Underemployment and Shadow Economy; Is There a Structural Relationship? A Lab-Experimental Test

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Abstract

This study examined the potential link between the shadow economy and underemployment through a controlled laboratory experiment. The study involved 240 undergraduate participants from the University of Peradeniya in Sri Lanka. It consisted of eight meticulously managed sessions, with 30 individuals in each, conducted in a computer laboratory. The results indicated that lower intensity in the assigned status of income and occupation reduced the participants' satisfaction with their occupational experience and motivated them to enroll in the shadow economy. Notably, awareness of the shadow economy did not significantly influence the participants' willingness to engage in similar activities, as the majority were primarily motivated by private rather than societal gains. Even those who expressed a preference for participating in the shadow economy were less ambitious and favored transactions outside official tax schemes. Additionally, income-driven underemployment was found to prompt participants to increase their involvement in the shadow economy. Therefore, addressing income-driven underemployment concerns could mitigate individuals' propensity to participate in the shadow economy.

Keywords: Job satisfaction, personal characteristics, socially assigned status, shadow economy, underemployment.

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1. Introduction

The prevalence of underemployment seems to be a significant factor in less developed countries, affecting public participation in the shadow economy (Samaranayake & Dayaratne-Banda, 2015; Samaranayake, 2016; Balkouti & Boujelbne, 2018; Menon, 2019). While existing literature has drawn this conclusion from empirical research, there is a need for thorough theoretical validation to effectively use underemployment data for estimating the scope of the shadow economy in these nations. As a result, Samaranayake (2016, 2017) made the initial effort to establish the structural relationship between these two dimensions, using the underemployment rate as a proxy for underemployment statistics. The theoretical framework drew on two influential studies by Hall (1979) and Dell'Anno & Solomon (2008).

This paper explores the practicality of theoretical insights through a laboratory experiment involving 240 undergraduates from the University of Peradeniya, Sri Lanka. The experiment offered a controlled test for the theoretical findings regarding the nature of the structural relationship between underemployment rates and the shadow economy. The experimental framework was developed based on the behavioral benchmarks and utility model introduced by Akerlof & Kranton (2000). The experimental design incorporated two distinct criteria - "job satisfaction" and "participation in the shadow economy" - to model the interconnectedness between underemployment, other influencing factors, and the shadow economy. Descriptive tools, payoff matrix analysis, binary logistic model, and SEM path analysis were used to review the nature of the relationships among the core variables using the experimental data. A review of the subsequent findings provided crucial insights into the internal validity of the theoretical extensions proposed by Samaranayake (2016, 2017).

2. Review of Literature

The shadow economy encompasses the covert activities of hidden economic operations, which present challenges in terms of measurement and have led to various definitions based on political, sociological, and economic perspectives. Two distinct approaches, "the definitional" and "the behavioral," have been identified in understanding the shadow economy (Fleming et al., 2000; Dell'Anno & Solomon, 2008). The definitional approach aims to estimate the size of the shadow economy, while the behavioral approach seeks to explain the reasons behind shadow activities (Fleming et al., 2000).

In the economic context, the convergence of these approaches defines the notion of the shadow economy, which encompasses illegal, irregular, household production, and informal economic

activities (Schneider et al., 2010; Schneider 2014; Hassan & Schneider, 2016). For the purpose of this study, the focus lies on productive economic activities contributing to the national income accounting in Sri Lanka, thereby excluding illegal transactions and household activities from the calculation of the Gross Domestic Production (GDP) (Schneider et al., 2010; Schneider 2014; Hassan & Schneider, 2016).

The interrelation between the shadow economy and the labor force is intricately linked to fluctuations in the unemployment rate (Dell'Anno & Solomon, 2008; Samaranayake & Dayaratne-Banda, 2015). Underemployment has emerged as a pressing issue in the labor markets of developing countries and appears to deter individuals from participating in official economic activities. Despite a dearth of academic literature on the relationship between these variables, several studies have highlighted the significance of underemployment in the shadow economy.

Initial estimations of the Sri Lankan shadow economy have revealed parallel growth alongside the official economy, as citizens, particularly the underemployed or those with low average incomes, engage in both official and shadow economies (Samaranayake & Dayaratne-Banda, 2015). This underscores the importance of direct interventions to alleviate issues such as underemployment and curtail the prevalence of shadow economic activities. Furthermore, Wenner & Clarke (2016) have pointed out the potential for confounding unemployment and underemployment data with the existence of a sizable shadow economy. Individuals seeking additional work and income might participate in the hidden economy, which may not be captured in official estimates of underemployment, thereby potentially underestimating both household income and consumption statistics.

Balkouti & Boujelbne (2018) found that in underdeveloped MENA countries, unemployment did not significantly impact the size of the shadow economy, whereas it did in developed OECD countries. This suggests that in developing nations, underemployment rather than unemployment motivates participation in the shadow economy. Therefore, underemployment appears to be a significant issue in underdeveloped countries. Several studies have attempted to emphasize the consequences of underemployment. According to Barnett (2017), individuals facing stagnant wages, limited full-time job opportunities, and high household expenses are pushed into informal economic activities. This conclusion is drawn from a survey carried out in the San Francisco region of the United States, indicating the prevalence of the connection between the shadow economy and underemployment even in developed nations.

Golub & Hayat (2014) analyzed the functions and characteristics of informal employment in Africa and highlighted that the primary reason for the prevalence of underemployment and the subsequent move towards engagement in the informal sector is the lack of demand for labor, rather than characteristics of the workers. Benjamin & Mbaye (2014) examined the relationship between informality, growth, and development in Sub-Saharan Africa. Their study explores how informality is connected to and drives economic growth, impacting development, and involving a significant portion of the African labor force.

Menon (2019) emphasizes the cyclic relationship between informal economic activities, the labor force, money supply, and policy perceptions in India. It points out that a significant portion of the Indian population is involved in the informal economy, so a large number of people who are considered unemployed as per official estimates are actually engaged in shadow economic activities to enhance their income levels and consumption patterns. These observations prompt consideration of the potential link between underemployment and the shadow economy. While there is no established theoretical framework to explore this connection, empirical evidence, including the underemployment rate and its determinants, can effectively predict the scale of the shadow economy. Thus, this study seeks to investigate the theoretical relationship between the underemployment rate and the shadow economy, followed by behavioral implications. The study focuses on the model developed by Hall (1979), which highlights the duration of employment as a significant factor influenced by both employers and employees, along with its associated wage.

The theory of natural unemployment is derived from the behavior of the fraction of unemployed individuals in the labor market equilibrium. In this context, the labor market equilibrium represents a scenario in which employers are unable to hire labor at lower costs (Hall, 1979). Consequently, there is no incentive to offer jobs at wages below the market rate, and unemployed individuals have no opportunity to enhance their real income by accepting lower wages in exchange for immediate employment. Any unemployment existing in such a scenario is considered the natural rate of unemployment. Hall (1979) developed a model to explain this situation, emphasizing that the duration of employment and its corresponding wage are of concern to both employers and employees. An efficient employment contract sets a duration and wage at a point where the iso-cost curve is tangent to the indifference curve. The analysis includes a partial examination of both job separation and job finding rates, where the job separation rate reflects how frequently workers lose their jobs and become unemployed, while the job-finding rate represents how often workers secure new employment (Dell'Anno & Solomon, 2008).

