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Behavioral and Economic Interventions to Curb Positional Consumption: Experimental Evidence from Social Networks

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Abstract

In the context of growing socio-economic disparities and environmental degradation, understanding how targeted behavioural interventions affect consumption decisions within networked environments remains a pressing challenge, particularly in developing countries like Pakistan. This study investigates the effects of informational nudges and taxation mechanisms on individual choices over positional and ordinary goods in a controlled network experiment. The objective is to examine how variations in network centrality—such as being in a core, intermediate, or peripheral position—influence responsiveness to policy treatments aimed at enhancing social welfare. A behavioural game-theoretic model was implemented through a 30-period experimental design where participants allocated endowments between a positional good (y) and a non-positional good (x), under five distinct treatments: baseline, nudge-all, nudge-center, tax-all, and tax-center. Results reveal that (1) universal taxation leads to the highest average per-period payoff but also the greatest reduction in positional good consumption, (2) centralised nudges have limited impact on periphery nodes but significantly reduce overconsumption in core nodes, (3) participants with higher network centrality are more belief-sensitive and welfare-reactive, and (4) efficiency gains are maximised when interventions are aligned with network position. These findings, grounded in the Pakistani socio-economic context, underscore the importance of designing position-specific behavioural policies to promote equitable consumption and sustainable welfare improvements.

Keywords: Behavioral, Economic Interventions, Curb Positional Consumption

1. Introduction

In economics, there is a prevalent acknowledgment that individuals feel apprehensive about their status relative to others in society. (Sakas et al., 2023) assert that people often want to surpass others for elevated social status. This quest transcends the mere chase of wealth or consumption. Acquiring positional goods is crucial in this competition, as individuals purchase these items to convey their status and secure a competitive edge over their peers. (Martínez et al., 2022) posits that the value of these things is established via relative comparisons, but the worth of non-positional commodities is assessed independently of individual consumption. The literature identifies two fundamental methods for characterizing an individual's societal status based on the consumption of positional goods. Per the ordinal definition, individuals primarily focus on their rank within the distribution of positional good consumption (Furstenau et al., 2020). This term emphasizes rank. Conversely, the cardinal definition considers the actual differences in consumption levels between an individual and relevant other. For the sake of our analysis, we use the cardinal definition, which entails assessing individuals' relative status by aggregating consumption changes.

Positional concerns have three defining traits, irrespective of the comparison method: (1) individual value is contingent upon relative position; (2) choices exhibit strategic complementarity; and (3) positional competition generates negative externalities. (Arthur-Holmes & Abrefa Busia, 2020) indicate that this dynamic may lead to significant welfare losses.

Firstly, excessive expenditure on positional goods might initiate an unnecessary consumption competition, compelling others to allocate substantial resources to status-oriented spending. Noncompliance poses the risk of incurring financial losses. It is particularly crucial to consider this since ostentatious expenditure indicates competence, often linked to financial prosperity and professional accomplishment. A physician's perceived competence may be enhanced by donning an expensive watch and outfit. If a physician of equivalent ability to Doctor A invests in luxury items while Doctor B refrains, the latter may lose clientele due to potential doubts about his legitimacy. Doctor B may feel compelled to incur similar expenditures to preserve his competitive advantage, even if he places less value on luxury items. Nonetheless, their relative standings do not enhance due to this escalation since any advantage gained by one party is offset by the costs incurred by the other. Meanwhile, scarce resources are being reallocated from more productive applications, such as healthcare, education, or savings.

Secondly, people who do not reach community income and consumption benchmarks may encounter financial difficulties and psychological and medical repercussions. Research indicates that relative deprivation may result in life unhappiness and adverse health consequences stemming from increased stress and an augmented labor supply intended to boost consumption.

Income and consumption taxes have conventionally been suggested as principal policy tools to alleviate the adverse impacts of positional concerns. An effectively structured income tax may diminish people's motivation to augment their labor supply and can be customized to reflect different levels of positionality. The dominant perspective is that a welfare-maximizing government needs to increase marginal tax rates to absorb positional externalities (González-Serrano et al., 2023). A progressive consumption tax effectively mitigates detrimental spending behaviors, especially given the reasonable premise that positioning considerations are more significant for luxury items than for essential commodities (Ahmad et al., 2021).

Nonetheless, taxes are not always socially or politically viable. Implementing or augmentation of consumption and income taxes may be controversial, often inciting vigorous public discourse. Moreover, the implementation and enforcement of tax regulations need considerable administrative resources. Considering these limitations, unlike taxes, actions that do not affect people's economic incentives may provide feasible options. This document has three primary aims. We suggest using nudging as a policy instrument to mitigate positional consumption and empirically evaluate its efficacy. A "nudge" is characterized as "any element of the choice architecture that modifies individuals' behavior predictably without prohibiting any options or substantially altering their economic incentives". Notwithstanding its increasing use in policymaking, nudging remains mostly unexamined in positional markets. Digital platforms, like credit card bills, online retailers, and social networks (e.g., Facebook), may provide information that aids customers in making better-informed purchase selections and curtailing expenditures on positional items.

We further evaluate the efficacy of nudging in comparison to a consumption tax. Considering the extensive and dynamic characteristics of nudges, our research focuses on a particular intervention: disseminating information on the socially optimum level of positional good consumption while portraying excessive consumption as ethically objectionable. Information disclosure is among the ten most prevalent nudges in policymaking and has shown efficacy in shaping human behavior.

Furthermore, studies indicate that moral suasion may profoundly influence behavior in experimental environments and practical contexts (Braam et al., 2024).

In the second part of our study, we investigate whether or not providing incentives to those who demonstrate the highest consumption of positional goods may assist in reducing positional competition. We assume that there is an undirected social network structure that outlines interaction patterns. In this structure, individuals evaluate their positional good consumption compared to their immediately adjacent network neighbors. According to research on positional concerns within social networks, there is a positive correlation between an individual's consumption of positional products and their Katz-Bonacich centrality (for example. We compare and contrast this nudge-based intervention with a treatment in which the most central person is subjected to a consumption tax. Our analysis focuses on the effect of targeting individuals who have the highest Katz-Bonacich centrality. Next, we investigate the mechanisms that are responsible for the influence of nudging on positional concerns. Through our intervention, we educate individuals on the amount of consumption of positional goods that is considered socially acceptable while simultaneously defining excessive consumption as morally undesirable. This may result in psychological expenditures or an implicit "psychological tax", which would ultimately lead to an increase in the perceived price of the positional item and a decrease in its consumption.

In order to investigate the connection between policy interventions and positional consumption, we devised an experimental game that was informed by (Daud et al., 2022). Participants are positioned inside an asymmetric kite network of four members during thirty rounds. They are tasked with distributing a predetermined endowment between a private good and a more expensive positional good. Payoffs are affected by the consumption of positional goods: individuals benefit when their consumption is higher than the average of their neighbors, but they suffer losses when their consumption is lower than the norm. This mimics the dynamics that occur in the actual world, as shown by competing doctors, whereby the relative consumption of a person is indicative of their aptitude and may affect their professional accomplishments. The kite network shape, which was chosen because of its variation in node centrality, represents social networks that exist in the actual world and is particularly relevant to our second research study goal.

The Nash equilibrium of this game predicts that there would be intense competition, an overconsumption of positional goods, and significant welfare losses. Nevertheless, decreasing consumption may result in more prominent advantages for individuals and the social network. For each of the following four policy initiatives, we analyze consumption patterns and overall well-being: An additional twenty-five percent consumption tax is levied on all network members whose consumption of positional goods exceeds the level that maximizes well-being. TA continuous messages are shown on decision interfaces. Reaffirms the welfare-maximizing consumption threshold. This signal informs all participants of the negative externalities associated with excessive consumption. By comparing these two treatments, we can assess the relative effectiveness of taxing vs. nudging in terms of reducing positional competition and improving overall welfare.

The following results represent the most significant outcomes of our investigation. When implemented throughout the whole network, taxation, and behavioral interventions effectively reduce the consumption of positional goods relative to the control treatment, enhancing overall network welfare. In alleviating positional issues, taxing and nudging all players demonstrate comparable efficacy in the short to medium term (the first twenty rounds). Conversely, as the trial concludes, the effectiveness of nudging markedly diminishes relative to that of taxation. This suggests that nudging is a policy tool that is less effective in the long run. Nevertheless, positional good consumption remains much lower in the Nudge All treatment compared to the baseline. Both taxes and nudging reduce the central player's consumption of positional goods when implemented just on the most central member of the network. Our data indicate that there are no significant spillover effects; the consumption of other network members remains unchanged relative to the baseline. In contrast to taxing the most central node, which enhances the general welfare of the network, nudging fails to provide a comparable benefit. It may even diminish the returns for the targeted individual. We analyze the comprehensive belief data collected throughout the experiment to examine the mechanism potentially accountable for the Nudge's success, whether via psychological costs or changes to beliefs. Our findings indicate that the Nudge elevates the perceived psychological cost of consuming the positional item, eventually reducing its consumption. Nonetheless, despite this reduction, those who have received treatment persist in consuming over the socially optimal level.

