

Three Essays on the Economics of Self Control

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SUMMARY

With the rapid development of a combination of psychology and economic studies, more and more aspects of psychological phenomena have been plunged into economic contexts. Through theoretical modelling, empirical analysis, and personality studies, this thesis studies the interplay between individual decision-making, self-control, and economic outcomes. It is structured into three chapters, each focusing on a distinct aspect of self-control and its implications.

The first chapter, titled "A Model of Multiple Selves," introduces a model dividing an individual into a central executive system (Ego) and two sub-selves: the rational self (Cold) and the impulsive self (Hot). Ego allocates resources between the sub-selves but lacks its own preferences. The analysis shows that Ego's optimal allocation prevents either sub-self from achieving its preferred bundle, resulting in more extreme choices by the sub-selves than if they controlled all resources independently.

The second chapter, "Revealed self-control: Cultural Difference in the New Year's Resolution of UK and China," investigates self-control behaviours after festive indulgence in the UK and China using search trend data. Search trends for healthy lifestyle keywords increase after Christmas (especially the new year) in the UK, reflecting a rebound in self-control. In contrast, no similar pattern is observed after major Chinese festivals, highlighting cultural differences in self-regulation.

The third chapter, titled "The Effect of Personality Traits and self control on Wages," focuses on the relationships between personality traits, self-control, and wages. Based on data from the Household, Income, and Labour Dynamics in Australia (HILDA) Survey and the Big Five personality traits framework, the study uses factor analysis and regressions to identify key influences. The findings highlight that traits such as Neuroticism, Conscientiousness, and Extroversion positively correlate with higher wages, while Agreeableness has a negative correlation. Moreover, self control has a significantly positive impact on wage levels, emphasizing its role in economic success.

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1. Chapter 1: A Model of Multiple Selves

1.1. abstract

We propose a model of individual decision making that separates a central executive system (“Ego”) from a sub-self with its own preferences (“Cold”) and an impulsive sub-self with different preferences (“Hot”). Ego cares only about the payoffs of the other two sub-selves and allocates available resources between them. For standard neoclassical preferences over joint consumption, we show that in subgame perfect Nash equilibrium, Ego will choose a resource allocation that enables neither Hot nor Cold to attain their most preferred affordable bundle. Moreover, the two sub-selves each choose a more extreme and specialized bundle than they would choose if they unilaterally controlled all available resources.

Keywords: Multiple self, menu dependence, individual choice.

⁰This Chapter is coauthored with Dan Friedman, and Simon Weidenholzer, and a version of it is forthcoming in *Theory and Decision*

1.2. Introduction

The late Stanford psychologist Walter Mischel was famous for his marshmallow test. Between 1967 and 1973 he offered about 500 preschoolers the choice between a treat now (typically one marshmallow) or a bigger treat (typically two marshmallows) a little later. Mischel and coauthors reported, e.g., in Shoda et al. (1990), that the kids who could hold out for the bigger treat were more successful later in life.¹

How should decision theorists think about such self-control problems? We adapt ideas from the multiple self literature of recent decades, and parse the marshmallow test as follows. A typical kid prefers two marshmallows to one, and that preference is captured in a “cold self” who takes a broader perspective. A typical kid also prefers marshmallows now to marshmallows later, and this preference is captured in a “hot self” who responds more strongly to immediate impulses. A central executive system, which we refer to as “ego,” allocates resources to the hot and cold sub-selves. For some kids (especially four year olds), more attentional resources go to the hot self, but some other kids (especially five year olds) allocate enough resources to the cold self to pass the marshmallow test.

As explained below, multiple self models can explain phenomena such as menu dependence and time inconsistency. Our multiple self model differs from most predecessors in that it separates the central executive system (Ego) from the carriers of conflicting preferences (Hot and Cold). This disaggregation allows us to focus on how resources can be allocated to meliorate internal conflicts, and to examine the consequences.

In particular, we consider consumption choices of a generic good and a temptation good such as chocolate or a trip to Capri. We allow general preferences — both Hot and Cold may enjoy both goods to some degree — but they conflict in that Hot cares more (has a higher marginal rate of substitution) than Cold for the temptation good. Ego doesn’t care about the goods *per se*. It does care about the utility of both Hot and Cold, and chooses an allocation of available resources between Hot and Cold that maximizes its social welfare function over their utilities.

¹Replication and followup studies generally confirm a positive correlation between broad measures of self control in preschoolers and later life outcomes, but find that by itself the marshmallow test has little to no predictive power; see e.g. Benjamin et al. (2020).

Imposing standard neoclassical assumptions on Hot and Cold preferences and Ego's social welfare function, we solve for subgame perfect Nash equilibrium of the three player game. We find, a bit to our surprise, that in equilibrium both Hot and Cold make more specialized and extreme choices than they would make given dictatorial powers. Indeed, to maximize its own welfare function, Ego will allocate resources such that Hot will acquire only the temptation good and Cold will only acquire the generic good. Ego's equilibrium allocation always leaves both Hot and Cold a bit frustrated, unable to attain their preferred consumption bundles. Our model can thus capture situations where a planner not only caters to the sensible Cold system but also to some degree indulges the needs of Hot. In this sense, the eventual action of an individual human is characterized by the outcome of the strategic interaction among their subselves Hot, Cold and Ego.

Economists have been interested in multiple self models at least since the seminal paper of Gul and Pesendorfer (2001). Their model features a present self and future self, who might agree what to pick from a limited menu but disagree when facing a larger menu. They capture such conflicts in a set betweenness axiom (menus satisfy $A \succ B \implies A \succ A \cup B \succ B$); the main policy implication is that people are happier when temptations are removed from the choice set.

Bénabou and Pycia (2002) propose a related two-self model featuring a planner and a doer. The planner gives instructions to the doer who, with some probability, may deviate towards indulgence. The policy implication again is that commitment devices (such as a limited menu) can help. Samuelson and Swinkels (2006) obtain a similar implication from a evolutionary model of preference formation, where utility depends directly on actions as well as on outcomes. Fudenberg and Levine (2006) focus on the cost function for the future self (or planner) to control the present self (or doer). Outcomes depend more sensitively on its functional form than one might have supposed.

Our own model is motivated in part by Alonso et al. (2014) who emphasize the role of the Central Executive System in allocating scarce mental resources to other brain sub-systems. On a conceptual level our model also shares certain aspects with Freud's (1923) psychoanalytic theory describing the human psyche as the result of the interaction of three

sub-selves, the instinctual and uncoordinated *id*, the critical and moralizing *super-ego*, and *ego* which mediates between the other two sub-selves.