The relationship between the shadow economy and the unemployment rate has been examined by various researchers to determine its size. According to the empirical results presented by Davidescu & Dobre (2012), there is strong evidence of a one-way causality running from the unemployment rate to the shadow economy at the 1 percent level of significance. This positive correlation has been used as a key indicator to estimate the size of the shadow economy in different economies. Additionally, various types of employment, such as public employment, private employment, and self-employment, are considered as contributing factors in shaping the shadow economy.

Research in the social sciences aims to model the behavior of the incredibly diverse entity known as human beings. People's choices, behaviors, and structures are diverse, leading to differences in economic outcomes. It has been understood that individuals' identities impact their choices and economic outcomes (Akerlof & Kranton, 2000). The empirical applications of this study focus on how an individual's identity - their sense of self - influences their choices, given the determinants, when deciding to engage in shadow economic activities. This aligns with the utility model proposed by Akerlof & Kranton (2000), which incorporates psychological and sociological factors of identity and their role in determining economic choices.

$$U_j = U_j(a_j, a_{-j}, I_j) \quad \text{(equation 1)}$$

Where the utility depends on j's identity I_j as well as j's actions a_j and other actions a_{-j}. Further, a person's identity is determined through the following factors,

$$I_j = I_j(a_j, a_{-j}; C_j, \varepsilon_j, P) \quad \text{(equation 2)}$$

Where a person's identity depends on j's assigned social categories C_j, j's own given characteristics ε_j, as well as the prescriptions "P". Here the "P" indicates the extent to which j's own given characteristics (ε_j) assigned social categories to match the ideal of j's assigned social categories (C_j). Therefore, these factors are supposed to impact people's utility where higher the utility provides higher satisfaction and economic gains. Therefore, the proposed experiment in this study is designed based on utility models and their interactive nature considering the underemployment and other determinants in an economy with the presence of the shadow economy.

3. Methodology

3.1. Experimental Design

The research employed a choice experiment to investigate individualistic behavior in the context of underemployment and shadow economic activities within a hypothetical societal framework. Contemporary data analysis in social sciences relies on two primary types of data: happenstance data and experimental data (Falk & Fehr, 2003). Happenstance data arises from uncontrolled, natural economic activities, while experimental data is gathered under controlled conditions. Data collected from field surveys typically falls into the happenstance category, whereas data recorded from laboratory experiments is considered experimental. This study aims to advance research on the shadow economy by utilizing experimental data obtained from a laboratory experiment. Due to the challenges associated with collecting data on the shadow economy through surveys, many empirical efforts seek to construct or simulate data. This approach enables the testing of individuals' choices and behavioral tendencies related to key determinants of the shadow economy. Additionally, it can support theoretical investigations into the structural relationship between underemployment rates and the shadow economy under laboratory conditions.

Concerning the utility model developed by Akerlof & Kranton (2000), this study uses two distinctive criteria; "*job satisfaction*" and "*the enrollment in shadow economy*" in modeling the degree of interlink between the underemployment, other determinants, and the shadow economy. Accordingly, the utility model for "*job satisfaction*" is developed by featuring the elements of j's identity (I_j) as follows,

(1) Assigned Social Category (C_j): The occupation j's assigned to provide the service.
(2) Own given characteristics (ε_j): The degree of educational/professional qualifications, skills/talents, experience, and preference j's belongs to.
(3) Prescription (P): The difference between (C_j) and (ε_j).

Similarly, the utility model for "*the enrollment in shadow economy*" is developed by featuring the elements of j's identity (I_j) as follows,

(1) Assigned Social Category (C_j): The level of income (income category) j's assigned by the occupation he/she recently involved.
(2) Own given characteristics (ε_j): The degree of j's expenditure in different activities.
(3) Prescription (P): The difference between (C_j) and (ε_j).

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Then these utility models converge and design a payoff matrix with hypothesized outcomes belonging to the subject j along with his/her choices made. The designed game was launched in a laboratory to obtain the results out of the choice architectures designed over the base matrixes featuring the elements of j's identity (I_j) as above. The experiment was designed concerning two dimensions namely, 'SATISFACTION' and 'ENROLLMENT' which are psychological features of the same individual. The 'SATISFACTION' represents two cognitive players in the game based on the assigned social category of jth individual. Also, 'ENROLLMENT' includes two choices, which refer to the subject j's cognitive decision to enroll in the shadow economy or not. This game allows respondents to make their own decisions along with their cognitive payoffs, to decide whether to enroll or not in alternative activities. Accordingly, the hypothetical framework of the strategic outcomes of the game is given below.

S (II)

		Y	N
S (I)	Y	0,0	0,1
	N	1,0	**1,1**

Figure 1. The Hypothesized Outcome Matrix
Source: The authors.

Therefore, the S (I) and S (II) represent the respondent's satisfactory status based on the assigned Social Category (C_j) and the own given characteristics (ε_j) respectively. Also '1' represent "ENROLLMENT" in alternative activities and '0' for 'NON-ENROLLMENT'. The alternative activities given in the experiment are mostly embedded with the features of a shadow economic activity. Once individuals become aware of the existence of the shadow economy, they make decisions fully conscious of the potential negative consequences and harm caused by engaging in shadow economic activities. As shown in the provided matrix, the anticipated outcome is represented using a binary numbering system, indicating whether individuals choose to participate in alternative activities or not. For example, if an individual meets both satisfactory conditions, they will not enroll in alternative activities. Conversely, if an individual is dissatisfied with both dimensions of 'SATISFACTION,' they are more likely to enroll in alternative activities. This concept reflects the dominant strategy of each individual and demonstrates the "Nash Equilibrium" in the hypothetical game. Additionally, an individual dissatisfied with only one

dimension of either S(I) or S(II) finds themselves indifferent between enrolling and not enrolling in alternative activities.

This theoretical framework will be tested through a pre-designed experimental game conducted in a laboratory setting. A sample of 240 respondents will be selected from undergraduate students at the University of Peradeniya, representing the Faculty of Arts and the Faculty of Management in Sri Lanka. The experiment will consist of eight equally facilitated sessions, with thirty respondents participating in each session in a computer laboratory. The game will be designed using the "Node.js" and "Visual Studio Code" open-source software to create a cross-platform computing environment with sequential sessions. The researcher will provide instructions and payoffs to the respondents during the game. The results will be analyzed using both descriptive and econometric tools.