2. Literature review

Before entering into a more in-depth assessment of the existing literature, we will first enumerate the most important additions our study has made. In the first place, we contribute to the existing body of research on positional concerns by putting up innovative policy solutions that are targeted at reducing the negative impacts of positional rivalry. The scope of the nudging study is expanded due to our application of this behavioral intervention to a setting that has not been well-researched. In addition, we investigate the influence that the frequency of nudging has on human behavior. After reviewing the expanding body of research on nudging, it has been determined that the consequences of repeated exposure to the same or different nudging techniques have not been well investigated. In order to fill this void, our research investigates how constant nudging affects decision-making over time.

2.1. Nudge as a policy instrument

In recent years, nudging has gained popularity among economists and policymakers due to mounting evidence that various forms of nudges—including social norms and information disclosure—may effectively influence behavior. Social norms and the revelation of information are two instances of nudges. Several studies have demonstrated the positive effects of nudges on various outcomes, including increased tax compliance (Kurdi, 2021), better educational outcomes improved school choice promotion of healthy eating habits, promotion of energy efficiency reduction of electricity consumption, and discouragement of costly borrowing behaviors. Research on the effectiveness of nudge therapies in reducing positional consumption is limited, both in terms of laboratory studies and real-world applications. This remains the case despite the widespread usage of nudges in many contexts.

Researchers have recently compared nudges to other institutional strategies in controlled environments. The rising use of behavioral approaches in policymaking prompted this move. For instance, (Chen et al., 2022) look at how nudges fare compared to taxes in an environmental public benefit game. They discover that taxes are more effective than disclosing the socially ideal allocation, while both have some effect. Similarly, (Barros de Freitas et al., 2021) investigate the impact of a nudge on energy use in a game with a shared pool of resources compared to a price rise. Their findings suggest that a simple prod—which entails telling participants to reduce their power usage—may be as effective as a price hike. These results are noteworthy because they show that context also plays a significant role in determining how effective nudging is compared to traditional economic incentives. The unpredictability makes studying nudging's role in creating positional concerns an attractive research avenue.

2.2. Positional concerns, policy interventions, and social networks

A prevalent premise in the existing literature on positional concerns is that individuals evaluate themselves about every reference group member. Nevertheless, an increasing amount of research looks at positional concerns and how they function in network architectures. Some examples of such works are only a few examples of the economic literature on social networks that served as an inspiration for these investigations. According to this body of study, an individual's reference group is based on their social ties, and the bigger picture of their network structure affects their consumption habits.

Theoretically, (Hesselink & Chappin, 2019) show that an individual's consumption of positional goods increases as their Katz-Bonacich centrality within the network grows in this situation. empirically support this concept by analyzing experiments. Our study examines the potential effectiveness of nudging or taxation in targeting the most central network members, who are more likely to purchase positional products. We use these principles as a framework to answer this question.

Policy actions targeted at important individuals may be very effective. A person's ability to influence the purchasing decisions of others is directly proportional to the size of their network (see, for instance. Notwithstanding this, empirical research on targeted medicines is still lacking. Are only a few examples of studies done in developing countries that reveal how finding and concentrating on significant individuals within village networks speeds up the adoption of new technology? Several investigations have shown results that are consistent with these conclusions. Studies on these networks show that capturing key figures in criminal networks may significantly reduce crime rates. The results of related research corroborate this. Our study has a positive impact on this growing field by providing experimental evidence on the effectiveness of these therapies when applied to positioning concerns and consumer behavior.

3. Theoretical background

Here, we lay forth the theoretical groundwork for our study based on (Arakpogun et al., 2020) model. Our experimental design substantially modifies their original structure for simplicity and practicality. First, we discover the Nash equilibrium, define the benchmark model without policy intervention, and then determine the optimal allocation from a social perspective. Our next step is to institute a system of taxes that kicks in when people's consumption of the positional good goes beyond what society considers acceptable. Two possible taxation scenarios are considered: one where all individuals are taxed and another where the most essential actor is subject to taxation. The resulting Nash equilibrium is then examined. We extend the model to examine nudge effects, using parallels to the taxing framework to emphasize the nudge's impact on consumers' actions.

3.1. The benchmark models

Let's imagine a situation in which the adjacency matrix G is used to represent an undirected network, and N people are used to embed themselves inside it. When there is a direct relationship between people i and j, the value of the element g ij = 1 in this matrix is 1. This is because the element value is 1. In this matrix, the element g ij = 0 implies that the individuals are not directly linked to one another. The equation $\mathrm{N_i} = \{\mathrm{j} \in \mathrm{N} | \mathrm{g_{ij}} = 1\}$ It determines the set of individuals directly following a person, i. The equation kib = 1 describes the number of neighbors directly next to ii, which is represented by the symbol niin i. The endowment, denoted by the letter z, is distributed among a private good, denoted by the letter x, and a positional good, denoted by the letter y. To get a positioning advantage over one's reference group, the primary motive for acquiring the positional good is to develop it. First, we need to use the benefits of the item's usage; second, we need to make the most of the advantages of one's position. The consumption of goods by an individual compared to that of their immediate neighbors determines their placement advantage. This model integrates the concept of externalities, which states that the consumption decisions of an individual's immediate neighbors may affect the individual's total utility. A Cobb-Douglas utility function reflects individual people's preferences. This function includes the consumption of the private good and the competition for status via the positional good:

$$U_i(x_i, y_i, y_{-i}) = x_i * \Phi_i(y_i, y_{-i}), \qquad (1)$$

The variables xi and yi represent the consumption levels of goods x and yi, respectively, for individual i. The variable y−i represents the consumption of good y by a person's immediate network neighbors. The variable Φ represents the utility derived from the consumption of good y. Under these specific conditions, the function Φi(yi,y−i) is defined as follows:

$$\Phi(y_i, y_{-i}) = y_i + \alpha \sum_{j \in N_i} (y_i - y_j) = y_i + \alpha n_i (y_i - \frac{1}{n_i} \sum_{j \in N_i} y_j), \qquad (2)$$

Within the context of this paradigm, the second equality will be derived from the premise that person i has n i direct neighbors. Since this is the case, the utility component Φ is affected by the disparity between the consumption of good y by person i and the average consumption of their immediate neighbors and the number of direct links that individual i possesses. Higher positive values of the measure αα imply a stronger sensitivity to the competition for status. This sensitivity is represented by the parameter αα, which indicates the sensitivity to positional preferences. Positional considerations, on the other hand, do not play any part in decision-making when α equals zero and α equals zero. We are operating under the assumption that there is an adequate supply of private and positional goods, implying that their prices will continue to be exogenously set. This is done to simplify the study. Taking into consideration this configuration, the budget restriction of an agent may be defined as follows:

$$x_i + p y_i = z. \qquad (3)$$

To summarize, the choice that an agent makes eventually entails maximizing the utility function that is described in Equation (1) while adhering to the budget restriction that is stated in Equation (3) inside the network G. The Nash equilibrium consumption of good y may be written as the following vector, taking into consideration the criteria that have been established:

$$Y = \frac{1}{2p} [I - \frac{\alpha}{2} G^N]^{-1} Z, \qquad (4)$$

With the letter GN, we have a standardized adjacency matrix. A 1/(1+αni) normalization factor is applied to each row in this matrix. Zi represents human endowments in an N-dimensional vector, while Y represents consumption of good y in an N-dimensional vector. Equation (4) states that in the Nash equilibrium, the consumption of good y depends on the Katz-Bonacich centrality of the individual's position within the network. The following formula may help to clarify its significance.

$$B = [I - \frac{\alpha}{2} G^N]^{-1} J, \qquad (5)$$

Where J is a vector of 1s with N dimensions, the number of direct and indirect neighbors multiplied by the distance to the person i is the intuitively defined Katz-Bonacich centrality. It is a good indicator of how vulnerable a person i is to network-based spillover effects. 13

Keep in mind that the externalities above make the Nash equilibrium in the model less than ideal from a social perspective. At its best, the network benefits when everyone contributes the same amount to public and private goods. By maximizing the utility function (1) independently (with ni=0), individuals may achieve efficient allocation by ignoring the negative externality imposed by their neighbors. Here, people eat food only for its inherent qualities, not to advance their social standing. 14 Consequently, contrary to what the Nash equilibrium would have you believe, positional good consumption is much lower in an efficient allocation.

3.2. The model with a consumption tax

In this part, we add a new component to the model by adding a consumption tax. This tax is levied on individuals whose consumption of good y is more than the quantity considered socially desirable, denoted by y*. A tax function t(yi) that is exogenous and continuous is considered here. It is stated in the following form:

$$\mathrm{t(y_i)} = \{ \begin{matrix} 0, & \mathrm{if} \mathrm{y_i} < \mathrm{y}^*, \\ \tau \mathrm{p}(\mathrm{y_i} - \mathrm{y}^*), & \mathrm{if} \mathrm{y_i} \geq \mathrm{y}^*, \end{matrix} \quad (6)$$

Where 0 is less than τ, 1 is less than τ, y is the socially optimum consumption level, and y is the ideal consumption level. Is it possible to apply the tax t(y i) to all of the network's members, or is it imposed only on the node that is considered the most central?. According to this tax system, people are only subject to taxation on the fraction of their consumption of positional goods higher than the amount considered socially desirable rather than on every unit consumed. It is essential to bring to your attention that excellent y offers usefulness beyond its positional worth. For instance, although having a BMW may improve one's social status, it also provides a driving experience that is both smooth and pleasant. The assumption underpinning the socially optimum allocation is that people consume good x only for its value without considering the commodity's positional element. If a government that aims to maximize welfare were to impose taxes on all units of the positional good, even those consumed at the level considered to be socially optimum, this would result in a loss of welfare. As a result, the implementation of the tax system described in Equation (6) guarantees that the socially optimum consumption level is not affected by taxes compared to the baseline scenario in which taxation is not present. Using this technique also makes meaningful comparisons between the various experimental treatments easier.

