ▶ 6 items, 1994-2015, 2,894 individuals
3 German Socio-Economic Panel study

- Unbalanced representative panel of German households since 1984
- Use data from 2004-2015, approx 4,400 individuals per year.
- **Risk:**
  - Question “Are you generally a person who is fully prepared to take risks, or do you try to avoid taking risks?”
  - Response on a scale 0 (unwilling)-10 (fully prepared)
  - Experimentally validated by Dohmen et al (2011)

- **Trust**
  - Q: ”One can trust other people”
  - 5 point scale
4 US: American Life Panel
   - Unbalanced representative panel of US households collected by RAND
   - Use data from 2008-2011, 3 waves, approx 1,252 individuals per year
   - **Risk:**
     - Same question as GSOEP
5 Thailand Socio Economic Panel
   ▶ Funded by the German government and run by Leibniz University Hannover
   ▶ Risk:
      ▶ Same question as GSOEP

6 Vietnamese Socio Economic Panel
   ▶ Risk:
      ▶ Same question as GSOEP
Data

7 Life in Kyrgyzstan

- Panel representative of Kyrgyzstan, 4 waves (2010-2013), 3000 households and 8000 individuals per wave.
- Low income country (World Bank)
- Collected by DIW Berlin and Humboldt
- Risk and Trust:
  - Same questions as GSOEP
Data: Summary

<table>
<thead>
<tr>
<th></th>
<th>Risk</th>
<th>Patience</th>
<th>Trust</th>
<th>Big 5</th>
<th>Locus of Control</th>
<th>Alturism</th>
</tr>
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<tbody>
<tr>
<td>Australia</td>
<td>Y</td>
<td></td>
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<td>Y</td>
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<tr>
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<td>Kyrgyzstan</td>
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<td>Y</td>
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</tr>
</tbody>
</table>

- Controls for all data include: gender, age, income, education, employment and marital status
Results

Risk
## Risk: Developed Countries, GMM IV

<table>
<thead>
<tr>
<th></th>
<th>Aus Risk (1)</th>
<th>Aus Risk (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged risk aversion ($\alpha$)</td>
<td>0.963</td>
<td>0.949</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>$H_0: \alpha = 1$</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Corrected risk aversion ($\alpha$)</td>
<td>0.963</td>
<td>0.949</td>
</tr>
<tr>
<td></td>
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<td>(0.008)</td>
</tr>
<tr>
<td>$H_0: \alpha = 1$</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Idiosyncratic var. ($\sigma^2_\eta$)</td>
<td>0.080</td>
<td>0.083</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Measurement error var. ($\sigma^2_\varepsilon$)</td>
<td>0.391</td>
<td>0.390</td>
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<tr>
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<tr>
<td>Noise to signal ratio</td>
<td>0.643</td>
<td>0.640</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Controls</td>
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</tr>
<tr>
<td>Ho: joint sig. controls</td>
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<tr>
<td>Obs.</td>
<td>67,378</td>
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## Risk: Developed Countries, GMM IV

<table>
<thead>
<tr>
<th></th>
<th>Aus Risk (1)</th>
<th>Dutch Risk (2)</th>
<th>German Risk (3)</th>
<th>US Risk (4)</th>
<th>(5)</th>
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<th>(8)</th>
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<tbody>
<tr>
<td>Lagged risk aversion ($\alpha$)</td>
<td>0.963 (0.007)</td>
<td>0.949 (0.008)</td>
<td>0.970 (0.011)</td>
<td>0.966 (0.010)</td>
<td>0.992 (0.007)</td>
<td>0.992 (0.008)</td>
<td>1.027 (0.058)</td>
<td>0.944 (0.059)</td>
</tr>
<tr>
<td>$H_0: \alpha = 1$</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.012]</td>
<td>[0.018]</td>
<td>[0.176]</td>
<td>[0.217]</td>
<td>[0.636]</td>
<td>[0.346]</td>
</tr>
<tr>
<td>Corrected risk aversion ($\alpha$)</td>
<td>0.963 (0.007)</td>
<td>0.949 (0.008)</td>
<td>0.970 (0.008)</td>
<td>0.966 (0.011)</td>
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<td>[0.000]</td>
<td>[0.012]</td>
<td>[0.018]</td>
<td>[0.176]</td>
<td>[0.217]</td>
<td>[0.636]</td>
<td>[0.346]</td>
</tr>
<tr>
<td>Idiosyncratic var. ($\sigma^2_\eta$)</td>
<td>0.080 (0.000)</td>
<td>0.083 (0.000)</td>
<td>0.047 (0.012)</td>
<td>0.048 (0.012)</td>
<td>0.071 (0.000)</td>
<td>0.057 (0.000)</td>
<td>0.000 (0.000)</td>
<td>0.000 (0.000)</td>
</tr>
<tr>
<td>Measurement err. var. ($\sigma^2_\varepsilon$)</td>
<td>0.391 (0.000)</td>
<td>0.390 (0.000)</td>
<td>0.296 (0.012)</td>
<td>0.296 (0.012)</td>
<td>0.378 (0.000)</td>
<td>0.378 (0.000)</td>
<td>0.476 (0.025)</td>
<td>0.480 (0.003)</td>
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<td>Noise to signal ratio</td>
<td>0.643 (0.000)</td>
<td>0.640 (0.000)</td>
<td>0.418 (0.023)</td>
<td>0.418 (0.023)</td>
<td>0.607 (0.000)</td>
<td>0.607 (0.000)</td>
<td>0.909 (0.091)</td>
<td>0.923 (0.011)</td>
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<td>10,404</td>
<td>44,386</td>
<td>44,386</td>
<td>1,252</td>
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OLS
Risk: Dutch Data