Toussaert (2018) reports a laboratory experiment testing the menu-limitation predictions of models following Gul and Pesendorfer (2001). Another empirical study more directly connected to our own paper is Cherchye et al. (2020) who report that purchases of healthy food decline from January to December each year, and also vary over weekly cycles. They use a dual self model, where the counterpart of Ego in our model maximizes a weighted average of healthy self’s utility and unhealthy self’s utility. Those weights change arbitrarily over time in their model. Our model is more fully developed in that Ego’s weights reflect stable preferences and take the more flexible form of resource allocation. Also, our selves are less specialized, and potentially value all sorts of consumption, albeit to different degrees.

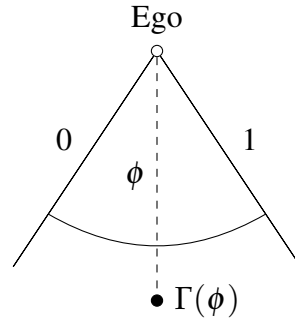
The next section lays out the elements of our model. It then solves the subgame played between the “doer” sub-selves Hot and Cold, given any fixed resource allocation. Points are illustrated and conclusions foreshadowed in a parametric example. Finally, we find the subgame perfect Nash equilibrium allocation choice by the “planner” self Ego. In a concluding discussion, we mention some variants (e.g., a “Stackelberg” version of the doer subgame) and extensions of the model, as well as different interpretations such as a Principal with two Agents and joint consumption. Some mathematical details are collected in an Appendix.

1.3. Model

Consider an extensive form game played between “planner” sub-self Ego (E) and two “doer” sub-selves Cold (C) and Hot (H). In the first stage, Ego decides on the fraction $\phi \in [0, 1]$ of available resources to be allocated by Cold, with Hot allocating the remaining fraction $1 - \phi$. In the second stage the two sub-selves simultaneously choose levels of two activities, A and B , given their resources. This gives rise to the subgame $\Gamma(\phi)$, as in Figure 1.1 below.

Our analysis builds on well-known insights from microeconomics, so the exposition

Figure 1.1: The Multiple Self game tree



will use standard microeconomics terminology such as consumption, income, budget shares, etc. Section 1.4.1 below offers broader interpretations of the game variables.

In the subgame, x_i^j denotes how much of good i sub-self j purchases. The vector $x^j = (x_A^j, x_B^j)$ denotes the bundle chosen by sub-self j , $X_i = x_i^C + x_i^H$ denotes the combined consumption of good i , and $X = (X_A, X_B)$ denotes the combined bundle. Let $p > 0$ denote the (relative) price of good A , and normalize income and the price of good B to 1. Then the budget constraints are

$$\begin{aligned} px_A^C + x_B^C &\leq \phi \quad \text{and} \\ px_A^H + x_B^H &\leq 1 - \phi, \end{aligned} \tag{1.1}$$

for sub-selves Cold and Hot respectively.

Since they inhabit the same body, both sub-selves benefit from the consumption of the combined amount of goods, irrespective of which of them purchased particular units. Thus, the preferences of the two sub-selves are defined over the aggregate levels of consumption X_A and X_B . We assume standard neoclassical preferences over the two goods. Specifically, in terms of utility functions, we impose

Assumption 1. *The utility functions $U^C(X)$ and $U^H(X)$ for the two sub-selves are strictly positive, strictly monotone increasing, strictly quasiconcave and twice continuously differentiable at every strictly positive allocation $X = (X_A, X_B)$.*

Note that, among other things, this assumption implies that $MRS^j(X) = \frac{\partial_A U^j(X)}{\partial_B U^j(X)}$, the marginal rate of substitution of sub-self j , is continuously differentiable at every strictly

positive $X = (X_A, X_B)$.²

While our monotonicity assumption implies that both sub-selves benefit from the consumption of both goods, we are interested in a scenario where they differ in the relative benefit they derive from the two goods. Specifically, we assume that at any allocation the Hot system is willing to trade in more units of good B to acquire one additional unit of good A than the Cold system is willing to do. In this sense, good A is a *temptation good* for the Hot system. (Of course, with only two goods, B can then be seen as a temptation good for the Cold system.) The formal definition relies on the single crossing property:

Definition 1. *Good A is a temptation good if $MRS^H(X_A, X_B) > MRS^C(X_A, X_B)$ at every allocation $(X_A, X_B) > 0$.*

Often we will also impose Inada conditions, that at least a small amount of each good is essential to both sub-selves. Specifically,

Assumption 2. *Utility functions satisfy $\lim_{X_A \rightarrow 0} MRS^j(X_A, X_B) = \infty$ and $\lim_{X_B \rightarrow 0} MRS^j(X_A, X_B) = 0$ for $j = H, C$.*

Finally, it remains to specify the payoff of Ego. We assume that Ego cares only about the happiness of both sub-selves. More specifically, Ego's payoff is just a weighted average of the hot- and the cold- systems utility: for any strictly positive $X = (X_A, X_B)$,

$$U^E(X) = \gamma U^C(X) + (1 - \gamma) U^H(X), \quad (1.2)$$

for some given $\gamma \in (0, 1)$.³

Thus the normal form subgame $\Gamma(\phi)$ in Figure 1.1 consists of the three players Ego, Cold and Hot, with the payoff functions U^E, U^C and U^H just specified. Given price $p > 0$ and Ego's action $\phi \in [0, 1]$, the action sets for Cold and Hot are defined in equations (1.1), together with the usual non-negativity constraints.

²We use the notation $\partial_i U^j(X) = \frac{\partial U^j(X)}{\partial X_i}$ for the partial derivative of j 's utility with respect to the aggregate level of consumption of good i .

³We'll see later that less restrictive welfare functions (e.g., a Cobb-Douglas aggregator function) will suffice, but the linear aggregation in (1.2) is convenient and intuitive.

1.3.1. The Cold vs. Hot Subgame

As a first step we analyse the subgame $\Gamma(\phi)$, taking the budget allocation ϕ as given.

Cold chooses her purchases (x_A^C, x_B^C) to solve the following problem,

$$\begin{aligned} \max_{x_A^C, x_B^C} \quad & U^C(x_A^C + x_A^H, x_B^C + x_B^H) \\ \text{s.t.} \quad & px_A^C + x_B^C \leq \phi, \quad x_A^C \geq 0, \quad x_B^C \geq 0. \end{aligned}$$

taking the consumption levels (x_A^H, x_B^H) of Hot as given. Similarly, Hot solves

$$\begin{aligned} \max_{x_A^H, x_B^H} \quad & U^H(x_A^C + x_A^H, x_B^C + x_B^H) \\ \text{s.t.} \quad & px_A^H + x_B^H \leq 1 - \phi, \quad x_A^H \geq 0, \quad x_B^H \geq 0. \end{aligned}$$

It turns out to be convenient to rewrite these problems in the following way.

$$\max_{X_A, X_B} U^C(X_A, X_B) \qquad \max_{X_A, X_B} U^H(X_A, X_B) \qquad (1.3)$$

$$\text{s.t.} \quad pX_A + X_B \leq px_A^H + x_B^H + \phi \qquad \text{s.t.} \quad pX_A + X_B \leq px_A^C + x_B^C + 1 - \phi \qquad (1.4)$$

$$X_A \geq x_A^H \qquad X_A \geq x_A^C \qquad (1.5)$$

$$X_B \geq x_B^H \qquad X_B \geq x_B^C \qquad (1.6)$$

Under this alternative formulation, each of the sub-selves chooses the overall amount of the two goods, taking the contributions of the other sub-self as given.