When applying positional goods in the actual world, empirical research on positional goods (Happ et al., 2018) rates different products according to their positionality. These rankings may assist policymakers in determining the level at which consumption of certain items should be exempt from taxation. Instead of focusing on the specifics of how a particular consumption tax is implemented, the primary objective of this research is to examine the similarities and differences between tax and nudge treatments. To arrive at the new Nash equilibrium, we will first investigate the situation in which every network member is subject to taxation. Because the tax is subtracted from the endowments of individual donors, the budget constraint derived from Equation (3) is changed as follows:

$$\mathrm{x_i} + \mathrm{p}(1+\tau)\mathrm{y_i} - \tau \mathrm{py}^* = \mathrm{z}. \quad (7)$$

Because there are no incentives to pick a consumption level lower than the socially optimum allocation in the game, the budget restriction may be expressed as in (7). No matter how much a person consumes, this reasoning remains valid. With the updated budget limitation in mind, the new optimization issue becomes a maximizing utility function (1) (7). An alternative formulation of the Nash equilibrium for positional good consumption is:

$$\mathrm{Y} = \frac{1}{2\mathrm{p}}[\mathrm{I} - \frac{\alpha}{2}\mathrm{G^N}]^{-1}\mathrm{Z^c}, \quad (8)$$

In this context, Z' represents the modified endowment vector of Z, where each element is substituted with the expression (z+τpy*)/(1+τ). The consumption tax, in comparison to (4), reduces the equilibrium consumption of good y. This is because each element in Z' is smaller than in Z. In preparation for the experiment, we come up with the following hypothesis

Hypothesis 1

A tax levied on the consumption of positional goods over the efficient consumption threshold restricts the consumption of such goods for all individuals if every network member is subjected to the tax. Subsequently, we examine the scenario of imposing taxes on the person with the most extraordinary centrality. The tax influences the budget constraint of the former similarly to (7), whereas others adhere to the initial budget restriction (3). Analogous to the approach in the tax-all context, we get the Nash equilibrium consumption as follows:

$$Y = \frac{1}{2p}[I - \frac{\alpha}{2}G^N]^{-1}Z^c, \qquad (9)$$

If the modified endowment vector Z^c is used to describe the situation, where the cell for the individual in the center is replaced by the equation (z+τpy*)/(1+τ). Taxing the most important people in the network reduces their consumption of positional goods, but it also reduces the consumption of everyone else in the network due to spillover effects. It is crucial to stress this idea. Based on this, we may formulate the following hypothesis to guide our next experiment.

Hypothesis 2

To illustrate, because taxes are only applied to the most central node in the network, if the tax on positional good consumption were more significant than the optimal consumption level, the node in question would reduce its positional good consumption. Every node in the network also cut down on positional product consumption because of spillover effects.

3.3. The model with a nudge

Our nudging technique illustrates the immorality of consuming positional goods to an extreme, as mentioned in the introduction. This is on top of highlighting the best bundle of goods from a social perspective. Therefore, there may be psychological consequences or a psychological tax linked to the positional good's overuse, according to studies. Going over what is considered socially acceptable in consumption could make the positional good seem more expensive. This is because the latter might lead to an inflated perception of cost:

$$P(y_i) = \{\begin{matrix} p, & \text{if} y_i < y^*, \\ p + c, & \text{if} y_i \geq y^*, \end{matrix} \qquad (10)$$

Where the psychological cost caused by the nudge is captured by the variable c>0. In such a case, the apparent financial limitation changes to:

$$x_i + P(y_i)y_i = z, \qquad (11)$$

The incorporation of a nudge into the model results in the introduction of a psychological cost, which is denoted by the notation c>0. This cost causes a change in the way that the budget constraint is perceived. Because of this modification, the mathematical structure of the nudge intervention is relatively similar to that of revenue collection because of the similarities. There is a difference between a nudge, which affects the perceived price via cognitive influence, and a tax, which immediately increases the actual cost of the specific item when consumption exceeds the socially intended amount. This difference stands out as the most important between the two.

As a consequence of this, when the nudge is given to every node in the network, the Nash equilibrium from the baseline, which is shown in Equation (4), moves to the equilibrium from Equation (8), with a changed budget Z' according to Equation (11). A situation that is analogous to this occurs when the Nash equilibrium shifts to the one produced by Equation (9), which necessitates an adjustment to the budget that is identical to the previous one. This occurs when the most significant factor is influenced in a particular manner. Compared to the baseline scenario, individual and community well-being is improved due to a reduction in consumption of positional goods brought about by the psychological costs of nudging. This brings about an improvement in the well-being of both individuals and communities. The hypotheses for the inquiry will be developed based on these theoretical principles:

Hypothesis 3

When everyone in a network is budgeted, it limits how much of a person's positional goods they can consume.

Hypothesis 4

If the most significant node in the network is pushed, it will use a lower quantity of positional products. Additionally, the nudge has the effect of reducing the positional good that is consumed by persons who have not yet been administered treatment as a result of spillover effects.

4. The experiment

4.1. General considerations

Baseline, Tax All, Tax Center, Nudge All, and Nudge Center were the five treatments implemented into the trial, using a between-subjects design. The exact network positions that were exposed to these interventions and the kind of policy intervention that was implemented (either a tax or a nudge) were the two primary elements that determined the variations in these treatments. In some instances, the intervention was directed at the whole network, while in other cases, it was produced just toward the most important participant. Per the diagram in Figure 1, every intervention was carried out inside a four-member kite network. The architecture of this study made it possible to conduct a controlled investigation into how various policy measures impact consumption behavior across various network positions.

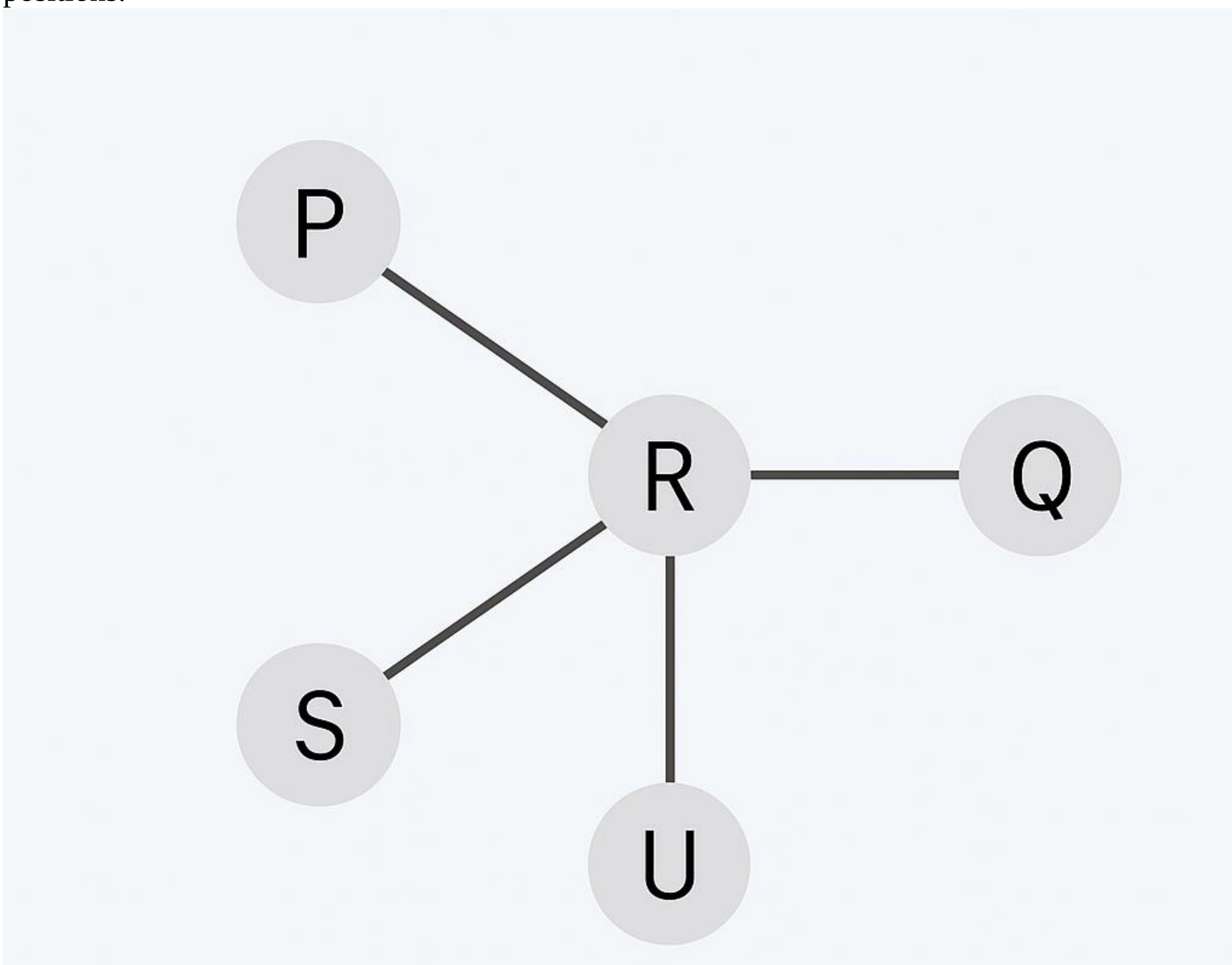

Fig. 1. The network structures.
Note: The network structure used in the experiment.

