# Institutions and preferences: How cotton sector governance shapes farmers' risk and time preferences in Uzbekistan

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# Problem background

- Cotton dominated the economies of most Central Asian Republics until the disintegration of the USSR
    - the Soviet cotton system in Central Asia was driven by production quotas and state-controlled pricing and value chains (Rumer, 1989)
- Following the Soviet Union's collapse in 1991, Uzbekistan inherited entire structure of the cotton production system (Shtaltovna and Hornidge, 2014)
    - the government took gradual transition keeping the control over the cotton sector (Pomfret, 2019),
    - private farms were established up until 2007
    - farm consolidation after 2008
- Since early 2018, Uzbekistan has introduced the cotton-focused “cluster system” for local production and processing (Babadjanov & Petrick, 2023)


# Problem background

- Farmers in Uzbekistan operate under two distinct institutional frameworks, depending on their location
  - **Cotton producing area**
    - subject to heavy state intervention, with
      - government-mandated production quotas,
      - price controls, and
      - restrictions on land use
  - **Horticultural producing area**
    - facing fewer interventions in land use
      - experience greater market autonomy

# Problem background

- Farmers' risk attitudes vary with policy regimes, market structures, and perceived autonomy (Garcia et al., 2024; Rommel et al., 2023).
    - higher market uncertainty combined with greater decision-making control increases crop producers' risk tolerance (Zhao & Yue, 2020).



- Studies highlight the importance of market integration, socio-economic characteristics, and institutional environments in RT preferences (e.g., Finger et al., 2023; Garcia et al., 2024).
- RT preferences affect technology adoption, investment, and sustainability outcomes in agriculture (Dessart et al., 2019).

*whether differences in farmers' **risk and time preferences** correspond to **differences in agricultural governance systems** within a country.*

# Data

- Lab-in-the-field experiments with 307 farm managers in Samarkand region of Uzbekistan
  - Lottery game to elicit respondents risk and time preferences
  - Post experiment survey


| | |
|---|---|
| Cotton-producing farmers | **177** |
| Horticulture farmers | **130** |

within the project **UzFarmBarometer**: Better Understanding of the Adoption of Sustainable Agricultural Practices

# Perceived institutional differences between cotton and non-cotton farmers in Uzbekistan

| Parameter | Cotton farmers (N=177) | Non-cotton farmers (N=130) | Mean difference |
|---|---|---|---|
| Number of times the farm size was changed due to optimization | 2.718 (2.171) | 2.246 (1.570) | 0.471** |
| Importance of land registration documents for tenure security (1=Completely unimportant; 5=Extremely important) | 4.164 (0.918) | 4.215 (1.019) | -0.052 |
| Perceived freedom in deciding which crops to cultivate (1=Completely disagree; 5=Completely agree) | 3.593 (1.593) | 3.785 (1.386) | -0.191 |
| Perceived freedom in choosing cultivation methods (1=Completely disagree; 5=Completely agree) | 4.695 (0.737) | 4.792 (0.631) | -0.097 |
| Perceived freedom in collecting harvest from own land (1=Completely disagree; 5=Completely agree) | 4.186 (1.194) | 4.362 (1.134) | -0.175 |
| Perceived freedom in deciding where, how, and for how much to sell crops (1=Completely disagree; 5=Completely agree) | 2.350 (1.553) | 2.715 (1.516) | -0.365** |