Denote by $\tilde{X}^C = (\tilde{X}_A^C, \tilde{X}_B^C)$ and $\tilde{X}^H = (\tilde{X}_A^H, \tilde{X}_B^H)$ the solutions of problem (3-4), temporarily ignoring constraints (5-6). Because the utility functions are strictly quasi-concave, these solutions are unique. Assumption 2 ensures that, for any p , the solutions are interior and characterized by the first order condition, $MRS^j(\tilde{X}^j) = p$ for $j = C, H$.

Returning now to the full problem (3-6), a constraint in (5) or (6) will bind whenever $\tilde{X}_i^j < x_i^{-j}$, i.e., whenever sub-self j 's desired consumption of good i is less than the given amount purchased by the other sub-self. In that case, j will choose the corner pur-

chase $x_i^j = 0$ and spend her entire budget on the other good $-i$. Thus, in terms of final consumption, Cold's best response is

$$(X_A^{C*}, X_B^{C*}) = \begin{cases} (\frac{\phi}{p} + x_A^H, x_B^H) & \text{if } \tilde{X}_A^C \geq x_A^H \text{ and } \tilde{X}_B^C < x_B^H \\ (\tilde{X}_A^C, \tilde{X}_B^C) & \text{if } \tilde{X}_A^C \geq x_A^H \text{ and } \tilde{X}_B^C \geq x_B^H \\ (x_A^H, \phi + x_B^H) & \text{if } \tilde{X}_A^C < x_A^H \text{ and } \tilde{X}_B^C \geq x_B^H \end{cases} \quad (1.7)$$

We can rule out the remaining case, that the constraints bind for both goods, because that would imply that total expenditure is less than Hot's expenditure. More formally, $\tilde{X}_A^C < x_A^H$ & $\tilde{X}_B^C < x_B^H \implies p\tilde{X}_A^C + \tilde{X}_B^C < px_A^H + x_B^H \implies 1 < \phi$, a contradiction.

To rewrite in terms of Cold's choice variables, x^C , we subtract Hot's given purchase (x_A^H, x_B^H) , yielding the best response function

$$(x_A^{C*}, x_B^{C*}) = \begin{cases} (\frac{\phi}{p}, 0) & \text{if } \tilde{X}_A^C - x_A^H \geq 0 \text{ and } \tilde{X}_B^C - x_B^H < 0 \\ (\tilde{X}_A^C - x_A^H, \tilde{X}_B^C - x_B^H) & \text{if } \tilde{X}_A^C - x_A^H \geq 0 \text{ and } \tilde{X}_B^C - x_B^H \geq 0 \\ (0, \phi) & \text{if } \tilde{X}_A^C - x_A^H < 0 \text{ and } \tilde{X}_B^C - x_B^H \geq 0 \end{cases} \quad (1.8)$$

Similarly, Hot's best response function is

$$(x_A^{H*}, x_B^{H*}) = \begin{cases} (\frac{1-\phi}{p}, 0) & \text{if } \tilde{X}_A^H - x_A^C \geq 0 \text{ and } \tilde{X}_B^H - x_B^C < 0 \\ (\tilde{X}_A^H - x_A^C, \tilde{X}_B^H - x_B^C) & \text{if } \tilde{X}_A^H - x_A^C \geq 0 \text{ and } \tilde{X}_B^H - x_B^C \geq 0 \\ (0, 1-\phi) & \text{if } \tilde{X}_A^H - x_A^C < 0 \text{ and } \tilde{X}_B^H - x_B^C \geq 0 \end{cases} \quad (1.9)$$

As shown in Figure 1.2, we thus potentially have nine cases, according to whether each sub-self has an interior solution or either of the two corner solutions. Before proceeding further, we consider a parametric example that will provide helpful insight.

	$x_A^{H*} > 0, x_B^{H*} > 0$	$x_A^{H*} > 0, x_B^{H*} = 0$	$x_A^{H*} = 0, x_B^{H*} > 0$	$x_A^{H*} = 0, x_B^{H*} = 0$
$x_A^{C*} > 0, x_B^{C*} > 0$	①	②	③	
$x_A^{C*} > 0, x_B^{C*} = 0$	④	⑤	⑥	
$x_A^{C*} = 0, x_B^{C*} > 0$	⑦	⑧	⑨	
$x_A^{C*} = 0, x_B^{C*} = 0$				

Figure 1.2: Possible cases for joint best response.

1.3.2. Cobb-Douglas Example

To illustrate the analysis so far, consider Cobb-Douglas utility functions for two subselves,

$$U^j(X_A, X_B) = X_A^{\alpha^j} X_B^{1-\alpha^j}, \quad j = C, H \quad (1.10)$$

for given budget share parameters $\alpha^j \in (0, 1)$. It is well-known (and easily verified) that these utility functions satisfy Assumptions 1 and 2, and that the marginal rate of substitution is

$$MRS^j(X_A, X_B) = \frac{\partial_A U^j}{\partial_B U^j} = \frac{\alpha^j X_B}{1 - \alpha^j X_A}. \quad (1.11)$$

The last expression in equation (1.11) tells us that A is a temptation good for Hot $\iff \frac{\alpha^H}{1-\alpha^H} > \frac{\alpha^C}{1-\alpha^C} \iff \alpha^H > \alpha^C$.

Budget exhaustion follows from Assumption 1, so $px_A^C + x_B^C = \phi$ and $px_A^H + x_B^H = 1 - \phi$. Plugging in those expressions, we see that budget constraint (4) reduces to

$$pX_A + X_B = 1. \quad (1.12)$$

We previously noted that the relaxed solution \tilde{X}^j (ignoring non-negativity constraints) was characterized by the first order condition $MRS^j(X) = p$. Combining that observation with (1.12), we obtain the familiar result

$$\tilde{X}_A^j = \frac{\alpha^j}{p}, \quad \tilde{X}_B^j = 1 - \alpha^j, \quad j = H, C. \quad (1.13)$$

That is, the relaxed expenditure shares for each sub-self coincide with their given Cobb-Douglas parameters.