3.2. Binary Logistic Model for Categorical Data Analysis

The proposed computer application for the laboratory experiment comprises four equally important rounds, each representing a different situation based on satisfactory status, qualifications/experience, and income level within a hypothetical setup. In each round, respondents are presented with a final question allowing them to choose whether to enroll in alternative activities. Preceding questions and respondent profile data are identified as impactful factors influencing the respondents' decisions. This intuition is supported by the review of literature in the second chapter. Therefore, a regression analysis using a randomized sample can be conducted to observe the impacts of these factors across the four rounds. The regression analysis will focus on a binary dependent variable, as respondents are given two options at the end of each round. Due to the nature of the dependent component in the experimental data, this study opted for a Binary Logistic Model (BLM) to analyze the data. The BLM defines the model used in the study to analyze data collected over eight experimental sessions.

$$ln\frac{P}{(1-P)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \dots\dots\dots\dots + \beta_n X_n + \varepsilon \quad \text{(equation 3)}$$

According to the regression provided above, the dependent component expresses the log of the odds ratio. Here the odd ratio $P/(1-P)$ represents the probability of respondents preferring to enroll in alternative activities when compared to the probability of the respondents who do not prefer to enroll. Then β_0 represents the constant of the model whereas $\beta_1 X_1 + \beta_2 X_2 \dots + \beta_n X_n$ represent the causal variables and their coefficients derived from the experiment. The ε represents the error component for the unobserved factors affecting the odds ratio.

3.3. SEM Path Analysis

The final phase of the experimental analysis aims to explore the potential for creating a model to examine the importance of data and variables in characterizing the shadow economy when it is treated as a hidden variable. This involves conducting an analysis using a measurement model developed based on various combinations across four rounds in the experiment. The goal is to assess the model's ability to load factors at each round when the shadow economy is treated as the underlying dependent component. As a result, the structure of the path analysis uses the latent variable as the causal factor on each occasion to confirm the model's ability to load factors. The equations that link indicators (Y_n) with the latent (unobserved) variable (η) is called the measurement model in the Structural Equation Modeling. So, the shadow economy linearly determines subject to a set of observable exogenous indicators $(Y_1, Y_2, Y_3 \ldots Y_n)$ and to error terms $(\xi_1, \xi_2, \xi_3 \ldots \xi_n)$.

$$Y_1 = \alpha_1 \eta + \xi_i, \ Y_2 = \alpha_2 \eta + \xi_i, \ Y_3 = \alpha_3 \eta + \xi_i \ldots, \ Y_i = \alpha_i \eta + \xi_i \ \text{(equation 4)}$$

Here the structural error term (ε_n) and measurement errors $(\xi_1, \xi_2, \xi_3 \ldots \xi_n)$ are normally distributed, mutually independent and all variables are taken to have zero expectation. The experimental data used for the analysis across all four rounds are converted into the scale format based on the Likert scale. Thereafter the reliability test on the experimental data is demonstrated the following information.

4. Results and Discussion

The challenges of gathering data on the shadow economy through surveys have led most empirical studies to either construct or simulate data. By examining people's choices and behavioral patterns, these efforts can shed light on the key factors driving the shadow economy. Moreover, they can help to further explore the structural relationship between underemployment and the shadow economy under controlled conditions. In a recent experiment, 240 undergraduates from the University of Peradeniya, representing all academic years, participated using a random sampling technique. The participants were divided into three equally sized groups based on the experiment's parameters. The experiment involved the use of three different versions of an application, with

respondents' occupation statuses taken into account. Additionally, each category of respondent was split into two equal clusters of forty based on information provided during the experiment.

The laboratory experiment involved eight sessions, with thirty respondents participating in each session. During each session, four rounds were conducted, each presenting a different hypothetical scenario based on the assigned characteristics and individual traits of the respondents. Subsequently, the experimental outcomes were analyzed from four different perspectives. The initial step involved a descriptive analysis of the collected experimental data. Next, a payoff matrix was utilized to assess the scores achieved by each group in the four rounds. The third stage involved using the Binary Logistic Model (BLM) to study the impact of explanatory factors on the respondents' decision to "ENROLL" or "NOT ENROLL" in the alternative activities across all four rounds. Lastly, the experiment concluded with the implementation of Structural Equation Modeling and appropriate path analysis to pinpoint the factors that define the shadow economy from the explanatory factors presented in each round.

4.1. Descriptive Analysis on the Experimental Data

According to the descriptive analysis, the following can be considered as the most important outcomes. Those are provided with a summary of findings across each round.

- Pressure created through the underemployment reduces the respondent's satisfaction with the occupation assigned (see APPENDIX I).

The respondents were given few options to assess the nature of impact from the underemployment to the satisfactory status of the officially assigned job. According to the analysis, the majority of respondents were satisfied with the officially assigned jobs having very few who were not satisfied at the initial round. This round provided a situation that matches 'the assigned social category' (C_j) and 'the own given characteristics' (ε_j). Then the second round consisted of signals for severe underemployment based on the respondents' qualifications and experience. Therefore, the assigned social category (C_j) and the own given characteristics (ε_j) do not perfectly match. Somehow, according to the results, the respondents' satisfaction was marginally reduced with very few more respondents were not satisfied with the job assigned. Then, the third round creates the imbalance between C_j and ε_j based on the gap between the income and expenditure levels of individuals. This made a significant impact on the respondents' decision and increased the number of respondents who were in-between and not satisfied with the officially assigned job. Finally, the fourth round created significant pressure on the respondents with imperfections among both the

income-expenditure status and the job-related experience and qualification. It made the majority of respondents who were in-between in the third round not to satisfied with the officially assigned job.

- No significant difference was made by the awareness of the shadow economy on their willingness to engage in alternative activities (see APPENDIX II and APPENDIX IV).

As per the respondents' preferences, the most popular choices among the alternative activities are private tuition, part-time entrepreneurship, and online/computer-based activities. Despite the awareness of the shadow economy, it was found that it did not have a significant impact on the respondent's decision regarding engagement in alternative activities. This suggests that, although the respondents are aware of the implications of their actions in the shadow economy, the majority still choose to participate. Furthermore, it was observed that a majority of respondents who preferred alternative activities, such as part-time entrepreneurship and online/computer-based activities, were from the cluster of respondents who were aware of the shadow economy, as shown in the comparison cluster bar diagrams. This finding emerged unexpectedly but proved to be significant in the context of the respondents' engagement in the laboratory experiment.

- The burden of income-driven underemployment stimulates respondents to improve their engagement in the shadow economy (see APPENDIX III and APPENDIX IV).

The exploratory analysis utilized various factors to examine the potential for respondents to engage in shadow economic activities. Among these factors, the respondents' attitudes toward taxation were considered crucial determinants. The definition of the shadow economy is closely linked to the taxation of economic activities. If an activity operates without paying official taxes, it may be classified as part of the shadow economy. The third round of the survey revealed the most significant shift in preferences among respondents regarding their willingness to pay taxes for their official employment. A majority of respondents who had initially expressed a willingness to pay taxes changed their minds in the third round. These developments indicated potential underemployment, highlighting the disparity between C_j and ε_j based on the gap between individuals' income and expenditure levels.

Furthermore, respondents were asked to express their preferences regarding the payment of taxes for alternative activities they could pursue. Comparatively, the third round of the study saw the highest number of respondents unwilling to pay taxes for alternative activities. This suggests that the strain of income-driven underemployment is driving respondents to increase their involvement in shadow economic activities.