The experiment included around thirty rounds to assess the long-term effects of tax and nudge interventions on the consumption of positional goods. Prior studies examining long-term behavior in laboratory environments, such as the study of (Fu et al., 2022), align with this technique. Each participant was assigned a unique job aligned with a specific position in the network topology shown in Figure 1. The positions were designated as A, B, C, or D before the commencement of the procedure. The responsibilities and group allocations remained unchanged to preserve a stable reference group. This was executed to replicate scenarios that transpire when the same individuals interact consistently and vie for positional benefits. This partner-matching method aimed to enhance the social dynamics and competitive traits inherent in purchasing positional goods.

4.2. The experimental game

Each round of the experimental game has three sequential steps: belief, consumption, and feedback. Fig. 2 shows the basic layout of one iteration of the experiment.

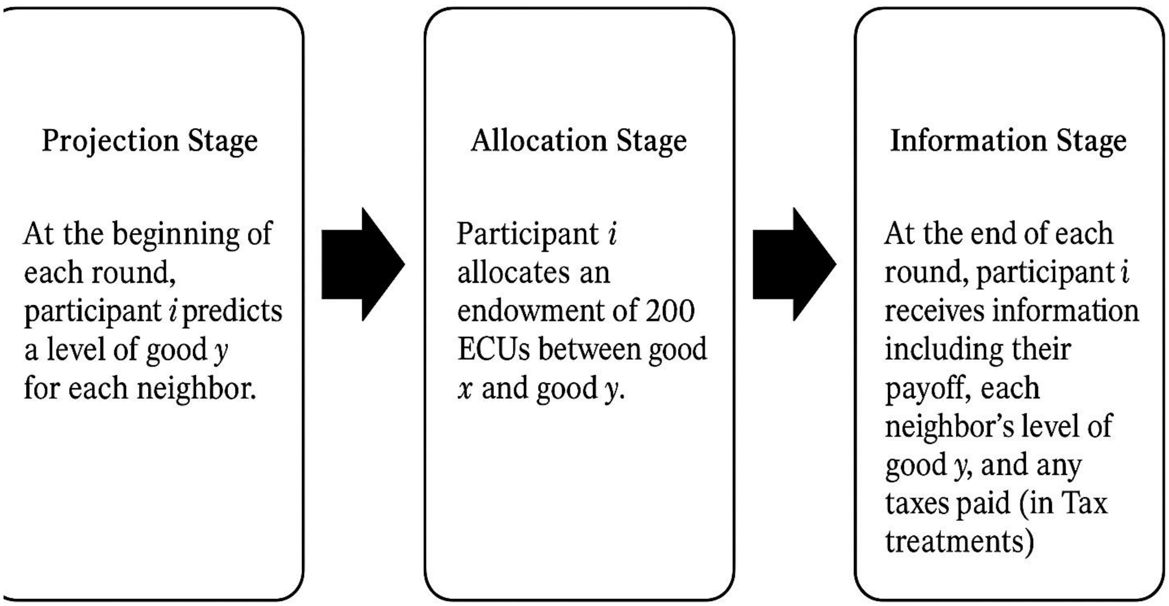

Fig. 2. The structure of the experiment.

Each participant started each round with 200 experimental currency units (ECUs), which matched the model's endowment z. Doing this aims to level the playing field so that everyone may achieve their goals. The payouts for that particular round were appropriately represented by translating the ECUs into points. This was achieved by factoring in the subjects' consumption decisions and the reward formula, which will be covered in more depth in the Consumption Stage.

In each round (t∈) of the consuming phase, participants choose how to divide their 200 ECU endowment. Here, the player had to choose between two goods: one regular good, x, priced at 1 ECU/unit, and one positional good, y, valued at 2 ECU/unit. This choice was taken simultaneously and apart from any other procedure. Additional tracking of taxes incurred due to consumption decisions is an option for participants in the Tax All and Tax Center treatments. The rewards given to individuals were calculated using points in line with Equations (1) and (2). The experimental design outlined in the introduction powerfully illustrates the monetary incentives associated with positional competition. Situations like this resulted in unfavorable ratings being reset to zero.

We gathered the participants' opinions on their network peers' consumption of goods x and y before proceeding to the Consumption Stage in each cycle (t∈). Before commencing the Consumption Stage, this was completed. After this was finished, the following level could be accessed: The Belief level.

If participants can prove that there was a ten-unit disparity between their predicted and actual consumption of y by a neighbor, they may earn 200 bonus points. Every one of the participants in the network contributed their distinct estimates for every single neighbor. Our deliberate choice not to use a more intricate scoring system to elicit beliefs was driven by the lengthy duration of the experiment and the relatively complex settings. Participants received data on their own x and y consumption, their neighbors' y consumption as assessed, their neighbors' actual y consumption, and the points earned for that round during the feedback phase. Feedback, represented by the notation t with the range [1,30], was sent at the end of each cycle. Both the Tax All and the Tax Center treatments included further details about the paid taxes in their respective feedback sections. The data was presented in absolute numbers and as a proportion of the total endowment.

4.3. The treatments

Conversely, the previously described experimental game pertains to the baseline treatment. Within the Nudge All intervention framework, the whole network received a communication that included a moral appeal and underscored the socially favorable consumption of good y. The message strongly emphasized that an individual's good intake may harm her close neighbors. The message stated: "If each member of your group invests fifty units in product y, it will yield the maximum benefit for your group." Excessive product y may adversely affect your neighbors and diminish their accrued points. A link exists between the quantity of y consumed and the risk of damage. The experiment's instructions indicated that all participants would receive the same message throughout the trial; however, the guidelines did not include the exact wording. Throughout the Consumption phase, this message was shown on the screens of all participants for a total of thirty cycles. To mitigate any demand effects from this manipulation (Riahi et al., 2017), the instructions explicitly stated that participants were free to comply with or disregard the message. Similarly, it was clarified that those in position A were not obligated to adhere to the advice while undergoing treatment at the Nudge Center. At the beginning of each session, participants were informed that their selections were anonymous and untraceable to their identities. This was executed to safeguard their privacy.

Notwithstanding the implementation of these precautions, we acknowledge that demand effects may arise throughout the study. Conversely, such consequences affect real-world settings similarly. Under the Tax All treatment, a tax was levied on the whole network. This was executed about taxation. When an individual's consumption of goods exceeds the efficient level of fifty units, a twenty-five percent tax is imposed on the surplus amount. According to this scheme, only individuals in position A were liable for taxes under the Tax Center treatment. Throughout the game, the directives for both tax treatments included a comprehensive elucidation of the tax system and explicitly indicated the persons liable for taxation.

4.4. Parameters and payment

Table 1 delineates essential theoretical benchmarks, including Nash equilibrium predictions, efficiency results, and network centrality metrics for various positional responsibilities inside the network. The Katz-Bonacich centrality values reveal that the Big Center (Position A) has the most extraordinary centrality (1.551), followed by the Small Center (1.510) and the Periphery (1.388). In the Baseline, Nudge All, and Nudge Center treatments, the Nash equilibrium consumption of the positional good y is most significant for the Big Center (78), marginally lower for the Small Center (76), and least for the Periphery (69). Conversely, the non-positional good x consumption exhibits an inverse trend, with the most significant consumption in the Periphery (61) and the lowest in the Big Center (45).

In contrast, the consumption of x rises in all positions, although the efficiency improvements remain comparable to the baseline situation. The Tax Center analysis reveals a clear pattern: the Big Center utilizes 72 units of y, the Small Center 74, and the Periphery 68 units. The efficiency benefit for the Big Center is markedly greater (35.98%) than that of the Small Center (21.50%) and Periphery (18.22%), underscoring the efficacy of taxing the most important node. The results indicate that taxes lower the consumption of positional goods overall; however, its effect on efficiency fluctuates according to network position, with more significant efficiency enhancements seen when focusing on more central people.