These expressions for \tilde{X} together with the general best response function (1.8-1.9) enable us to find Nash equilibrium of $\Gamma(\phi)$. To begin, suppose that $\phi \in (0, 1 - \alpha^H)$. Then $\alpha^H < 1 - \phi$, i.e., Hot's relaxed expenditure $p\tilde{x}_A^H = p\frac{\alpha^H}{p} = \alpha^H$ on their temptation good is less than their allocated budget $1 - \phi$. Thus Hot will purchase a positive amount of good B as well as a positive amount of A, and so the relevant column in Figure 1.2 is the first (cases 1, 4 or 7). It is intuitively clear that case 4 is not relevant: surely Cold will purchase some of her preferred good to increase her consumption of it beyond that chosen by Hot, who cares less for it. It is also intuitively clear that case 1 is not relevant, since it implies that Cold will not choose to improve on Hot's optimal relaxed bundle \tilde{X}^H . (The next subsection will rigorously support these intuitions.) We conclude that case 7 applies, with $x_A^H = \tilde{x}_A^H = \frac{\alpha^H}{p}$, $x_B^H = 1 - \phi - \alpha^H$ and $x_A^C = 0, x_B^C = \phi$.

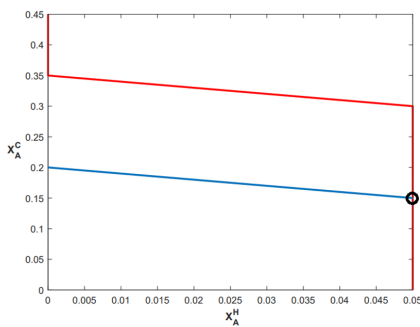
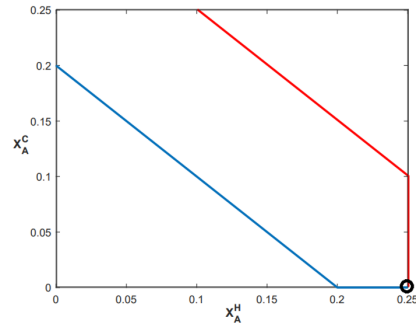
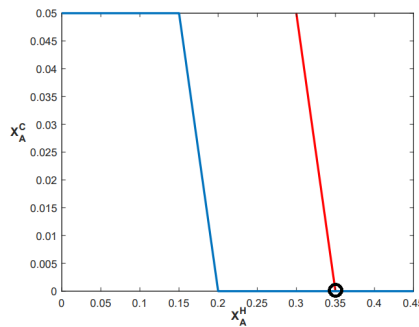
(a) $\phi = 0.1$ (b) $\phi = 0.5$ (c) $\phi = 0.9$

Figure 1.3: Best responses in Cobb-Douglas example with $\alpha^C = 0.4$, $\alpha^H = 0.7$, and $p = 2$. Blue lines show best responses x_A^{C*} to x_A^H (with $x_B^H = 1 - \phi - px_A^H$) and red lines show best response x_A^{H*} to x_A^C (with $x_B^C = \phi - px_A^C$). The black circles indicate Nash Equilibria.

Now suppose that $\phi \in (1 - \alpha^C, 1)$. Equation (1.13) shows that now Cold can purchase more good B than in their optimal relaxed bundle $\tilde{X}^C = (\frac{\alpha^C}{p}, 1 - \alpha^C)$, so the top row of Figure 1.2 applies. The same intuition as previously rules out cases 3 (Hot doesn't purchase any of their temptation good) and 1 (Hot is happy with Cold's relaxed choice of total consumption). Thus case 2 applies, with $x_A^H = \frac{1-\phi}{p}, x_B^H = 0$ and $x_A^C = \frac{\alpha^C + \phi - 1}{p}, x_B^C = \tilde{X}_B^C = 1 - \alpha^C$.

When $\phi \in (1 - \alpha^H, 1 - \alpha^C)$, neither sub-self will have the purchasing power to unilaterally acquire their desired amount of their preferred good. It is intuitively clear that case 8 applies, where each of them will use their entire budget on their preferred good. That is, now the unique NE is $x_A^H = \frac{1-\phi}{p}, x_B^H = 0$ and $x_A^C = 0, x_B^C = \phi$. Figure 3 shows the best responses and Nash equilibrium for an allocation ϕ in each of the three relevant ranges. Note that one of the selves is completely specialized ($x_A^i = 0$ or $x_B^i = 0$) in NE in panels (a) and (c), and that both selves are completely specialized in panel (b).

To take the analysis a step further, consider the NE payoffs in this parametric example as a function of ϕ :

$$U^{C*} = \begin{cases} \left(\frac{\alpha^H}{p}\right)^{\alpha^C} (1 - \alpha^H)^{1 - \alpha^C} & \text{if } 0 \leq \phi < 1 - \alpha^H \\ \left(\frac{1-\phi}{p}\right)^{\alpha^C} \phi^{1 - \alpha^C} & \text{if } 1 - \alpha^H \leq \phi \leq 1 - \alpha^C \\ \left(\frac{\alpha^C}{p}\right)^{\alpha^C} (1 - \alpha^C)^{1 - \alpha^C} & \text{if } 1 - \alpha^C < \phi \leq 1 \end{cases} \quad (1.14)$$

and

$$U^{H*} = \begin{cases} \left(\frac{\alpha^H}{p}\right)^{\alpha^H} (1 - \alpha^H)^{1 - \alpha^H} & \text{if } 0 \leq \phi < 1 - \alpha^H \\ \left(\frac{1-\phi}{p}\right)^{\alpha^H} \phi^{1 - \alpha^H} & \text{if } 1 - \alpha^H \leq \phi \leq 1 - \alpha^C \\ \left(\frac{\alpha^C}{p}\right)^{\alpha^H} (1 - \alpha^C)^{1 - \alpha^H} & \text{if } 1 - \alpha^C < \phi \leq 1 \end{cases} \quad (1.15)$$

Figure 3 graphs these payoff functions as functions of ϕ for a particular choice of $\alpha^C < \alpha^H$, together with Ego's payoff, $U^E = \gamma U^{C*} + (1 - \gamma)U^{H*}$ for $\gamma = 0.5$.