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4.2.The Payoff Matrix Analysis

This matrix seeks to elucidate the decision-making behavior that can enhance societal well-being (see APPENDIX V). When all the respondents have the option to participate in alternative activities, there is a greater likelihood of increased shadow economic activities. Reducing the number of respondents enrolling may lessen the intensity of generating shadow economic activities. Conversely, if all respondents choose not to enroll in alternative activities, they could decrease the intensity of shadow economic activities.

Table 1. Estimated Respondents Preferences: From a Given Session in Average

Round	Cluster	Preference	Value	Approx.	Score/Points
1	A-Private	ENROLL	8.875	9.0	20
		NOT ENROLL	1.125	1.0	10
	B-Public	ENROLL	9.625	9.5	15
		NOT ENROLL	0.375	0.5	05
	C-Self	**ENROLL**	**8.5**	**8.5**	**25**
		NOT ENROLL	**1.5**	**1.5**	**15**
	Total	ENROLL	9.0	9.0	20
		NOT ENROLL	1.0	1.0	10
2	A-Private	ENROLL	8.625	8.5	25
		NOT ENROLL	1.375	1.5	15
	B-Public	**ENROLL**	**8.25**	**8.0**	**30**
		NOT ENROLL	**1.75**	**2.0**	**20**
	C-Self	ENROLL	8.875	9.0	20
		NOT ENROLL	1.125	1.0	10
	Total	ENROLL	8.58	8.5	25
		NOT ENROLL	1.42	1.5	15
3	**A-Private**	**ENROLL**	**8.5**	**8.5**	**25**
		NOT ENROLL	**1.5**	**1.5**	**15**
	B-Public	ENROLL	8.75	9.0	20
		NOT ENROLL	1.25	1.0	10
	C-Self	**ENROLL**	**8.375**	**8.5**	**25**
		NOT ENROLL	**1.625**	**1.5**	**15**
	Total	ENROLL	8.54	8.5	25
		NOT ENROLL	1.46	1.5	15
4	A-Private	ENROLL	8.75	9.0	20
		NOT ENROLL	1.25	1.0	10
	B-Public	ENROLL	8.75	9.0	20
		NOT ENROLL	1.25	1.0	10
	C-Self	**ENROLL**	**8.625**	**8.5**	**25**
		NOT ENROLL	**1.375**	**1.5**	**15**
	Total	ENROLL	8.71	8.5	25
		NOT ENROLL	1.29	1.5	15

Source: The authors.

When we look at the responses from all participants, regardless of the provided clusters, we observe that the highest number of respondents, 90 percent, preferred to "ENROLL" in the first

round, while only 20 and 10 percent of respondents chose "ENROLL" and "NOT ENROLL" respectively. Similar patterns were observed in the following three rounds, with approximately 85 percent choosing "ENROLL" and the remaining percentages favoring "NOT ENROLL." However, in the final round, there was a slight improvement in the preference for "ENROLL." This suggests that respondents initially showed interest in alternative activities but later considered reducing their level of involvement in them.

It was noted that some respondents changed their decision based on situational pressure, lower satisfaction, and concerns about income. Despite these changes, the majority of respondents maintained their choice to "ENROLL" across each round. This majority preference resulted in low scores for the respondents according to the matrix, indicating that most respondents were motivated by personal gains rather than societal gains.

The self-employed cluster consistently earned the highest score across three rounds, suggesting that individuals in this cluster were least likely to enroll in alternative activities. It was also found that half of the sample respondents were made aware of shadow economic activities through the experiment. It was expected that once participants recognized activities as part of the shadow economy, they would be less likely to enroll in them. However, the data revealed that the majority of respondents who preferred to enroll in alternative activities belonged to the cluster that was aware of the shadow economy at all four rounds.

4.3.The BLM Analysis

In this study, a Binary Logistic Model (BLM) was preferred to analyze the collected data from 240 respondents over eight experimental sessions. The results showed that all four BLMs run across four different rounds were statistically significant according to the Omnibus Test of Model Coefficients and the Hosmer & Lemeshow (HL) Test. The BLM regressed in the first round was identified as the most fitted model based on the Pseudo r-squared measures. Subsequently, the regressed models for each round provided equations to describe the association between the term and the response.

Round 1:

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = \beta_{4(1)}\ Ambition\ (1) + \beta_{5(2)}Occupation(2) - \beta_{9\ (1)}R_{Q6}(1) - \beta_{9(2)}R_{Q6}(2) + \varepsilon$$

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = 4.184^{***} + 1.868^{*} - 2.095^{***} - 1.655^{*}$$

Round 2:

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = \beta_{4(1)}\ Ambition\ (1) - \beta_{9\ (1)}R_{Q6}(1) - \beta_{9(2)}R_{Q6}(2) + \beta_{11(1)}Assigned\_j\ (1) + \varepsilon$$

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = 2.246^{*} - 3.086^{***} - 3.295^{***} + 1.668^{**}$$

Round 3:

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = \beta_{4(1)}\ Ambition\ (1) + \beta_{7}\ R\_Q4\ (2) - \beta_{9\ (1)}R_{Q6}(1) - \beta_{9(2)}R_{Q6}(2) + \beta_{10}\ Awareness + \varepsilon$$

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = 2.250^{*} + 1.502^{**} - 3.376^{***} - 2.397^{***} + 0.805^{*}$$

Round 4:

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = \beta_{4(1)}\ Ambition\ (1) + \beta_{4(3)}\ Ambition\ (3) - \beta_{9\ (1)}R_{Q6}(1) + \varepsilon$$

$$ln\left[\frac{Enroll}{Not\ Enroll}\right] = 3.111^{***} + 0.988^{*} - 2.328^{***}$$

Based on the data from all four rounds, two key factors stand out among the responses: $Ambition\ (1)$ and $R_{Q6}(1)$ appeared consistently across all four models. When analyzing the estimated coefficients for $Ambition\ (1)$, it becomes evident that respondents who felt their ambition was below average had a significantly positive influence on their decision to participate in alternative activities, compared to those who considered their ambition to be the lowest. Similarly, the magnitude and sign of $R_{Q6}(1)$ indicate that individuals who prefer enrolling in alternative activities without any taxes are more likely to influence the final decision, compared to those who are undecided about the matter.

Additionally, factors such as preferred occupation, assigned job, concerns about paying taxes for the assigned job, and awareness of the shadow economy also showed significance across the four rounds. This analysis demonstrates how these factors impact the decision to participate in alternative activities and shape the nature and characteristics of the shadow economy based on respondents' choices.

4.4. SEM Path Analysis

Analysis of the data obtained from the laboratory experiment in previous stages indicated a notable inclination towards the creation of a shadow economy through alternative activities that respondents may partake in. This section of the experimental analysis aims to examine the potential for developing a model to explore the significance of the data and variables in describing the shadow economy as a latent variable. The experimental data from all four rounds were converted

into Likert scale format. Subsequently, the reliability test on the experimental data (APPENDIX VI) yielded a significant value of 0.758, confirming the suitability of the data for multivariate analysis.