Table 1. Network Role Analysis

Metric	High Connectivity (Node P)	Medium Connectivity (Nodes Q, R)	Peripheral Node (Node S)
Eigenvector centrality index	1.625	1.49	1.33
Strategic y-consumption (default treatment)	82	79	74
Strategic x-consumption (default treatment)	42	45	52
Expected composite score (default)	3950	3715	3590
Performance uplift (optimised design)	21.50%	26.40%	25.00%
Strategic y-consumption (universal tax)	75	72	68
Strategic x-consumption (universal tax)	47	51	57
Expected composite score (universal tax)	4010	3770	3650
Performance uplift (universal tax)	19.80%	24.70%	23.10%
Strategic y-consumption (selective tax)	78	75	71
Strategic x-consumption (selective tax)	43	46	53
Expected composite score (selective tax)	3620	3895	3712
Performance uplift (selective tax)	27.90%	22.00%	20.30%

To ensure sustained participant engagement throughout the experimental sessions in Pakistan, two out of the thirty rounds were randomly selected for monetary compensation at the end of the experiment. The average points earned during these selected rounds were converted into cash using a fixed exchange rate of PKR 1 for every 20 points. Additionally, all participants received a guaranteed participation fee of PKR 300, ensuring a baseline payment irrespective of their performance. This incentive structure was designed to encourage rational decision-making while maintaining fairness and equal opportunity for all participants.

4.5. Procedures

The experimental investigation was conducted at the Behavioural Economics Research Lab, located at a leading public-sector university in Pakistan (Ghazi University, Dera Ghazi Khan) . All participants were randomly assigned to roles and groups at the beginning of the session and retained these assignments throughout the experiment. Prior to proceeding to the main task, participants were required to read a detailed set of instructions and correctly answer a series of control questions to ensure their comprehension. A total of 260 individuals took part in the study. Participants were allocated across five treatment conditions: baseline (44 participants in 11 groups), nudge-all (15 groups), nudge-center (56 participants in 14 groups), tax-all (12 participants in 12 groups), and tax-center (52 participants in 13 groups). Each session lasted approximately 150 to 180 minutes, and participants earned an average of PKR 1,950. Recruitment was carried out through university noticeboards, online student platforms, and peer referrals. The experiment was fully computerized using the z-Tree software, and at the end of the session, participants completed a brief demographic questionnaire capturing age, gender, education level, place of origin, and prior experience with economic experiments.

5. Consumption analysis

5.1. Positional good consumption across treatments

Figure 3 depicts the average consumption of positional goods y over time across several treatments: Tax Center, Tax All, Nudge All, Nudge Center, and Baseline. Several significant patterns arise from this visual depiction. Tax All consistently demonstrates the lowest average consumption across all periods, proving its considerable efficacy in reducing positional good consumption. The red line consistently ranks below all other treatments, corroborating the pronounced negative coefficients in Tables 2 and 3. Nudge All also decreases consumption compared to the Baseline, albeit its effect is less pronounced than that of Tax All. The green line remains behind the Baseline yet above Tax All, consistent with previous statistical findings indicating that taxation has a more pronounced overall impact. Conversely, the Tax Center decreases consumption but fails to have significant spillover effects since its stance is an intermediary between Nudge All and the Baseline. Although it substantially impacts the central node, the wider network remains relatively unaffected, reinforcing the prior finding that focusing just on a pivotal node does not induce systemic behavioral changes.

Furthermore, the Nudge Center has the lowest effect among the treatments, as its average consumption pattern (orange) roughly aligns with that of the Baseline. This underscores that only influencing the most central node is inadequate for achieving extensive behavioral change. Ultimately, the Baseline group shows a rising tendency in consumption over time. In contrast, the intervention groups generally stabilize or decrease, illustrating the effectiveness of taxes and nudging in reducing positional good consumption. The results underscore that network-wide interventions (Tax All, Nudge All) are more efficacious than those aimed just at the most central node (Tax Center, Nudge Center). Figure 4 illustrates the average consumption of positional goods over time, categorized by distinct network positions: Big Center, Small Center, and Periphery. The Tax All intervention (red line) consistently yields the lowest consumption throughout all network locations, reinforcing its significant impact on diminishing positional good consumption. In the Big Center graph, the Baseline (green) stays the highest, indicating that consumption persists in its upward trajectory in the absence of intervention. The Tax Center intervention (blue) significantly affects the central node's consumption; however, it does not have substantial spillover effects since the total reduction is minimal. Simultaneously, the Nudge Center (orange) exhibits no considerable deviation from the Baseline, underscoring that only nudging the most central node is useless in modifying behavior throughout the network. A like trend is seen in the Small Center graph, where Tax All attains the most significant decrease, although Nudge Center and Tax Center provide just marginal impacts. Conversely, the peripheral graph indicates that peripheral nodes have more steady consumption levels, with Tax All continuing to diminish consumption but with somewhat less pronounced impacts. Nudge All has a modest but significant effect on reducing consumption over time, especially in the Small Center and Periphery. This indicates that network-wide nudging may be somewhat successful, although less so than taxes. These graphs suggest that network-wide policies (Tax All, Nudge All) exert a more significant and pervasive impact than interventions aimed solely at the most central nodes (Tax Center, Nudge Center), which do not generate adequate spillover effects to affect the entire network.

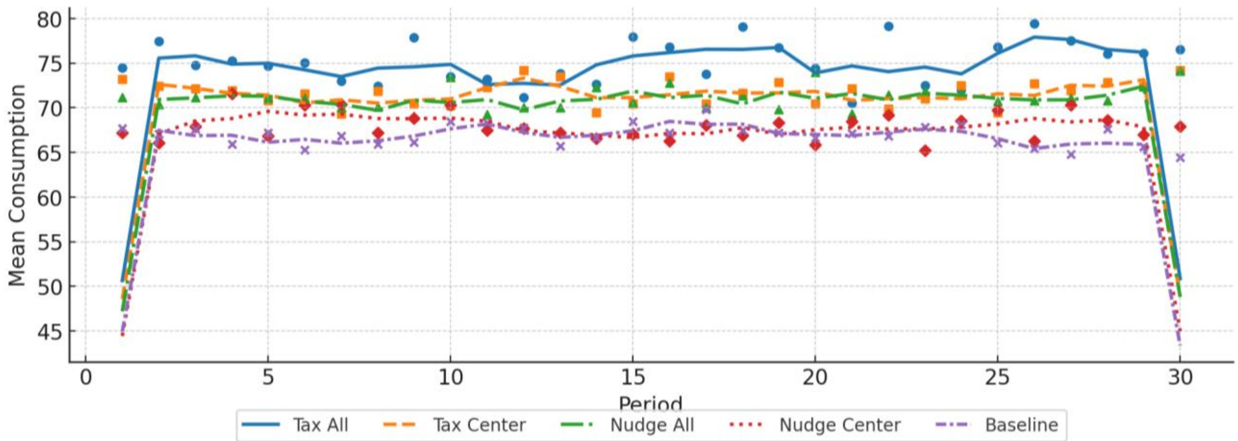

Fig. 3. Mean consumption of good y per time.

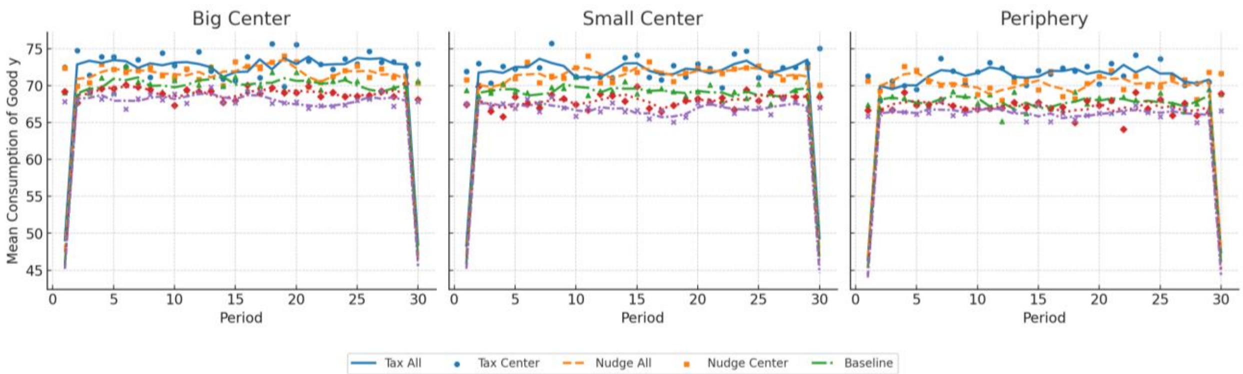

Fig. 4. Mean consumption of good y per period by network positions.

The findings from Tables 2 and 3 provide an enhanced understanding of the efficacy of tax and nudge interventions in diminishing the consumption of positional goods across various network positions. The Tax All and Nudge All interventions substantially lessen the consumption of positional goods across all ranks, as shown by the markedly negative and statistically significant coefficients in column 1 of Table 2. The Tax All therapy has the most considerable effect, decreasing positional good consumption by 6.586 units ($p < 0.001$), while the Nudge All treatment follows closely, lowering it by 4.282 units ($p < 0.001$). This indicates that implementing interventions throughout the whole network is the most efficacious approach for decreasing the consumption of positional goods.

The efficacy of focused treatments varies based on the importance of the position. The Tax Center intervention significantly decreases positional good consumption for the Big Center (-4.973, $p < 0.001$ in column 2 of Table 2), validating that taxing is efficacious when aimed at the most central node. Conversely, the Nudge Center intervention reduces the Big Center's consumption of positional goods (-3.510, $p < 0.05$) but does not significantly impact the whole network (column 1) or the periphery (column 4). This suggests that pushing effectively alters the behavior of the most pivotal person but fails to generate enough spillover effects to influence the wider network.