**OLS**

**IV-GMM**

The graphs show the relationship between the autoregressive parameter ($\omega$) and the year-difference autocorrelation. The dashed line represents the predicted values, while the diamonds denote the actual values. The graphs are labeled as follows:

- OLS: Predicted and Actual values are plotted for the autoregressive parameter against the year-difference autocorrelation.
- IV-GMM: Predicted and Actual values are plotted similarly.

The y-axis represents the autoregressive parameter ($\omega$), and the x-axis represents the year-difference autocorrelation.
<table>
<thead>
<tr>
<th></th>
<th>Thai Risk</th>
<th>Viet Risk</th>
<th>Kyrg Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
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<tr>
<td>Lagged risk aversion ($\alpha$)</td>
<td>0.385 (0.208)</td>
<td>0.350 (0.234)</td>
<td>0.117 (0.079)</td>
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<td>[0.001]</td>
<td>[0.003]</td>
<td>[0.000]</td>
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<td>Corrected risk aversion ($\alpha$)</td>
<td>0.727 (0.131)</td>
<td>0.705 (0.157)</td>
<td>0.490 (0.079)</td>
</tr>
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<td>$H_0 : \alpha = 1$</td>
<td>[0.001]</td>
<td>[0.003]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Idiosyncratic var. ($\sigma_{\eta}^2$)</td>
<td>1.215 (0.000)</td>
<td>2.289 (0.000)</td>
<td>55.523 (0.000)</td>
</tr>
<tr>
<td>Measurement error var. ($\sigma_\epsilon^2$)</td>
<td>0.785 (0.000)</td>
<td>0.684 (0.000)</td>
<td>0.224 (0.000)</td>
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<td>Noise to signal ratio</td>
<td>3.645 (0.000)</td>
<td>2.164 (0.000)</td>
<td>0.289 (0.000)</td>
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Results

Trust
## Trust

<table>
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<tr>
<th></th>
<th>German Trust</th>
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<th>Kyrg Trust</th>
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<tbody>
<tr>
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<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Lagged trust ($\alpha$)</td>
<td>0.909</td>
<td>0.906</td>
<td>1.154</td>
<td>1.149</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.050)</td>
<td>(0.093)</td>
<td>(0.096)</td>
</tr>
<tr>
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<td>[0.062]</td>
<td>[0.097]</td>
<td>[0.122]</td>
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<tr>
<td>Corrected trust ($\alpha$)</td>
<td>0.981</td>
<td>0.981</td>
<td>1.154</td>
<td>1.149</td>
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<tr>
<td></td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.093)</td>
<td>(0.096)</td>
</tr>
<tr>
<td>$H_0: \alpha = 1$</td>
<td>[0.000]</td>
<td>[0.062]</td>
<td>[0.097]</td>
<td>[0.122]</td>
</tr>
<tr>
<td>Idiosyncratic var. ($\sigma^2_\eta$)</td>
<td>0.196</td>
<td>0.173</td>
<td>0.255</td>
<td>0.291</td>
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<td>(0.000)</td>
</tr>
<tr>
<td>Measurement error var. ($\sigma^2_\varepsilon$)</td>
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<td>0.511</td>
<td>0.591</td>
<td>0.565</td>
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<td>Noise to signal ratio</td>
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<td>6,430</td>
<td>6,430</td>
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</table>
Robustness

- **Two important questions:**
  1. What if we assume stability when preferences are not stable?
     - For instance correlate risk at a point in time with outcomes later
  2. What is the severity of the bias when $\alpha! = 1$
Robustness

To estimate severity of bias from extrapolation of preferences

► Simulate a contemporaneous relation between an outcomes $y_t$ and preference $P_t$
  ► Simulate preferences using the data generating process evolving in equation 3 and 2
  ► Examine what happens when we increasingly use ‘stale” measures of preferences to predict outcomes $y_t$

► As we increasingly use stale preferences (move further away from the initial measure), estimates drift from the true effect.