The analysis was conducted using the statistical software "SPSS-AMOS 23". The results of the initial measurement model, including all exogenous indicators, showed relatively lower values for the fitness indices of the designed SEM path. Consequently, exogenous indicators with weak coefficients were eliminated, and the model was revised to examine the statistical outcomes. The new estimates demonstrated a marked enhancement in the fitness status of the revised measurement model (APPENDIX VII).

Table 2. Regression Weights – Revised Measurement Model

Variable			Coefficient (β)	Significance
Round 1				
R1_Q3	<---	F1	1.07	0.0032***
R1_Q9	<---	F1	2.93	0.0000***
R1_Q10	<---	F1	1.00	-
Round 2				
R2_Q1	<---	F2	-0.432	0.0860*
R2_Q7	<---	F2	2.91	0.0000***
R2_Q8	<---	F2	1.00	-
Round 3				
R3_Q7	<---	F3	2.79	0.0000***
R3_Q8	<---	F3	1.00	-
Round 4				
R4_Q3	<---	F4	0.74	0.1069
R4_Q7	<---	F4	4.08	0.0000***
R4_Q8	<---	F4	1.00	-

Source: Author estimations using the SPSS-AMOS Statistical software

In the revised structural model, the estimated regression weights indicate that both the job satisfaction of the respondents (R1_Q3) and their willingness to engage in alternative activities when there are no taxes to pay (R1_Q9) are statistically significant with positive coefficients at a significance level of less than one percent in the first round. In the second round, the respondents' willingness to engage in alternative activities when there are no taxes to pay (R2_Q7) emerged as the most significant explanatory indicator with the highest coefficient for describing the shadow economy. Additionally, the job satisfaction of the respondents (R2_Q1) is only significant at a 10 percent level with a negative coefficient, indicating an inverse impact.

Moving to the third round, only the respondents' willingness to engage in alternative activities when there are no taxes to pay (R3_Q7) was significant as an explanatory indicator for describing the shadow economy. Even in the final round, only the respondents' willingness to engage in alternative activities when there are no taxes to pay (R4_Q7) was found to be significant for describing the shadow economy, with a very high and positive coefficient.

Consequently, the respondents' willingness to engage in alternative activities when there are no taxes to pay emerged as the most important explanatory indicator for describing the shadow economy throughout the SEM path analysis in all rounds of the laboratory experiment.

5. Conclusion

The laboratory experiment simulated the theoretical derivations (Samaranayake, 2017) to assess the impact of underemployment on participation in the shadow economy. Based on the analysis of the experimental data, three key outcomes were identified. Firstly, it was noted that the pressure arising from changes in certain factors decreased the satisfaction of the respondents with their current occupations. Secondly, awareness of the shadow economy did not significantly influence the willingness of the respondents to participate in alternative activities. Lastly, underemployment driven by income motivated the respondents to increase their involvement in the shadow economy. The results obtained from the Binary Logistic Model indicated two common significant insights from the responses. Respondents who perceived their ambition to be below average compared to others had a significantly positive impact on their engagement in alternative activities. Additionally, individuals who preferred to engage in alternative activities tended to favor economic activities outside the official tax schemes. Path analysis further revealed that the respondents' willingness to engage in alternative activities with no taxes to pay was a crucial exploratory indicator of participation in the shadow economy. The analysis of the experimental data underscored the importance of the consequences of underemployment in amplifying participation in the shadow economy.

It is important to consider the impact of underemployment driven by low income on the participation of individuals in the shadow economy. The disparity between an average employee's regular expenses and their income from work should be carefully examined. Employers can influence decision-making processes by implementing sound financial solutions. Additionally, the taxation system plays a critical role in curbing the size of the shadow economy in Sri Lanka. Introducing more progressive tax policies, as opposed to regressive ones, would be beneficial. Regressive taxation can create negative incentives and promote participation in shadow economic

activities by widening the gap between expenditures and income. In contrast, progressive taxes take into account a worker's income and discourage unnecessary engagement in alternative activities.

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7. Appendix

Round 1
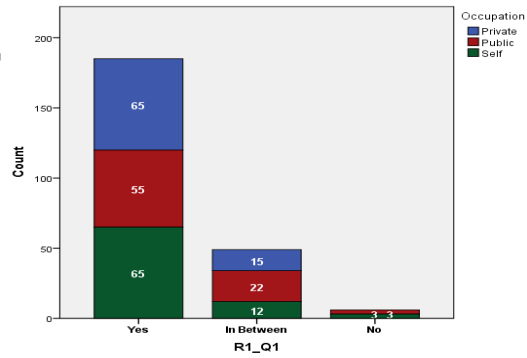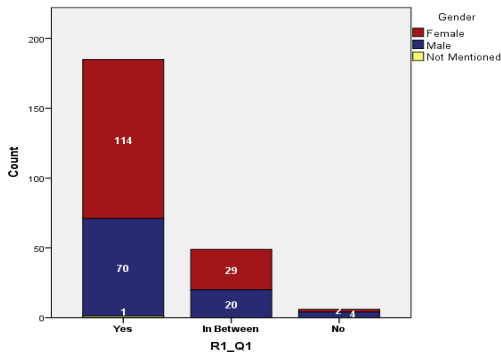
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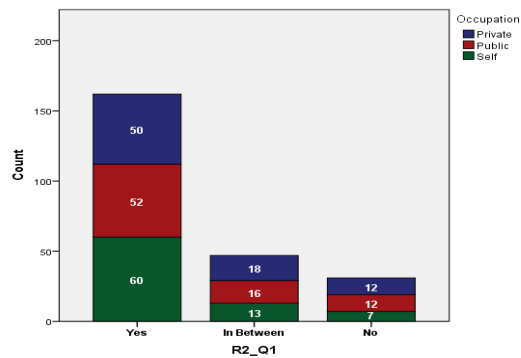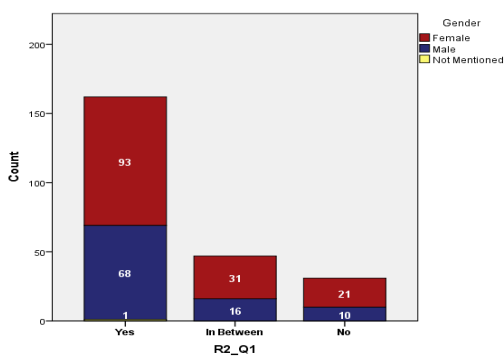
Round 3
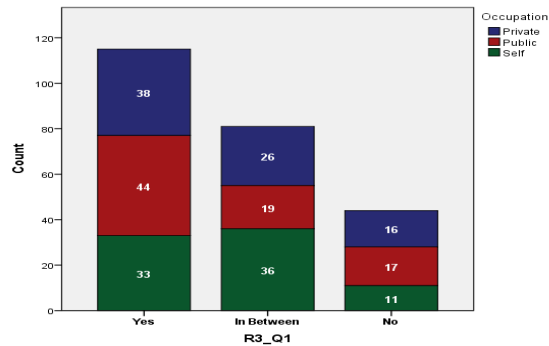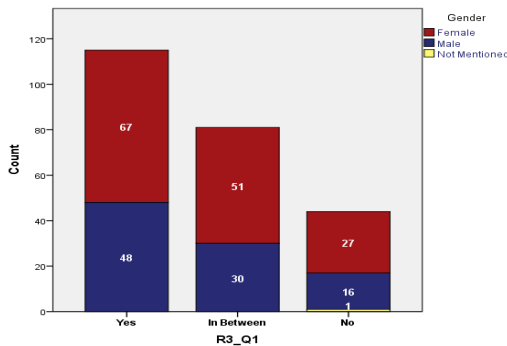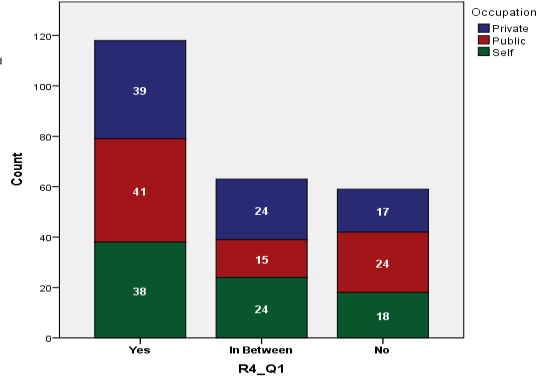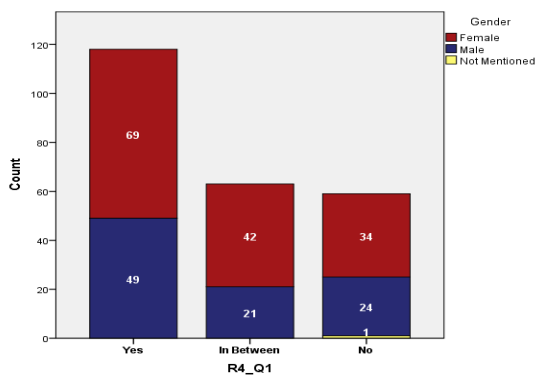
Round 4