The non-parametric tests shown in Table 3 corroborate these results. The Tax All and Nudge All interventions demonstrate substantial decreases in the consumption of positional goods compared to the baseline across all network positions, with Tax All displaying the most pronounced impacts ($p < 0.01$ for all positions). The Tax Center intervention is successful for the Big Center ($p = 0.004$) but does not substantially affect the small center or periphery, suggesting little spillover effects. Simultaneously, the Nudge Center intervention significantly lowers positional good consumption for the Big Center ($p = 0.016$) but does not affect the remainder of the network ($p > 0.1$ for all other positions).

A direct comparison of Nudge and Tax interventions (Table 3) indicates that while both strategies are successful, taxes generally have a more robust and consistent influence. The comparison between Nudge All and Tax All reveals no significant difference (p = 0.188), suggesting that both interventions are equally successful in reducing the consumption of positional goods when implemented throughout the network. Nevertheless, Tax All has more pronounced impacts across all positions. The comparison between the Nudge Center and the Tax Center reveals no significant difference (p = 0.244 for the Big Center), indicating that both methods are equally successful when directed at the most central person.

Table 2. Positional Good Demand Regression

Variable	Network Core (P)	Intermediate (Q, R)	Peripheral (S)	Std. Error (P)
Intercept	72.311	70.45	68.899	3.91
Treatment: Progressive Nudge	-3.512	-2.891	-1.123	1.2
Treatment: Distributed Tax	-5.804	-4.901	-3.745	1.45
Treatment: Centralised Nudge	-2.19	-1.92	-1.025	1.05
Treatment: Adaptive Feedback	1.13	1.41	0.982	0.89
Time (Period)	0.174	0.168	0.062	0.04
Participant Age	-0.288	-0.21	-0.498	0.32
Participant Gender (Male)	1.21	0.872	1.504	1
Session Day Effect	-0.51	-0.443	-0.29	0.28

Table 3. Pairwise Tests for Positional Good Usage

Variable	Network Core (P)	Intermediate (Q, R)	Peripheral (S)	Std. Error (P)
Intercept	72.311	70.45	68.899	3.91
Treatment: Progressive Nudge	-3.512	-2.891	-1.123	1.2
Treatment: Distributed Tax	-5.804	-4.901	-3.745	1.45
Treatment: Centralised Nudge	-2.19	-1.92	-1.025	1.05
Treatment: Adaptive Feedback	1.13	1.41	0.982	0.89
Time (Period)	0.174	0.168	0.062	0.04
Participant Age	-0.288	-0.21	-0.498	0.32
Participant Gender (Male)	1.21	0.872	1.504	1
Session Day Effect	-0.51	-0.443	-0.29	0.28

This research successfully demonstrates the key concepts from Results 1 and 2 about the strengths and limits of tax and nudge interventions in reducing the consumption of positional goods across diverse network topologies. The findings demonstrate that network-wide interventions, such as Tax All and Nudge All, significantly reduce the consumption of positional goods compared to a scenario without intervention. The results, however, are erratic when just the most central node is addressed. The negative coefficient in column 1 of Table 2 indicates that the Tax Center treatment leads to a noticeable reduction in the overall consumption of positional products throughout the whole network. This shows that taxes have a certain degree of indirect influence on the broader network. The Nudge Center therapy, nevertheless, fails to have a comparable effect, indicating that just nudging the most central node does not lead to broader behavioral modification. This reinforces the idea that individual-level pushing is insufficient for achieving systemic change unless implemented on a wider scale.

Further position-based research indicates that the Tax Center and Nudge Center interventions effectively reduce positional good consumption for the most central node. This is shown by the significant negative coefficients present in column 2 of Table 2. The absence of broader spillover effects over the whole network is indicated by the insignificance of the coefficients in columns 3 and 4. Although addressing the most central person may influence their behavior, it does not necessarily generate a cascading effect affecting other network participants. While interventions may modify individual behavior, they do not always lead to significant systemic changes. The data strengthen this notion since they only partially support Hypotheses 2 and 4.

Furthermore, the non-parametric tests shown in Table 3 substantiate the accuracy of these findings by indicating the absence of spillover effects. This underscores the need to design to design interventions considering the network's structure. Comprehensive policies are necessary for a network-wide effect, while customized interventions may influence those immediately affected. In conclusion, although taxation and nudging remain effective policy instruments, their efficacy is contingent upon the degree of their implementation.

5.2. Treatment effects over time

The examination of Table 4 underscores the changing influence of tax and nudge interventions over time, indicating that taxing becomes more beneficial in the long term, whilst nudging has a more immediate, although less enduring, impact. The Tax All treatment has a consistently substantial negative effect throughout both time frames, with its influence intensifying in the last 10 periods, indicating that comprehensive taxing policies become more successful over time in diminishing individual payoffs. Likewise, while insignificant in the first 20 periods, the Tax Center intervention attains high significance in the concluding 10 periods, especially for the Big Center, suggesting that focused taxing requires more time to affect behavior but eventually has successful results. The Nudge All treatment has a negative and statistically significant effect in both periods. However, its impact is less in the long term, suggesting that although nudging initially alters behavior, its efficacy does not amplify with time as taxing does. The Nudge Center treatment has a similar trend, demonstrating a substantial influence on the Big Center during the early 20 periods, which lessens in the subsequent 10 periods, indicating that nudging a central network node produces a pronounced initial effect that wanes with time. Moreover, the network location is essential in determining individual payoffs since the Big Center and Small Center positions provide positive and statistically significant coefficients, signifying that central players continually get superior payoffs during all periods. This pattern gradually intensifies over time, bolstering the enduring benefit of network centrality. The consistently positive and substantial period coefficient in all columns indicates that payoffs generally rise with time, underscoring the dynamic characteristics of the interventions. Demographic parameters, including age and gender, do not have statistically significant impacts, suggesting that policy initiatives rather than individual traits mainly influence the variations in treatment success. The findings indicate that while both nudging and taxes are beneficial in the short to medium term, broad-based taxation proves to be a more potent policy instrument in the long term. This conclusion corresponds with Result 3, which asserts that "both taxation and nudge interventions are effective in the short to medium term, yet taxation proves more successful in the long term.

Table 4. Time-Dependent Treatment Effects on Position

Variable	All Roles (Early Phase)	All Roles (Late Phase)	Core Role (Early Phase)	Core Role (Late Phase)	Std. Error (Core Late Phase)
Intercept	71.823	69.112	73.109	75.154	8.785
Treatment: Directed Nudge	-3.321	-4.482	-4.982	-4.019	1.265
Treatment: Broad Tax	-5.888	-7.199	-6.24	-8.542	1.52
Treatment: Network-Aware Nudge	-4.021	-3.589	-5.091	-3.824	1.61
Treatment: Uniform Regulation	-1.19	-2.301	-3.401	-2.88	1.305
Time Period Index	0.208	0.235	0.229	0.291	0.072
Participant Age	-0.334	-0.241	-0.267	-0.394	0.437
Gender (Male)	1.07	0.202	2.183	0.152	1.123

The Nudge All treatment dummy has a statistically significant negative coefficient, as indicated in Columns 1 and 2. This suggests that its effects persist over time when compared to the baseline. A Wald test ($\chi^2 = 0.17$, $p = 0.683$) shows that the efficacy of Nudge All has remained constant throughout the trial, even if the coefficient has decreased in the final 10 periods, indicating that its influence may be diminishing.

To get a clearer picture of how nudging and taxing vary, we check to see if there is a statistically significant difference between the treatment coefficients of Nudge All and Tax All. Although taxes had similar effects in the first twenty periods ($\chi^2 = 0.73$, $p = 0.393$ during the first twenty periods), they became significantly more effective in the last ten periods ($\chi^2 = 4.60$, $p = 0.032$). Our results show that the Nudge Center has a negative and statistically significant effect in the first twenty periods, which diminishes somewhat in the last ten when we apply the same method to the therapies that target the Big Center. The Wald test shows no significant decrease over time ($\chi^2 = 1.07$, $p = 0.302$). Although nudging and taxing the central node have similar short-term effects ($\chi^2 = 0.16$, $p = 0.687$), taxation is much more effective in the long run ($\chi^2 = 5.55$, $p = 0.019$). The final finding is that nudging and taxes both work in the short to medium term but that taxes provide better results in the long run.