► We can also simulate different rates of $\alpha$ in eq. 3 for each model and then estimate the extent of the bias over years.
Stale Preferences

Simulation of OLS and IV-GMM estimates of a causal effect between an outcome and preferences with an increasingly stale preference.
Conclusion

- We estimate a new model that
  - Explicitly tests for stability
  - Addresses endogenity
  - Estimate the impact of changes in observable characteristics, the variation due to idiosyncratic shocks and measurement error
- We test stability of risk and time preferences, the Big Five personality traits, altruism, trust and locus of control
- Across large, representative household panel datasets from around the world
- Generally find that preferences and traits have strong autoregressive components essentially rendering them time-invariant
- This is not true for risk in developing countries.
From equation 3, take the $k^{th}$ difference of $\tilde{P}_{it}$ and replacing recursively yielding

$$\tilde{P}_{i,t+k} - \tilde{P}_{it} = \tilde{P}_{i,t+k}^* + \varepsilon_{i,t+k} - \tilde{P}_{it}^* - \varepsilon_{it}$$

$$= \alpha \tilde{P}_{i,t+k-1}^* + \eta_{i,t+k} + \varepsilon_{i,t+k} - \tilde{P}_{it}^* - \varepsilon_{it}$$

$$\vdots$$

$$= (\alpha^k - 1) \tilde{P}_{it}^* + \sum_{j=0}^{k} \alpha^j \eta_{i,t+k-j} + \varepsilon_{i,t+k} - \varepsilon_{it}$$
Replacing for $\tilde{P}_{it}^*$ and rearranging terms and simplifying, results in:

$$\tilde{P}_{i,t+k} - (\alpha^k) \tilde{P}_{it} = \sum_{j=0}^{k} \alpha^j \eta_{i,t+k-j} - \alpha^k \varepsilon_{it} + \varepsilon_{i,t+k}$$ (7)

$$= \nu_{i,t+k}$$

$\nu_{i,t+k}$ represents the collection of all error and noise terms. The LHS is expressed in terms of observable measures of $\tilde{P}_{i,t}$ and the parameter $\alpha$ which we have a consistent estimator.
To calculate the variance take the variance of both sides of equation 7

$$\text{Var}(\tilde{P}_{i,t+k} - (\alpha^k)\tilde{P}_{it}) = \text{Var}\left(\sum_{j=0}^{k} \alpha^j \eta_{i,t+k-j} - \alpha^k \varepsilon_{it} + \varepsilon_{i,t+k}\right)$$

$$\sigma^2_{\nu,k} = \sigma^2_{\eta} \sum_{j=0}^{k} \alpha^{2j} + \sigma^2_{\varepsilon}(\alpha^{2k} + 1)$$

We can identify $\sigma^2_{\eta}$ and $\sigma^2_{\varepsilon}$ by taking two different $k$-lengths.
Model

\[
\text{Var}(\tilde{P}_{i,t+k} - (\alpha^k)\tilde{P}_{it}) = \sigma^2_\eta \sum_{j=0}^{k} \alpha^{2j} + \sigma^2_\varepsilon (\alpha^{2k} + 1); \ k = 1, \ldots, K \ (4)
\]

For \( k = 1 \) and \( k = 2 \)

\[
\sigma^2_{v,1} = (\alpha^2 + 1)(\sigma^2_\eta + \sigma^2_\varepsilon)
\]

\[
\sigma^2_{v,2} = \sum_{j=0}^{2} \alpha^{2} \sigma^2_\eta + (\alpha^4 + 1)\sigma^2_\varepsilon
\]
### OLS Risk: Developed Countries

<table>
<thead>
<tr>
<th></th>
<th>Aus OLS Risk</th>
<th>Dutch OLS Risk</th>
<th>German OLS Risk</th>
<th>US OLS Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged risk aversion ($\alpha$)</td>
<td>0.571 (0.005) [0.000]</td>
<td>0.530 (0.005) [0.000]</td>
<td>0.653 (0.017) [0.000]</td>
<td>0.641 (0.017) [0.000]</td>
</tr>
<tr>
<td>$H_0 : \alpha = 1$</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Controls</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>$H_0$: joint sig. controls</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Obs.</td>
<td>67,378</td>
<td>67,378</td>
<td>10,404</td>
<td>10,404</td>
</tr>
</tbody>
</table>

### Notes
- The table presents the results of OLS regressions for lagged risk aversion ($\alpha$) across different countries.
- The model includes lagged risk aversion as a dependent variable and other controls as independent variables.
- The table compares the risk aversion for Australian (Aus), Dutch (Dutch), German (German), and US (US) countries.
- The coefficients for lagged risk aversion ($\alpha$) are reported along with their standard errors and p-values.
- The null hypothesis $H_0 : \alpha = 1$ is tested for each country, with significance levels reported in square brackets.
- The sample sizes (Obs.) vary across the countries, with the largest sample size being 44,386 for the US OLS Risk.