Appendix 1. Satisfaction of the Respondents on the Occupation
Source: The authors.
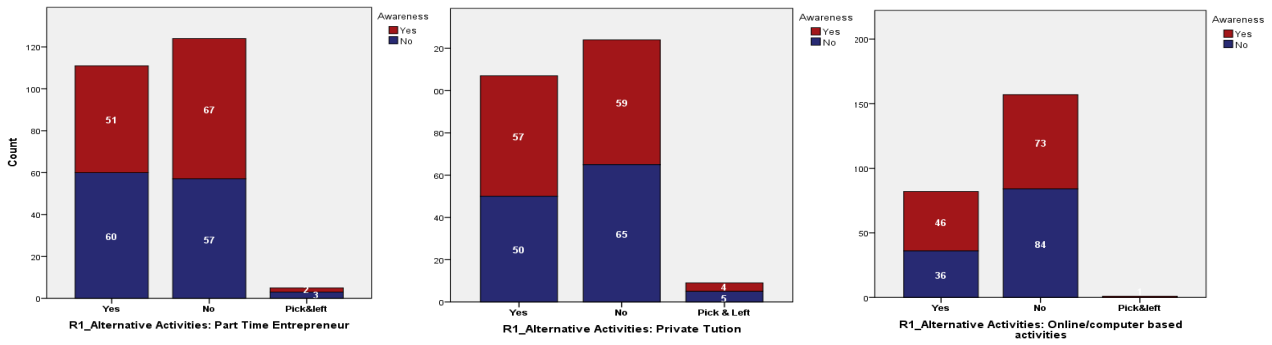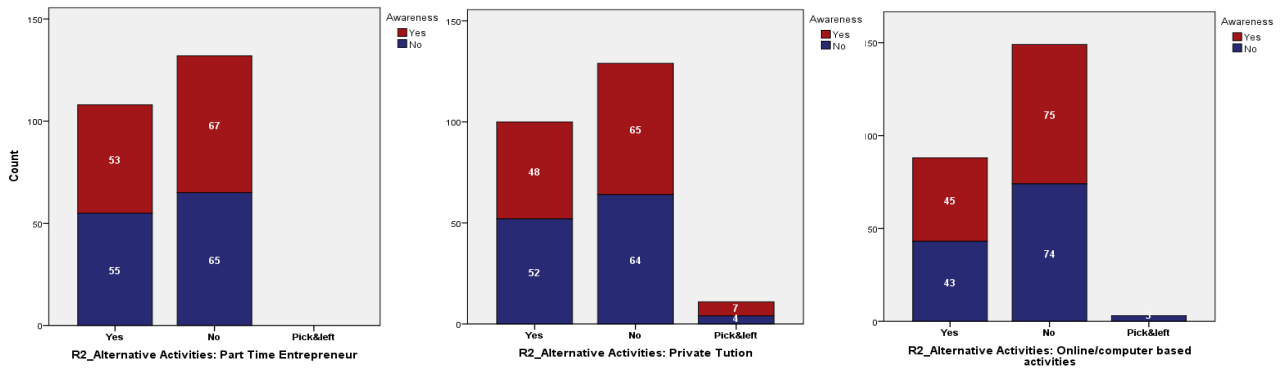
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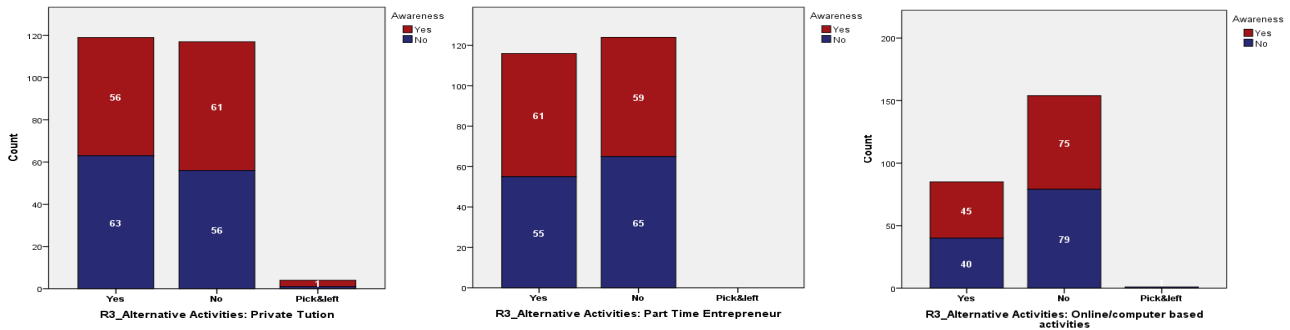
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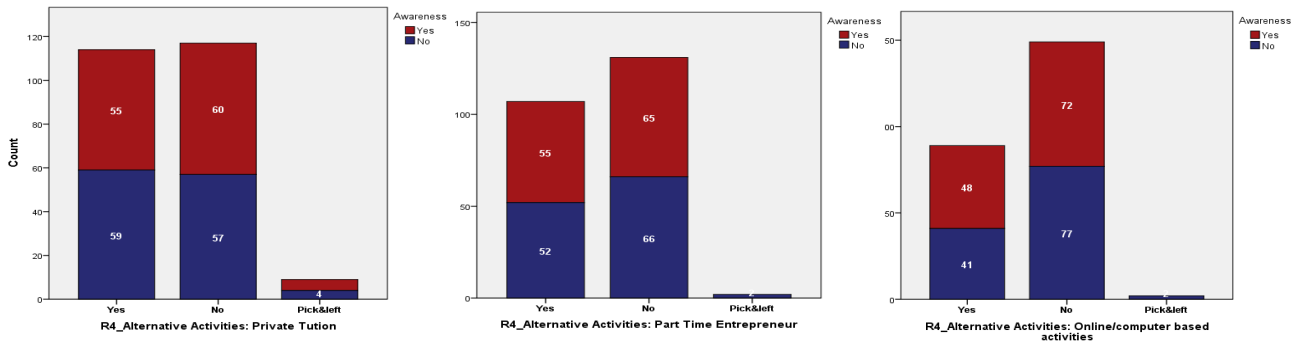
Round 3