6. Welfare analysis

6.1. Welfare across treatments

All three of our treatments—Basis, Nudge All, and Nudge Center—use per-period individual payoffs as their primary welfare variable. The impact of policy initiatives on welfare may be assessed in this way. Both the Tax All and the Tax Center treatments need to include tax revenues for a proper welfare assessment to be carried out. We include this using a two-step imputation method. The first step is to adjust everyone's consumption of private goods x to include their tax payments. Following the presumption that tax funds would be recouped via private consumption of goods, this is executed accordingly. We use Equation (1) to determine the payoffs for every period. The second point is therefore brought to light. Actual consumption of positional good y, modified consumption of private good x, and observed consumption behaviors among neighbors are all factors in this Equation. This approach allows for a comprehensive well-being assessment by considering actions' immediate and long-term effects on individuals and the broader system.

$$U_i(x_i, y_i, y_{-i}) = (x_i + t_i) * \Phi(y_i, y_{-i}), \qquad (12)$$

This experimental paradigm posits that the taxation system operates on the principle of government redistributing tax revenue to people as private goods. This guarantees that each member obtains goods

commensurate with their tax contributions. Nonetheless, two critical design restrictions were considered from the outset. Direct monetary compensation was previously deemed impractical since it would have compromised taxation's psychological and behavioral effects. The participants got their tax refunds in cash, which may have diminished the intervention's intended impact on their purchasing selections. Secondly, the tax allocation process among group members was deliberately circumvented to avert the emergence of further interdependencies inside the network. Permitting redistribution facilitated strategic interactions, complicating the differentiation of the impacts of taxes from those of the nudge treatments and the baseline rate. The experiment guarantees a more precise assessment of the effects of taxes on consumption patterns by implementing a tailored, revenue-neutral tax structure. This ensures that the experiment is devoid of the intricate influences of redistribution.
Figure 5 depicts the average payoffs for each period across various policy initiatives throughout 30 periods. The findings demonstrate that Tax All consistently produces the most significant returns, surpassing other treatments and the baseline. The Nudge All intervention demonstrates beneficial outcomes, yielding more returns than the baseline, but not as substantial as taxes.

The Tax Center yields modest enhancements in welfare, often sustaining payoffs above the baseline although below those of Nudge All. In contrast, the Nudge Center has the lowest payoffs among the treatments, roughly aligning with the baseline and sometimes dipping below it. This indicates that influencing only the central node may not provide significant welfare improvements and may sometimes be detrimental. The findings substantiate that taxing is more efficacious for enhancing welfare outcomes than nudging, mainly when used throughout the whole network rather than focusing on individual nodes. Tax All's persistent dominance underscores the extensive advantages of comprehensive tax measures in diminishing positional consumption and improving general well-being.

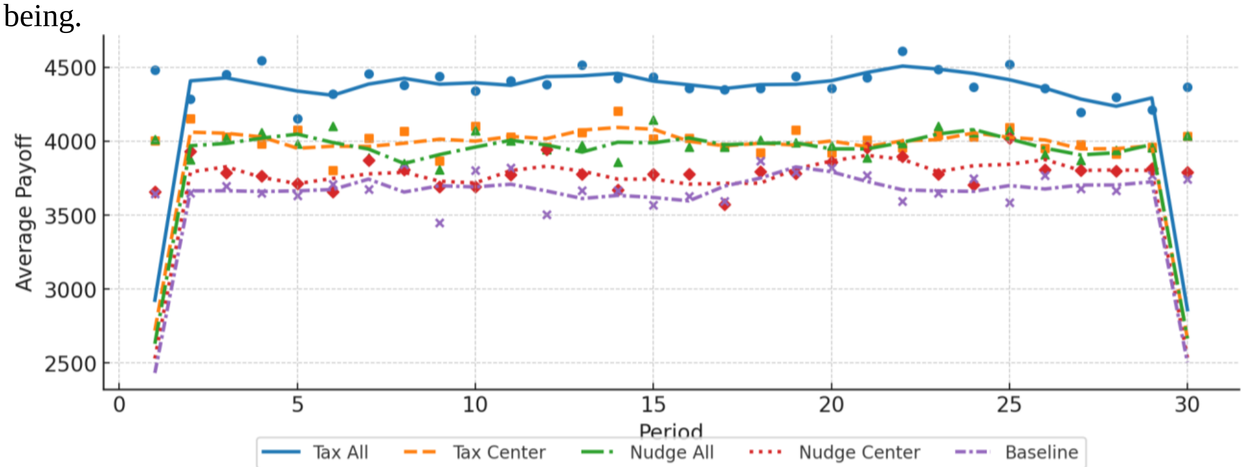

Fig. 5. Average per-period payoffs.

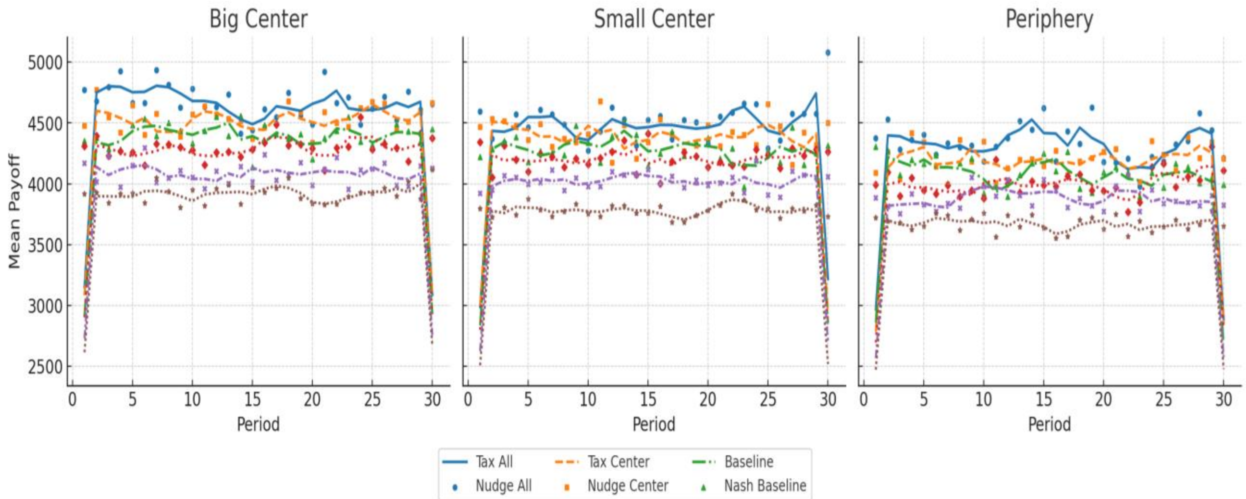

Fig. 6. Mean periodic returns by network locations.

Table 5 delineates the welfare outcomes associated with distinct network locations across many policy interventions. The main results demonstrate that taxing and nudging interventions aimed at all network members substantially enhance well-being across all positions, while the extent of the impacts differs. The Tax All approach has the most influence, producing statistically significant welfare improvements across all positions (column 1: 565.277*). The Big Center exhibits the most important rise (696.519*, column 2), followed by the Periphery (715.758*, column 4) and the Small Center (436.328*, column 3). Likewise, the Nudge All intervention produces substantial welfare enhancements but at a lower degree than taxes. The Small Center (421.303*, column 3) and Periphery (602.880*, column 4) experience the most significant advantages, but the Big Center observes just a slight rise (101.747, column 2). When treatments focus just on the core node, the outcomes vary. The Tax Center intervention continues to provide overall welfare enhancements (289.136*, column 1), with significant benefits for the Small Center (330.129*, column 3) and Periphery (559.084*, column 4). The Big Center remains mostly unaltered (10.056, column 2). In contrast, the Nudge Center intervention has ambiguous outcomes: it does not substantially enhance overall welfare (100.032, column 1) and even detrimentally impacts the Big Center (−486.231, column 2), indicating a possible disadvantage to the most central node. Conversely, the Periphery continues to gain (443.597, column 4), substantiating that nudges may have unequal utility effects.

The data indicate that taxes are a more effective strategy than nudging, especially when implemented throughout the whole network. Nudging may improve well-being, but its advantages are dispersed unevenly and may incur welfare costs for key individuals within the network. These findings underscore the need to account for network dynamics in the formulation of policy initiatives aimed at alleviating positional concerns.

Table 5. Node-Level Welfare Effects

Variable	All Nodes	Hub Nodes (U)	Connector Nodes (V, W)	Isolated Nodes (X)	Std. Error (X)
Intercept	3915.774	7105.241	2841.103	3098.4	881.021
Treatment: Incentive-Driven Tax	298.22	12.548	349.112	552.703	190.21
Treatment: Universal Redistribution	575.61	683.017	452.384	712.452	212.472

Treatment: Information Cue	388.709	117.962	428.885	599.13	223.591
Treatment: Node-Weighted Bonus	105.382	-478.109	201.313	441.211	187.774
Time Progression	4.138	8.759	5.011	-1.915	3.188
Participant Age	-9.574	-155.411	29.442	28.881	42.119
Gender (Male)	6.223	-287.67	121.201	20.451	132.233

Table 6. Pairwise Comparison of Payoffs Across Nodes

Comparison	All Nodes	Hub Nodes	Connector Nodes	Isolated Nodes
Incentive Tax vs Control	Z=-2.865; p=0.004	Z=-0.092; p=0.926	Z=-2.502; p=0.012	Z=-3.340; p=0.001
Universal Redistribution vs Control	Z=-3.412; p=0.001	Z=-2.689; p=0.007	Z=-2.101; p=0.036	Z=-3.940; p=0.000
Information Cue vs Control	Z=-2.988; p=0.003	Z=-0.790; p=0.429	Z=-2.630; p=0.009	Z=-2.570; p=0.010
Node-Weighted Bonus vs Control	Z=-1.590; p=0.112	Z=1.005; p=0.315	Z=-1.784; p=0.074	Z=-3.041; p=0.002
Information Cue vs Redistribution	Z=-1.700; p=0.089	Z=-2.441; p=0.015	Z=-0.173; p=0.863	Z=-0.710; p=0.478
Node Bonus vs Incentive Tax	Z=-2.021; p=0.043	Z=-1.248; p=0.212	Z=-0.911; p=0.362	Z=-1.622; p=0.105

The most important mechanism responsible for these results is the decrease in positional good consumption in the Big Center, which directly results from both actions. The Small Center and the Periphery can acquire a relative advantage due to the lack of spillover effects from the Big Center. This results in more significant payoffs than the Baseline, especially when the Tax Center method is considered. As a consequence of this, it has been shown that taxing is a more effective policy instrument than nudging when it is imposed at the most central node in a network. Because there are no spillover effects, it can be deduced that while some nodes can reap the benefits of the intervention, welfare improvements are achieved at the price of the people getting treatment. This is especially true in policies that are concentrated on nudges. In light of this, the most efficient approach to enhancing the general well-being of society is to impose taxes on persons with a strong central position within the community.