# Conceptual framework

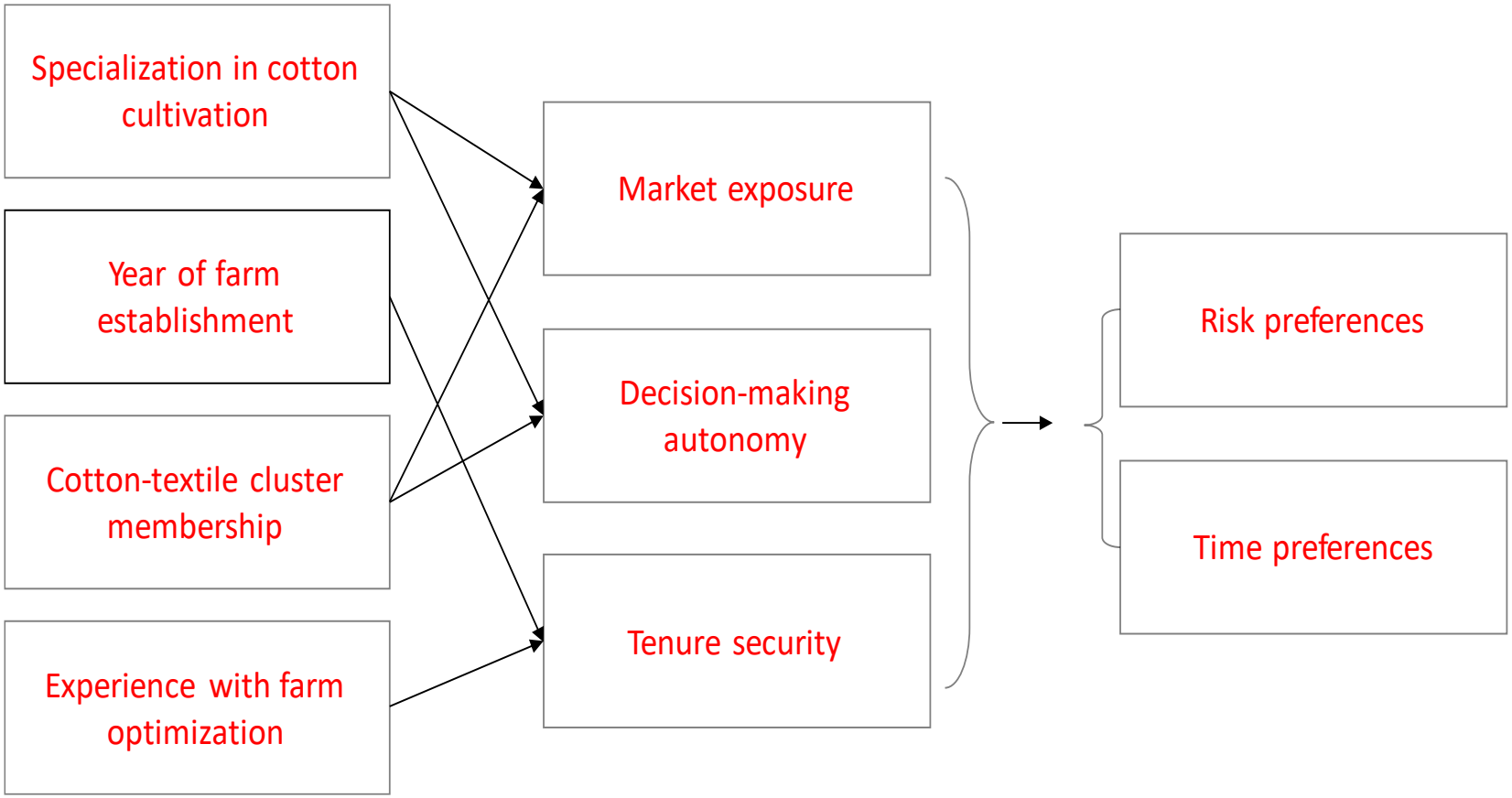


**Figure 1.** Conceptual linkages between institutional exposure and risk and time preferences

# Descriptive statistics of variables (N=307)

| Variable | Description | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| age | Farm manager's age, years | **45.062** | 10.976 | 22 | 72 |
| education | Farm manager has higher and special agricultural education (1/0, 1=yes) | **0.267** | 0.443 | 0 | 1 |
| farm size | Total land area in 2024, ha | **67.567** | 72.184 | 5 | 650 |
| plot location | Location of farm field near main irrigation canal (1/0, 1= farmland near main irrigation canal) | 0.202 | 0.402 | 0 | 1 |
| shock impact | Severity score of experienced shocks (numerical, high number means farm had more shocks that produced devastating impact on farm income) | 18.980 | 6.481 | 0 | 35 |
| distance to the input market | Distance to the input market from farm field, km | 23.412 | 12.214 | 1 | 80 |
| farm optimization | Number of experienced changes in farm size due to government farm optimization program | 2.518 | 1.951 | 0 | 15 |
| farm establishment | Farm establishment (..year ago) | 15.48 | 7.99 | 0 | 33 |
| cotton cluster | Cotton producer farm is a member of cluster (1/0, 1=if farm produced cotton and cluster membership) | 0.518 | 0.500 | 0 | 1 |
| **share of cotton land area** | The share of cotton area in total cultivated area (index, from 0 to 1) | 0.199 | 0.207 | 0 | 1 |