Round 4

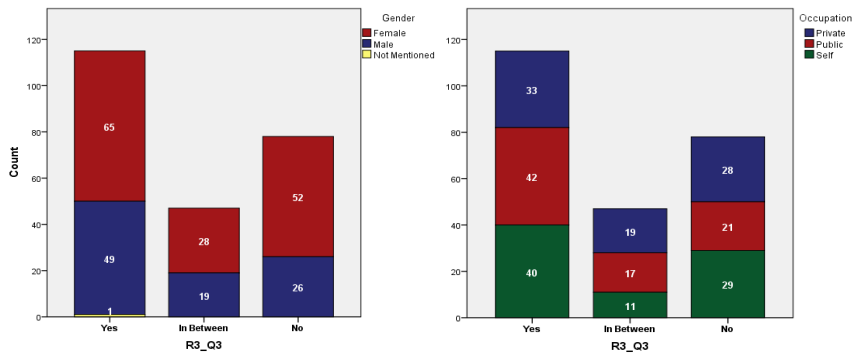**Appendix 1I.** Alternative Activities and the Awareness of the Shadow Economy
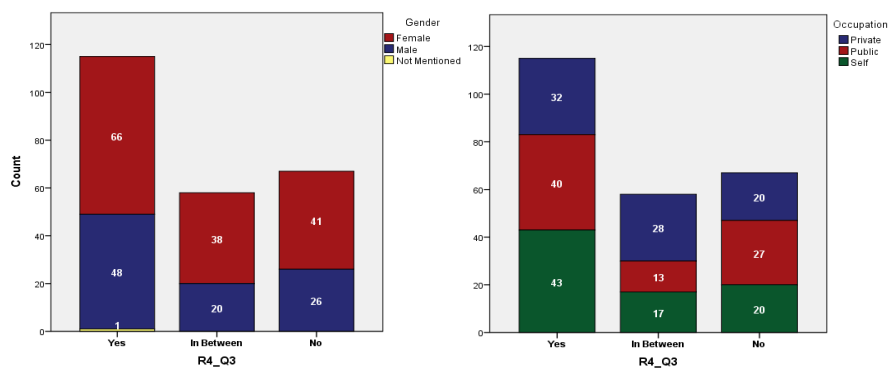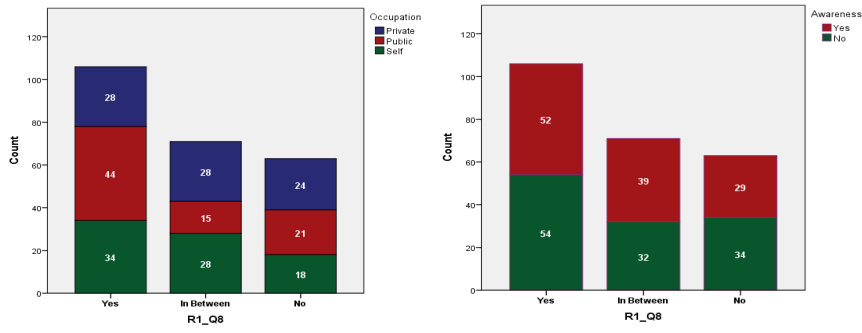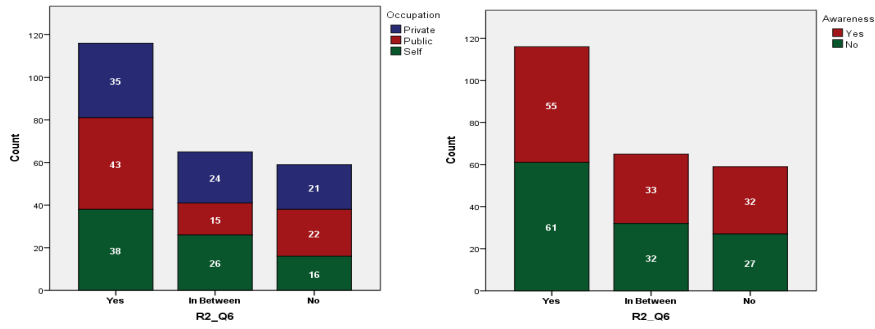**Source:** The authors.

22
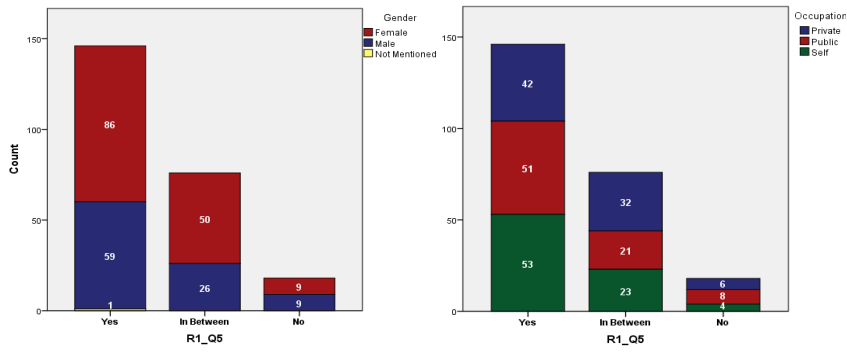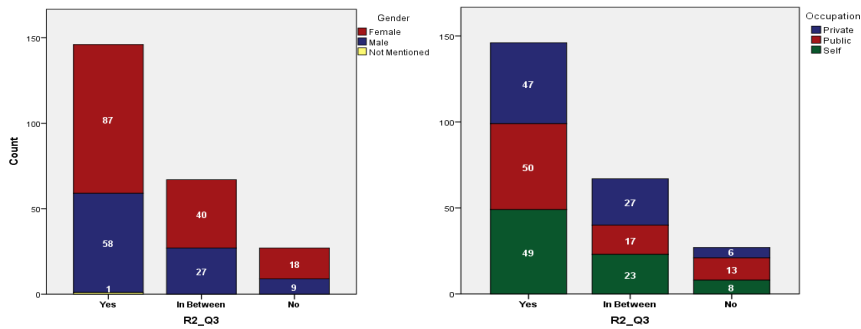
Round 1