Note that payoff for each of the three sub-selves is constant for $\phi \leq 1 - \alpha^H = 0.3$ and for $\phi \geq 1 - \alpha^C = 0.6$. For $\phi \in (0.3, 0.6)$, Hot's payoff decreases, Cold's decreases, while

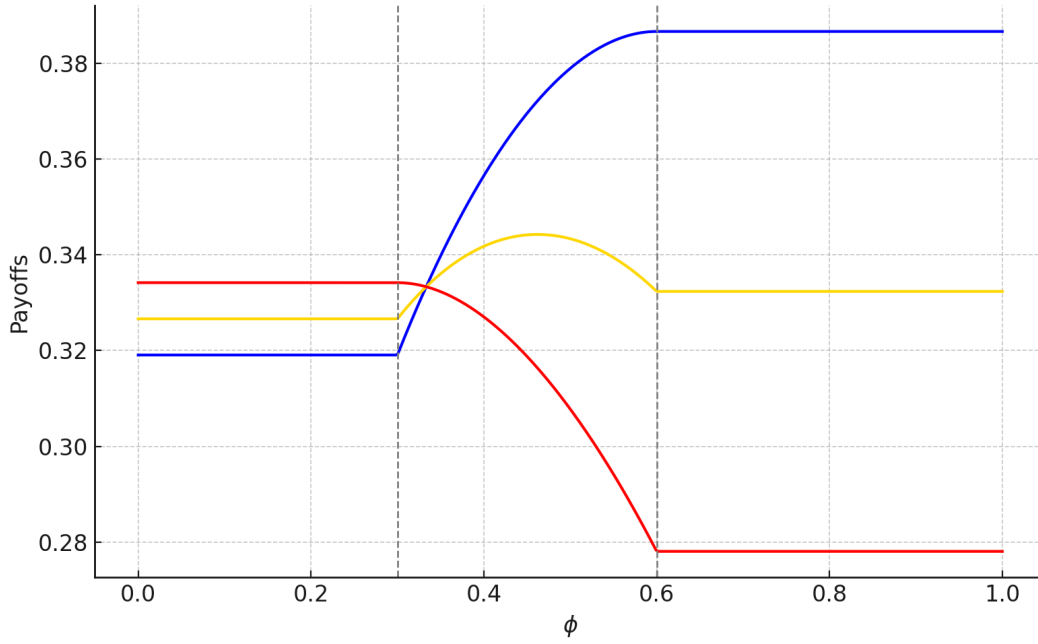


Figure 1.4: NE payoffs in Cobb-Douglas example with $\alpha^C = 0.4$, $\alpha^H = 0.7$, $\gamma = 0.5$ and $p = 2$. Red, blue and yellow lines respectively show payoffs for Hot, Cold and Ego.

Ego's payoff increases at first but then decreases. Thus Ego's optimal choice ϕ^* will lie in the interval $(0.3, 0.6)$. We will soon see that many qualitative features of this parametric example hold in the general case.

1.3.3. Subgame Nash Equilibrium

In the Cobb-Douglas example, only three of the nine possible cases arose in NE. We will now see that the same is true in our general model. We first eliminate what might seem to be the most natural case, where both sub-selves choose interior bundles.

Lemma 1. *Let A be a temptation good, and let preferences satisfy Assumption 1. Then case 1 can not occur in Nash equilibrium.*

Proof. Suppose to the contrary, that case (1) holds at $X = x^H + x^C$, where both components of x^H and of x^C are strictly positive. It follows from Assumption 1 and the standard first order conditions that $MRS^H(X) = \frac{\partial_A U^H(X)}{\partial_B U^H(X)} = p$. For the same reason, $MRS^C(X) = p$. Hence $MRS^H(X) = MRS^C(X)$, contradicting the assumption that A is a temptation good.

■

Lemma 2. *Let preferences satisfy Assumptions 1 and 2. Then at the Nash equilibrium of $\Gamma(\phi)$ for each $\phi \in [0, 1]$, total consumption is positive for both goods: $X_A > 0$ and $X_B > 0$.*

Proof. Suppose to the contrary that $X_A = 0$ at the NE of $\Gamma(\phi)$. If $\phi > 0$, then Cold could purchase some positive amount of A, and by Assumption 2 this would increase her utility. Thus $X_A = 0$ is not compatible with Cold choosing a best response, a contradiction. If $\phi = 0$, then the same contradiction is obtained by applying the Inada condition (Assumption 2) to Hot's choice. The same argument establishes that $X_B > 0$ at the NE of $\Gamma(\phi)$ for every $\phi \in [0, 1]$. ■

We now show that, not surprisingly, neither sub-self will purchase only her less preferred good.

Lemma 3. *Let A be a temptation good, and let preferences satisfy Assumptions 1 and 2. Then cases 3, 4, 5, 6 and 9 can not occur in Nash equilibrium.*

Proof. Suppose to the contrary that, at NE total allocation $X = x^H + x^C$, Hot purchases only good B, so $x^H = (0, \phi)$, as in cases 3, 6 and 9. At NE, the usual Kuhn-Tucker conditions will hold for Hot, and these imply that $MRS^H(X) \leq p$. It follows from Lemma 2 that Cold will purchase a positive amount of good A, so $X_A = x_A^C > 0$. Therefore, by Cold's first-order conditions, $MRS^C(X) \geq p$. Hence $MRS^C(X) \geq MRS^H(X)$, contradicting the assumption that A is a temptation good for Hot. A parallel argument eliminates the possibility that Cold purchases only good A, as in cases 4, 5, and 6. ■

As a benchmark, it turns out to be useful to consider the situations where either of the two sub-selves has the entire purchasing power. Let $\hat{X}^C(p) = (\hat{X}_A^C(p), \hat{X}_B^C(p))$ be Cold's most preferred affordable bundle at price p and $\phi = 1$, and let $\hat{X}^H(p) = (\hat{X}_A^H(p), \hat{X}_B^H(p))$ be Hot's most preferred affordable bundle when $\phi = 0$. Then,

Lemma 4. *Let A be a temptation good. Then $\hat{X}_A^H > \hat{X}_A^C$ and $\hat{X}_B^C > \hat{X}_B^H$.*

Proof. Since A is a temptation good, we have $MRS^H(X) > MRS^C(X)$ for all allocations, including $X = \hat{X}^C \equiv (\hat{X}_A^C, \hat{X}_B^C)$. Thus $MRS^C(\hat{X}^C) = p < MRS^H(\hat{X}^C)$. By a basic property of MRS, it follows that U^H will increase as we move from \hat{X}^C to $\hat{X}^C + (\varepsilon, -p\varepsilon)$

for sufficiently small positive ε . Since \hat{X}^C and \hat{X}^H lie on the same budget line of slope $-p$ and, by quasi-concavity, $MRS^H(X)$ decreases monotonically as we move along that budget line from \hat{X}^C towards higher X_A , we see that U^H continues to increase until we reach $X = \hat{X}^H$, where $MRS^H(X) = p$. Thus indeed $\hat{X}_A^H > \hat{X}_A^C$ and $\hat{X}_B^H > \hat{X}_B^C$. ■

We are now ready to fully characterize the subgame Nash equilibria for general preferences and any relative price $p > 0$. It turns out that, as the wealth allocation ϕ to Cold increases, the NE always transitions from one where Hot purchases both goods but Cold purchases only B (case 7) to both purchasing only their preferred good (case 8) to Cold purchases both goods but Hot purchases only A (case 2). More precisely,

Proposition 1. *Let A be a temptation good, and let preferences satisfy Assumptions 1 and 2. Then, for each $\phi \in [0, 1]$ and $p > 0$, the subgame $\Gamma(\phi)$ has a unique NE $x^*(\phi, p)$. Moreover, there are threshold values $0 \leq \underline{\phi}(p) < \bar{\phi}(p) \leq 1$ such that*

- $x^*(\phi, p)$ is case 7 for $\phi < \underline{\phi}(p)$
- $x^*(\phi, p)$ is case 8 for $\underline{\phi}(p) \leq \phi \leq \bar{\phi}(p)$
- $x^*(\phi, p)$ is case 2 for $\phi > \bar{\phi}(p)$.