# Methodology (theoretical framework and estimation strategy)

## Prospect Theory (PT)

$$v(x) = \begin{cases} x^{\sigma}; x > 0 \longrightarrow \text{for gains} \\ -\lambda(-x)^{\sigma}; x < 0 \longrightarrow \text{for losses} \end{cases} \quad w(p) = \frac{1}{[\exp(\ln(1/p))]^{\alpha}} \longrightarrow \text{the probability weighting function}$$

## Quasi-hyperbolic discounting

$$D(\beta, \delta, t) = \begin{cases} 1, & if\ t = 0 \\ \beta \exp(-\delta t), & if\ t > 0 \end{cases}$$

## Estimation strategy

### OLS model

$$y_i = x_i'\beta + u_i$$

where,
$y$ => $\sigma$, $\lambda$, $\alpha$
$x$ => control variables

### The logistic function using a nonlinear least-squares regression procedure

$$P(x > (y, t)) = \frac{1}{1 + \exp(-\mu(x - y\beta\exp[-\delta t]))}$$

where
$\beta = \beta_0 + \Sigma\beta_i X_i$
$\delta = \delta_0 + \Sigma\, \delta_i X_i$


Sources: Benhabib et al. (2010), Prelec, (1998), Tanaka et al. (2010), Tversky and Kahneman (1992)

# Results

Risk preference parameters for cotton and non-cotton farmers

| Prospect theory parameters | Cotton farmers (N=177) | Non-cotton farmers (N=130) | All (N=307) |
|---|---|---|---|
| Risk aversion (σ) | 0.817 | 0.821 | 0.819 |
| Loss aversion (λ) | 2.267 | 1.946 | 2.131 |
| Probability weighting (α) | 0.753 | 0.796 | 0.771 |

# Results

Time preference parameters for cotton and non-cotton farmers (quasi hyperbolic)

| | Cotton farmers | Non-cotton farmers | All |
|---|---|---|---|
| **Discount rate (δ)** | 0.005*** | 0.004*** | 0.005*** |
| **Present bias (β)** | 0.799*** | 0.872*** | 0.826*** |
| **N** | 5310 | 3900 | 9210 |
| **R2** | 0.532 | 0.544 | 0.534 |

* p<0.1, ** p<0.05, *** p<0.01

# Results

Regression results for risk preference parameters (N=307)

| | Risk aversion (σ) | Loss aversion (λ) | Prob. weighting (α) |
|---|---|---|---|
| **Share of cotton** | **0.431**** | **-1.923**** | **-0.042** |
| **st.err** | 0.175 | 0.934 | 0.127 |
| Cotton cluster | -0.055 | 0.535 | 0.002 |
| st.err | 0.070 | 0.426 | 0.050 |
| Farm establishment | -0.005 | 0.012 | 0.005** |
| st.err | 0.004 | 0.022 | 0.003 |
| High education in agriculture | -0.013 | -1.027*** | 0.088** |
| st.err | 0.054 | 0.310 | 0.041 |
| Prob > F | 0.047 | 0.005 | 0.001 |
| R2 | 0.062 | 0.081 | 0.092 |

* p<0.1, ** p<0.05, *** p<0.01.

- Farmers who have a **higher share of land** allocated to cotton;
  - less risk-averse and
  - less loss-averse
- Farms with a longer establishment history => tend to judge probabilities more accurately
- Higher educated farmers in agriculture;
  - less loss-averse
  - tend to judge probabilities more accurately

# Results

## Regression results for time preference parameters

| | | Discount rate (δ) | Present bias (β) |
|---|---|---|---|
| **Share of cotton** | | **0.790**** | -0.090 |
| | st.err | 0.276 | 0.086 |
| Cotton cluster | | -0.261** | 0.010 |
| | st.err | 0.095 | 0.029 |
| Farm optimization | | -0.028** | -0.005 |
| | st.err | 0.013 | 0.005 |
| Shocks | | -0.005 | 0.003* |
| | st.err | 0.005 | 0.002 |
| R-squared | | 0.536 | 0.536 |
| N | | 9210 (307 clusters) | 9210 (307 clusters) |

Note: * p<0.1, ** p<0.05, *** p<0.01. Parameters of quasi-hyperbolic discounting were estimated using a nonlinear least-squares regression procedure.