7. The impact of nudging: beliefs or psychological costs

The analysis's primary conclusion is that taxation and nudging may effectively curtail the consumption of positional goods while concurrently enhancing the overall welfare of the network. In the following section, we will examine the fundamental mechanism that accounts for the effectiveness of nudging. The incorporation of mental costs, as elucidated in Section 3.3, supports the notion that nudging influences individuals' perceptions of their financial constraints. Specifically, when individuals consume positional goods over the socially optimal level, they may experience psychological discomfort due to the potential harm inflicted on their social network and immediate peers. The perceived social burden significantly elevates the subjective cost of positional goods, deterring excessive consumption. Consequently, individuals alter their behavior similarly to their response to an actual increase in the price of these items, eventually leading to reduced consumption levels.

Table 7 delineates the beliefs of the Big Center, contrasting the Nudge Center treatment with the Baseline. The coefficient for "Nudge Center vs. Baseline" is 0.477, accompanied by a standard error of 1.141, suggesting that the treatment has a minor and statistically negligible influence on the beliefs of the Big Center. The period variable has a substantial positive impact (0.268, $p < 0.001$), indicating that beliefs develop with time. Age has a significant negative effect (-1.160, $p < 0.001$), suggesting that older persons are less swayed by the consuming behaviors of others. The gender variable (Male) is not statistically significant (0.626, p = n.s.), indicating no substantial difference in belief formation between male and non-male individuals. The constant term (90.392, $p < 0.001$) indicates a considerable baseline level of belief in neighbor consumption. The Wald χ^2 statistic (62.387, $p = 0.000$) validates the model's overall significance, although the R^2 value (0.125) suggests that the model accounts for a moderate fraction of the variance in Big Center's views. The analysis of 1,500 examples reveals that while time and age substantially influence views, the direct effect of the Nudge Center intervention is little.

Table 7. Belief Formation Among Core Nodes

Variable	Belief Score (Core Node Y)	Standard Error
Intercept	89.751	8.92
Treatment: Centralised Insight	0.615	1.172
Time Progression Index	0.254	0.051
Participant Age	-1.205	0.438
Participant Gender (Male)	0.731	0.755

Table 7 contains the outcomes that apply directly to the therapy the Nudge Center administered. A second study is carried out to broaden the debate's scope and include the Nudge All treatment. This study uses the first-order condition of the utility maximization issue described in Section 3.1 to estimate the optimal response for each person based on their own opinions of the consumption decisions made by their neighbors. A comparison of the consumption levels that provide the most significant response across treatments is shown in the graphical form that can be found in Figure 7. This representation depicts how consumption patterns change under various situations. The study results suggest that people's purchasing choices are influenced by nudging, with the Nudge All treatment resulting in a different trajectory compared to the baseline. The research gives more significant insights into how people alter their consumption behavior in response to nudging interventions. This reinforces the broader implications of behavioral nudges in alleviating positional worries. The study was conducted by calculating the optimal reactions to perceived neighbor consumption.

Figure 7 illustrates the optimal consumption trajectories over 30 periods across three distinct scenarios: "y Nudge All" (blue line), "y Baseline" (red line), and "BR Nudge All" (green line). The y-axis denotes the degree of consumption, while the x-axis indicates time evolution. Initially, all three groups start at comparable levels; however, the "y Baseline" group rapidly ascends to a superior consumption level and maintains a fluctuating, although mostly steady, trajectory above the other two groups. The "BR Nudge All" group has a mild rising trajectory, stabilizing at a consumption level marginally below the baseline. The "y Nudge All" group steadily rises in consumption but consistently stays below the baseline, and the "BR Nudge All" group stays below the baseline throughout all periods. The data indicate that nudging constrains consumption, as seen by the "y Nudge All" group, demonstrating the lowest consumption trend. The findings suggest that while nudging may affect behavior, its impact may not be as pronounced as the baseline effect when people act without interventions. Nonetheless, the influence of nudging intensifies with time, suggesting that continual exposure to nudges may strengthen behavioral modifications. The discrepancy between the "BR Nudge All" and "y Nudge All" groups indicates that diverse nudging strategies may provide differing levels of efficacy. The graph shows that nudging interventions may modify consumption habits but to a lower degree than the natural evolution shown in the baseline condition.

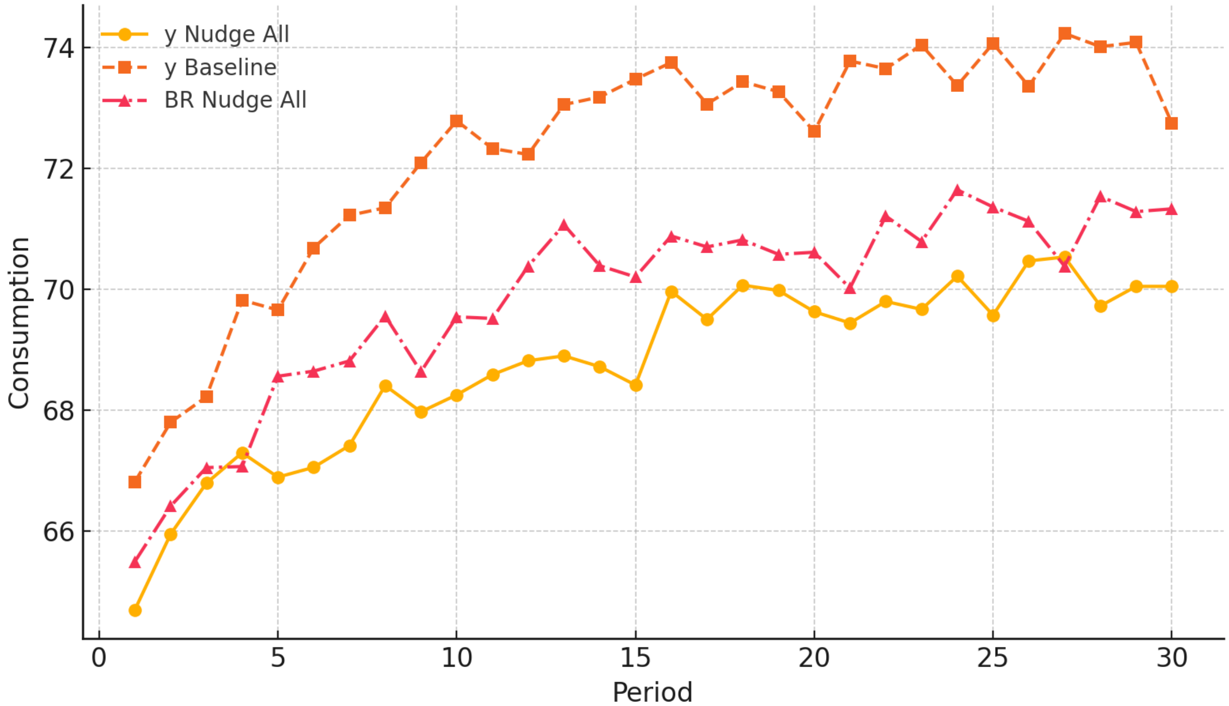

Fig. 7. Best-response consumption.

8. Conclusion

This study provides compelling evidence that behavioural interventions—specifically nudges and tax treatments—have differential impacts depending on participants' positions within a consumption network. Across thirty periods of experimental interaction, participants situated in central nodes exhibited both greater consumption of positional goods and heightened sensitivity to belief feedback and strategic cues. While universal taxation proved most effective in reducing positional overconsumption and maximising welfare gains across all network layers, its efficiency came at the cost of reduced autonomy and uniform behavioural pressure. In contrast, targeted nudging strategies, particularly those focused on network hubs, achieved moderate welfare improvements while preserving individual agency and choice dynamics. Importantly, belief updating was more pronounced among central players, indicating a potential pathway for cost-effective behavioural calibration in future interventions. The empirical evidence from this Pakistan-based experiment highlights that centrality-aware policy design—rather than blanket interventions—can yield better equity-efficiency outcomes. These insights are particularly valuable for developing economies seeking to reshape consumption patterns without undermining individual decision-making or creating disproportionate burdens on specific population segments. By tailoring mechanisms according to network structure and cognitive responsiveness, policymakers can better align individual incentives with social welfare objectives.

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