Proof. When Hot has unilateral power, $\phi = 0$, both players have trivial dominant strategies, so $x^H = \hat{X}^H(p), x^C = 0$ is the unique NE. It then follows from Lemma 2 that both components of $\hat{X}^H(p)$ are positive.

Set $\underline{\phi}(p) = 1 - p\hat{X}_A^H(p)$. Since both components of $\hat{X}^H(p)$ are positive and (by virtue of our normalizations) expenditure on that bundle is 1, it follows that $0 < \underline{\phi}(p) < 1$. For $\phi \in [0, \underline{\phi}(p))$, Hot's budget $1 - \phi$ suffices to purchase the temptation component $\hat{X}_A^H(p)$ of his preferred bundle with some left over for the other component. This eliminates cases 2 and 8 from the possible NE, and the Lemmas remove all other cases except 7. Thus the best response equations (7-8) tell us that NE is uniquely defined by

$$x^C = (0, \phi) \text{ and } x^H = (\hat{X}_A^H(p), \hat{X}_B^H(p) - \phi) \quad (1.16)$$

when $\phi \in [0, \underline{\phi}(p))$. Of course, the NE payoff vector consists of the three players' utilities at allocation $X = \hat{X}^H(p)$.

Similarly, consider Cold's most preferred affordable bundle when $\phi = 1$, denoted $\hat{X}^C(p) = (\hat{X}_A^C(p), \hat{X}_B^C(p))$. Set $\bar{\phi}(p) = \hat{X}_B^C(p)$, the expenditure (with price p_B normalized to 1) required to purchase the second component of that bundle. An argument parallel to that above establishes that there is a unique NE, which is case 2, when $\phi \in (\bar{\phi}(p), 1]$. It takes the form

$$x^C = \left(\hat{X}_A^C(p) - \frac{1-\phi}{p}, \hat{X}_B^C(p) \right) \text{ and } x^H = \left(\frac{1-\phi}{p}, 0 \right); \quad (1.17)$$

the payoff vector consists of the players' utilities at allocation $X = \hat{X}^C(p)$.

Note that by Lemma 4 we have $\hat{X}_A^H(p) > \hat{X}_A^C(p)$ and $\hat{X}_B^C(p) > \hat{X}_B^H(p)$. It follows that $\underline{\phi}(p) = 1 - p\hat{X}_A^H(p) = \hat{X}_B^H(p) < \hat{X}_B^C(p) = \bar{\phi}(p)$.

To complete the proof, suppose that $\underline{\phi}(p) \leq \phi \leq \bar{\phi}(p)$. Case 7 is not possible since, with $\underline{\phi}(p) \leq \phi$, Hot no longer has the purchasing power to acquire a positive amount of good B while purchasing \hat{X}_A^H . Likewise, with $\phi \leq \bar{\phi}(p)$, Case 2 is not possible. Having ruled out all other cases, it must be for this range of ϕ , the NE are case 8. It follows from the BR equations (7-8) that the NE is unique with

$$x^C = (0, \phi) \text{ and } x^H = \left(\frac{1-\phi}{p}, 0 \right). \quad (1.18)$$

■

Considering the joint consumption vector in Nash equilibrium $X^*(\phi, p) = x^{C*}(\phi, p) + x^{H*}(\phi, p)$ we obtain the following corollary.

Corollary 1.

$$X^*(\phi, p) = \begin{cases} \left(\frac{1-\phi}{p}, \underline{\phi} \right) & \text{if } 0 \leq \phi \leq \underline{\phi} \\ \left(\frac{1-\phi}{p}, \phi \right) & \text{if } \underline{\phi} < \phi < \bar{\phi} \\ \left(\frac{1-\bar{\phi}}{p}, \bar{\phi} \right) & \text{if } \bar{\phi} \leq \phi \leq 1. \end{cases} \quad (1.19)$$

Proof. The proof follows from adding up x^C and x^H in equations (1.16)-(1.18) and

noting that $\hat{X}^H(p) = \left(\frac{1-\underline{\phi}}{p}, \underline{\phi}\right)$ and $\hat{X}^C(p) = \left(\frac{1-\bar{\phi}}{p}, \bar{\phi}\right)$. ■

1.3.4. The Full Game

Figure 3 is for a particular numerical example, but Proposition 1 and Corollary 1 tell us that it nicely illustrates the general case. The kinks in NE payoff at the α 's in the example generalize to kinks at $\underline{\phi}(p)$ and $\bar{\phi}(p)$. The NE consumption bundles (and therefore NE payoffs) are constant below $\underline{\phi}(p)$ and above $\bar{\phi}(p)$. In the range $\phi \in [\underline{\phi}(p), \bar{\phi}(p)]$, NE payoff is decreasing for Hot and increasing for Cold. However, as we increase ϕ^* slightly starting at $\underline{\phi}(p)$, the kink in Cold's payoff indicates that their payoff increases faster than the (non-kinked) payoff for Hot decreases. Therefore Ego's payoff increases here for any weighting $\gamma \in (0, 1)$. Similarly, Figure 3 suggests that Ego's payoff is decreasing in ϕ slightly below $\bar{\phi}(p)$. Otherwise put, the player getting her preferred bundle loses utility only gradually with a small deviation from that bundle, while the other player gets a more direct boost. Thus it would seem that Ego's optimum must occur in that middle range of ϕ . More precisely, we have

Proposition 2. *Let A be a temptation good, and let preferences satisfy Assumptions 1 and 2. Then for any $\gamma \in (0, 1)$ and $p > 0$, Ego will choose $\phi \in (\underline{\phi}(p), \bar{\phi}(p))$, where both sub-selves completely specialize their purchases, in any subgame perfect Nash equilibrium (SPNE) of the full game.*

Proof. Fix $p > 0$ and streamline notation by omitting it. Let $X(\phi)$ represent the NE consumption vector characterized in the previous Proposition, and let $V^H(\phi) = U^H(X(\phi))$ and $V^C(\phi) = U^C(X(\phi))$ denote the corresponding NE payoffs for the two sub-selves. Also let $V^E(\phi) = \gamma V^C(\phi) + (1 - \gamma)V^H(\phi)$ be the corresponding payoff for Ego.