- **Higher share of land** allocated to cotton
  - negatively associated with patience (higher δ)
- Membership of clusters of **cotton** producers (dummy) is
  - positively associated with patience (lower δ)
- The number of experienced changes in farm size due to government farm optimization is
  - positively associated with patience (lower δ)

# Conclusions

*Differences in farmers' **risk and time preferences** correspond to*

***differences in agricultural governance systems** within a country*

*Risk preferences*

A higher proportion of land allocated to cotton reduces both risk and loss aversion among farmers

- state-controlled systems with price stabilization, input subsidies, and procurement guarantees reduce uncertainty
- these farmers do not fully operate in competitive markets, their exposure to market-driven risks is lower

*Time preferences*

Farmers with a larger share of cotton cultivated land become less patient and more focused on short-term returns

- greater cotton specialization increases exposure to delayed government payments, causing cash flow issues and a shift toward short-term income over long-term investment.
- these farmers imply more inflexibility in decision-making, reinforcing a short-term economic mindset aimed at securing quick returns rather than pursuing sustained financial growth

# Policy recommendations

Farmers with more cotton land take more risks and focus on short-term gains, limiting long-term sustainable investments

- Support measures and incentive structures should reflect this behavioral pattern, while promoting diversification to strengthen resilience and broaden investment horizons across the farming sector

Cluster membership and repeated farm optimizations are linked with greater patience

- Future reforms could therefore aim to balance institutional coordination with greater farmer participation and more transparent land tenure arrangements

**Thank you for your attention!**

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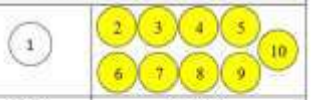
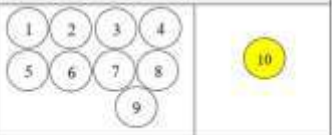
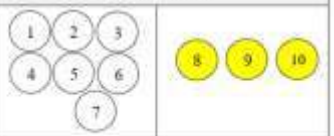
# Eliciting risk and time preferences (TCN approach)

## Risk preferences

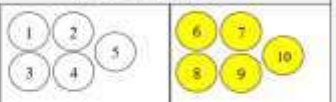
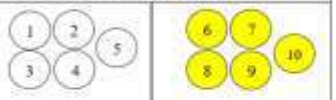
1-ROUND (total number of choices - 14) (in Uzbek SOUM, UZS)

| «A» OPTION | | | «B» OPTION | | |
|---|---|---|---|---|---|
|  | | |  | | |
| № | 30 % | 70 % | № | 10 % | 90 % |
| 1 | 400 000 | 100 000 | 1 | 680 000 | 50 000 |
| 2 | 400 000 | 100 000 | 2 | 750 000 | 50 000 |
| 3 | 400 000 | 100 000 | 3 | 830 000 | 50 000 |

2-ROUND (total number of choices - 14) (in Uzbek SOUM, UZS)

| «A» OPTION | | | «B» OPTION | | |
|---|---|---|---|---|---|
|  | | |  | | |
| № | 90 % | 10 % | № | 70 % | 30 % |
| 15 | 400 000 | 300 000 | 15 | 540 000 | 50 000 |
| 16 | 400 000 | 300 000 | 16 | 560 000 | 50 000 |

3-ROUND (total number of choices - 7) (in Uzbek SOUM, UZS)

| «A» OPTION | | | «B» OPTION | | |
|---|---|---|---|---|---|
|  | | |  | | |
| № | 50 % | 50 % | № | 50 % | 50 % |
| 29 | 250 000 | - 40 000 | 29 | 300 000 | - 210 000 |
| 30 | 40 000 | - 40 000 | 30 | 300 000 | - 210 000 |

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in Uzbek SOUM, 12800 UZS = 1 US$