Round 2

Round 3

Round 4

Appendix III. Respondents' Willingness to Pay Tax on the Official Job
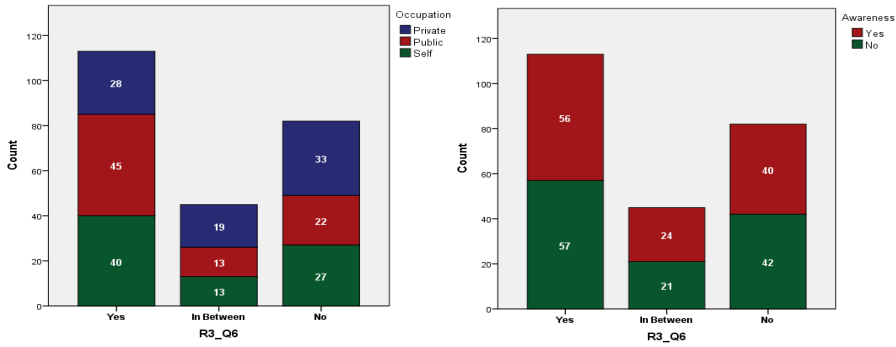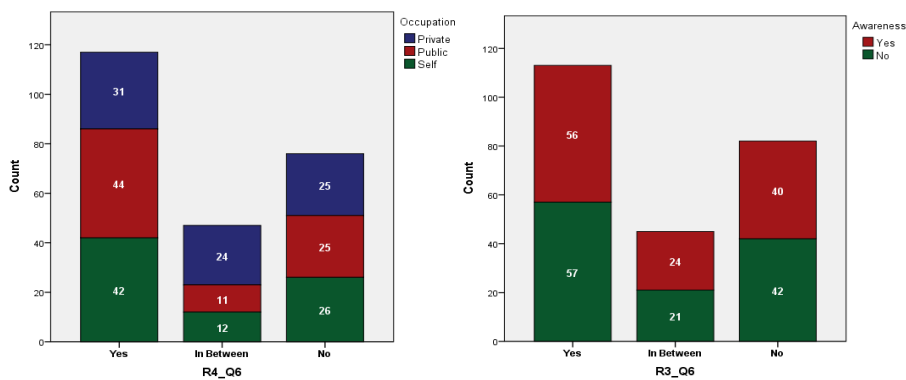**Source:** The authors.

Round 1

Round 2

Round 3

Round 4

Appendix IV. Respondents' Willingness to Pay Tax on the Alternative Activities
Source: The authors.

Appendix V. Payoff Matrix

Out of all ten players			Your Earnings/Cost in each round (in points)			
Enroll (E)	Not Enroll (NE)		If you take "E"		If you take "NE"	
		E (Numbers)	E (Your Points)	NE (Numbers)	NE (Your Points)
0	10	0	-	10	100
1	9	1	100	9	90
2	8	2	90	8	80
3	7	3	80	7	70
4	6	4	70	6	60
5	5	5	60	5	50
6	4	6	50	4	40
7	3	7	40	3	30
8	2	8	30	2	20
9	1	9	20	1	10
10	0	10	10	0	-

Source: The authors.

Appendix VI. Reliability Statistics

Test for the Reliability	Index/Significance
Cronbach's Alpha	*0.758*
Cronbach's Alpha based on standardized items	*0.751*
F value	*38.803****

Source: The authors.
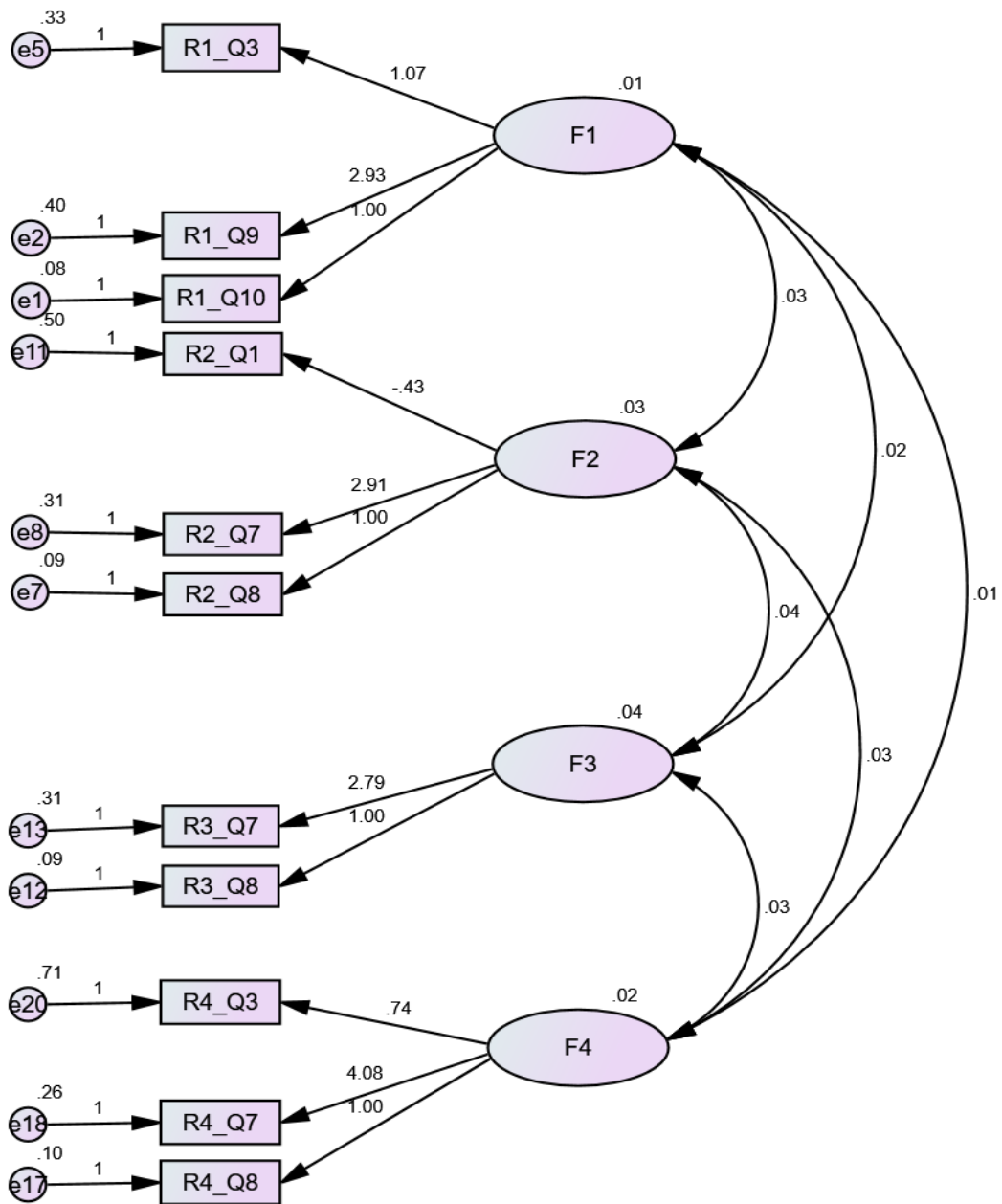
Appendix VII. The Revised Measurement Model
Source: The authors.