In SPNE, Ego maximizes the continuous function $V^E(\phi)$ over the compact set $\phi \in [0, 1]$. Such a maximum must exist. The key to completing the proof is the following

Claim. For $\varepsilon > 0$ sufficiently small, $V^E(\underline{\phi}) < V^E(\underline{\phi} + \varepsilon)$ and $V^E(\bar{\phi}) < V^E(\bar{\phi} - \varepsilon)$.

To prove the claim, note by Corollary 1 that the right derivative of $V^i(\phi)$ is given by

$$\partial_+ V^i(\phi) = -\frac{1}{p} \partial_A U^i \left(\frac{1-\phi}{p}, \phi \right) + \partial_B U^i \left(\frac{1-\phi}{p}, \phi \right) \quad (1.20)$$

$$= \left(p - MRS^i \left(\frac{1-\phi}{p}, \phi \right) \right) \frac{\partial_B U^i \left(\frac{1-\phi}{p}, \phi \right)}{p} \quad (1.21)$$

in the interval $[\underline{\phi}, \bar{\phi})$ and is 0 otherwise. Note that at $\hat{X}^H = \left(\frac{1-\phi}{p}, \phi \right)$ we have

$$MRS^H \left(\frac{1-\phi}{p}, \phi \right) = p > MRS^C \left(\frac{1-\phi}{p}, \phi \right)$$

where the inequality comes from Assumption 1. Thus, we have $\partial_+ V^H(\phi) = 0$ and $\partial_+ V^C(\phi) > 0$. Since $\partial_+ V^E(\phi) = \gamma \partial_+ V^C(\phi) + (1-\gamma) \partial_+ V^H(\phi)$ it follows that $\partial_+ V^E(\phi) > 0$. A similar argument establishes that the left derivative of ego's payoff at $\bar{\phi}$ is negative, $\partial_- V^E(\bar{\phi}) = \gamma \partial_- V^C(\bar{\phi}) + (1-\gamma) \partial_- V^H(\bar{\phi}) < 0$, and the claim follows.

To complete the proof of the Proposition, take a first order Taylor expansion for $V^E(\phi + \varepsilon)$. For ε sufficiently small, we have $V^E(\phi + \varepsilon) = V^E(\phi) + \varepsilon \partial_+ V^E(\phi) + o(\varepsilon^2) > V^E(\phi)$. By the same token, $V^E(\bar{\phi} - \varepsilon) \approx V^E(\bar{\phi}) - \varepsilon \partial_- V^E(\bar{\phi}) > V^E(\bar{\phi})$.

It follows that the maximum of $V^E(\phi)$ can't occur in $[0, \underline{\phi}]$ nor in $[\bar{\phi}, 1]$, after noting that $V^E(\phi)$ is constant over each of those intervals. By elimination, the maximum (i.e., Ego's best response to the subgame NE strategy profiles in $\Gamma(\phi)$) must occur at some $\phi \in (\underline{\phi}(p), \bar{\phi}(p))$. ■

1.4. Discussion

Proposition 1 tells us that “doer” sub-self Cold (resp. Hot) will obtain her most preferred affordable bundle in any Nash equilibrium of the subgame whenever the resource allocation ϕ is above a threshold $\bar{\phi}$ (resp. below a threshold $\underline{\phi}$). However, Proposition 2 tells us that Ego will ultimately choose a resource allocation $\phi^* \in (\underline{\phi}, \bar{\phi})$ such that neither of the “doer” sub-selves gets their preferred bundle. Taken together, the Propositions tell us that in SPNE both of the doer sub-selves overspecialize: Hot purchases only the temptation good and Cold purchases only the generic good, even though both of them include both

goods in their most preferred bundles.

1.4.1. Alternative interpretations.

To make use of standard terminology, we framed our model as consumer choice with multiple sub-selves sharing a bundle of public goods, with their budgets controlled by a benevolent principal. Of course, in thinking about the process behind a person's observed behavior, we have in mind something more general. The resource that the principal sub-self ("Ego") divides into shares $(\phi, 1 - \phi)$ for the other sub-selves might be time or attention rather than purchasing power per se. The other sub-selves might allocate their shares to activities other than consumption goods. In a "Robinson Crusoe" setting, for example, activity A might be napping (a temptation good for the impulsive sub-self) while activity B might be weaving gill nets to improve fishing productivity. The given price P then would reflect the opportunity cost, so $1/P$ would be the foregone hours of napping to weave a gill net.

Some readers might wonder whether Hot is capable of best-responding to the other sub-selves. By informally describing Hot as "impulsive" we do not mean to suggest that Hot is incoherent, but rather that its preferences are less aligned with the individual's long term health and well-being than sub-self Cold's preferences. Neither Hot nor Cold need to have a high degree of rationality for our conclusions to be valid: an extensive literature in game theory and biology obtains mutual best response as a typical outcome with sub-rational myopic adaptive agents.^{4,5}

The limitations of Ego may also deserve further discussion. If Ego cares directly about the total bundle X and has the power to choose it unilaterally, then our setup would be equivalent to the standard rational choice model for a unified self; the payoffs to Hot and Cold would be of no consequence. If one unifies Ego and Cold into a single sub-

⁴See Kuhn et al. (1996) who emphasize the "mass-action" interpretation introduced in John Nash's 1950 dissertation, and writers following Selten (1983) or Binmore (1987) who favor "eductive" over "deductive" interpretations of Nash equilibrium. Recent textbooks on evolutionary game theory include Sandholm (2010), and Friedman and Sinervo (2016).

⁵There is a separate, more specialized literature on the evolution of preferences, e.g., Frank (1988); Güth and Yaari (1992); Samuelson and Swinkels (2006); Friedman and Singh (2009). It provides a starting point for researchers interested in investigating how a choice architecture like our three subselves might evolve.

self, then our setup again would reduce to the standard model with Cold's preferences. Following classic psychological literature from Freud (1933) to Baumeister et al. (2018) and beyond, we prefer to model Ego as a principal (or an executive function) that can act only indirectly via allocating scarce internal resources to agents who act on their own preferences. That approach seems useful when some sort of inner conflict affects observed individual choices.