## Time preferences

Choices 1-5

| № | «A» – OPTION | № | «B» – OPTION |
|---|---|---|---|
| 1 | 1 200 000 UZS receive in one week | 1 | 200 000 UZS receive today |
| 2 | 1 200 000 UZS receive in one week | 2 | 400 000 UZS receive today |
| 3 | 1 200 000 UZS receive in one week | 3 | 600 000 UZS receive today |
| 4 | 1 200 000 UZS receive in one week | 4 | 800 000 UZS receive today |
| 5 | 1 200 000 UZS receive in one week | 5 | 1 000 000 UZS receive today |

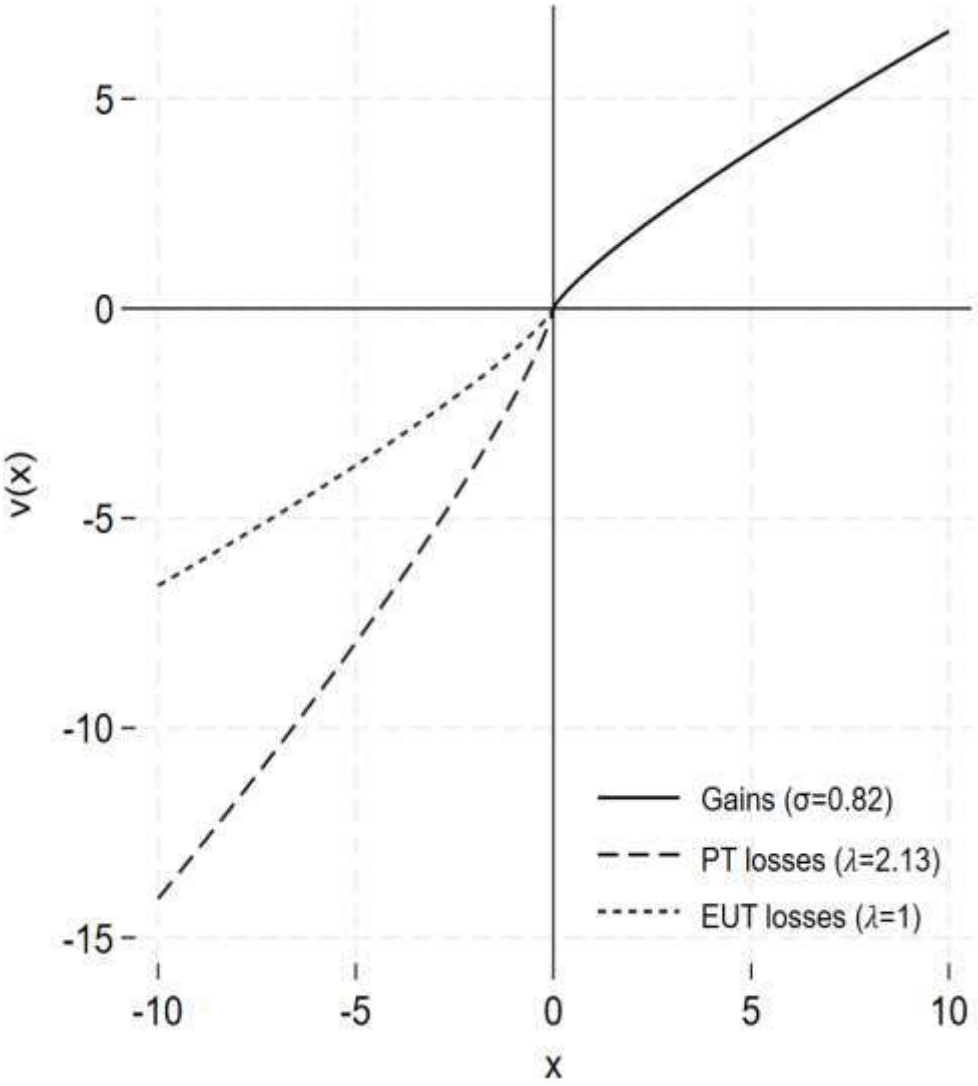
| № | «A» – OPTION | № | «B» – OPTION |
|---|---|---|---|
| 6 | 1 200 000 UZS receive in one month | 6 | 200 000 UZS receive today |
| 7 | 1 200 000 UZS receive in one month | 7 | 400 000 UZS receive today |
| 8 | 1 200 000 UZS receive in one month | 8 | 600 000 UZS receive today |
| 9 | 1 200 000 UZS receive in one month | 9 | 800 000 UZS receive today |
| 10 | 1 200 000 UZS receive in one month | 10 | 1 000 000 UZS receive today |

| № | «A» – OPTION | № | «B» – OPTION |
|---|---|---|---|
| 46 | 2 400 000 UZS receive in three days | 46 | 400 000 UZS receive today |
| 47 | 2 400 000 UZS receive in three days | 47 | 800 000 UZS receive today |
| 48 | 2 400 000 UZS receive in three days | 48 | 1 200 000 UZS receive today |
| 49 | 2 400 000 UZS receive in three days | 49 | 1 600 000 UZS receive today |
| 50 | 2 400 000 UZS receive in three days | 50 | 2 000 000 UZS receive today |

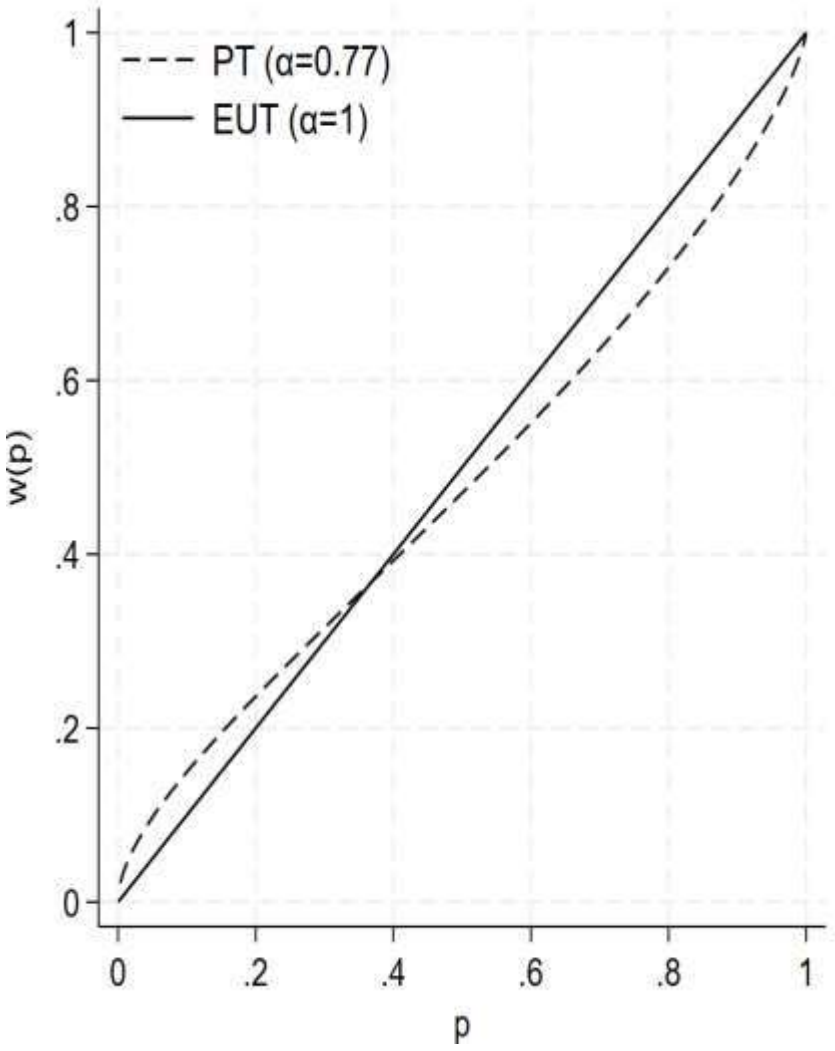
Totally 110 rows -> each row “A” or “B”

**TCN -> T**anaka, T., **C**amerer, C.F. and **N**guyen, Q. (2010)

# Results (functions)




PT value function




PT weighting function

# Results

Time preference parameters for cotton and non-cotton farmers (quasi hyperbolic)

| | Cotton farmers | Non-cotton farmers | All |
|---|---|---|---|
| **Discount rate (δ)** | 0.005*** | 0.004*** | 0.005*** |
| **Present bias (β)** | 0.799*** | 0.872*** | 0.826*** |
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