Variants of our model could potentially have applications beyond conflicted individual choice. For example, consider private provision of public goods or, more specifically, an international body that allocates budgets ϕ to its members. The members may purchase public goods (e.g., education or defense or pollution abatement) but differ in how much they benefit from those goods. In a similar vein, our model might be used to analyze altruism, where agents benefit from the wellbeing of their peers, or to analyze family dynamics where each member chooses some portion of joint consumption.

Variants of our model may also speak to the allocation of resources among multiple divisions or departments within a firm.⁶ Suppose that the CEO decides on the allocation of resources between two divisions, each one having an advantage in one aspect of production x_i (but also being able to provide the other). Then U^i would simply be divisional profits and U^E the sum of these. In this scenario, our model predicts that, no matter the relative importance of the divisions or their ability to diversify, the CEO will allocate resources so that each division specializes on production of just one good.

1.4.2. Extensions

The model can be extended in various ways. For example, equation (1.2) assigns a linear social welfare function to Ego. However, the proof of Proposition 2 still goes through when Ego's payoff is any smooth social welfare function strictly increasing in both doer sub-self payoffs. One could also explore the width of the range $[\underline{\phi}, \bar{\phi}]$ where Ego's SPNE choice lies. We conjecture that, for some sensible metric on the space of preferences,

⁶Alonso et al. (2008) emphasize the importance of decentralized decision making in organizations when there is a conflict between superior information of local branch managers and a need to coordinate at the company level.

that width is an increasing function of the distance between Hot's preferences and Cold's preferences.

Sequential subgame. In our main model we assume that Hot and Cold move simultaneously in the subgame $\Gamma(\phi)$. However, it seems equally plausible that they move sequentially. To capture the idea that Hot is more impulsive and Cold can anticipate what will happen, we might postulate that Cold moves before Hot, while maintaining the assumption that Ego moves first. The reason we assume that the Cold self moves first is to let Cold be able to anticipate the Hot self's response. This structure reflects the notion that the Cold self is more forward-looking and more capable of self-control, whereas the Hot self acts more impulsively and lacks strategic anticipation. Appendix ?? analyzes this "Stackelberg" game and shows that, with the exception of certain sub-games that are not reached in sub-game perfect equilibrium, outcomes are essentially the same as in the benchmark version where the sub-selves move simultaneously. In standard oligopoly games, by contrast, the sequential and simultaneous move versions yield very different predictions.

Dynamic extensions. Our model is a one-shot extensive form game in which the first mover, Ego, freely chooses the resource allocation ϕ . Perhaps more realistically, the central executive system might be able to adjust that variable only gradually. According to some existing psychological studies such as Baumeister et al. (2018), and Oaten and Cheng (2006), the power of self-control can be strengthened over time via a form of investment (or presumably weakened via disinvestment). If Ego faces adjustment costs (e.g., quadratic, possibly asymmetric), then dynamic programming methods may help the analysis. Such a model might provide insight into behavior over time, as a person matures or just struggles to quit smoking.

2. Chapter 2: Revealed self control: Cultural Difference in the New Year's Resolution of UK and China

2.1. abstract

This paper estimates the effect of self control after excessive indulgence. We implement empirical estimations for the New Year's Resolution after Christmas for the UK and the Spring and Mid-Autumn Festival for China, respectively. We run regression models on search trends data from Google Trends and Baidu Index with festival dummies and control variables. In the UK, We find empirical evidence for self control as the search for keywords related to healthy lifestyle increases after the festive period. On the other hand, we find no such effects following prominent festivals in China.

Keywords: New Year's Resolution, search trends, self control

2.2. Introduction

With the rapid development of modern society, health issues such as obesity, often caused by poor dietary decisions, have become a significant concern, see, e.g., Finkelstein (2005). An unhealthy lifestyle is increasingly dominating, exacerbating public health challenges. A healthy lifestyle, particularly one focused on balanced food choices, is closely linked to the definition of self control. self control allows individuals to regulate their emotions, thoughts, and behaviours when faced with temptations and impulses (Diamond, 2013). Previous research has documented empirical relationships between self control and healthy behaviours, such as diet, e.g., Cherchye et al. (2017), consuming healthier foods, e.g., Werner and Milyavskaya (2018), or quitting smoking, e.g., Kan (2007). These studies suggest that resolutions to adopt healthier behaviours—such as eating better at the beginning of the year—can be seen as efforts to exercise self control.

This paper studies attitudes toward healthy living, particularly dietary habits and smoking cessation, at the start of the new year, focusing on differences between Western and Eastern societies. Using cross-sectional data from Google Trends and Baidu Index, the study analyzes search trends for the keywords "healthy foods," "stop smoking," "gym," and "diet." To account for cultural and temporal influences, the analysis includes dummy variables for major festivals: Christmas in the UK and the Spring and Mid-Autumn Festivals in China. These search trends serve as proxies for self control levels during and after indulgent holidays. The regression model incorporates control variables such as holiday length, economic conditions, and geographical cultural factors. In the UK, search intensity for keywords aligns strongly with the tradition of New Year's Resolutions, showing a pronounced spike in January. Conversely, the Chinese data presents a contrasting pattern, where search intensity drops following the Spring Festival and returns to baseline levels, reflecting distinct cultural attitudes toward self control.

The tradition of making New Year's Resolutions has its roots in ancient Rome and has become widely recognized in the West as a way to plan for a healthier, more disciplined life at the start of the calendar year. While the research by Lehrer (2009) highlights that many people struggle to maintain their resolutions throughout the year, it emphasizes the

importance of initial commitment as a deliberate act of self control. Previous studies have drawn connections between keyword search trends and lifestyle attitudes, as demonstrated by Cherchye et al. (2010) and Dai et al. (2014). However, the New Year's Resolution is predominantly tied to the Western calendar. In contrast, Eastern cultures like China mark the start of their new year with the Spring Festival rather than January 1st. Moreover, there is no explicit culture of the New Year's resolution in China. However, it could well be that individuals engage in a healthier lifestyle following periods of excessive indulgence. To investigate this, the paper compares search trends from Google and Baidu, focusing on the UK and China.

In recent years, search trends have become a valuable method to understand the popularity of certain behaviours. For instance, Choi and Varian (2012) showed that it could help predict economic activity by addressing the delays in traditional indicators. Preis et al. (2013) and Bulut (2018) demonstrated how it reflects market sentiment and improves financial forecasts. Eysenbach (2006) also highlighted its value in health monitoring, showing its potential across different fields. This paper uses data from Google Trends and Baidu Index to generate revealed behaviours in the UK and China, respectively. Google Trends tracks the popularity of search queries across regions and languages, while Baidu Index provides similar insights for China. Both platforms are widely used in research to gauge public interest, including applications in healthcare (Nutti et al., 2014). The primary difference between the two platforms lies in their normalization methods: Google Trends scales search intensity between 0 and 100, whereas Baidu Index aggregates search volumes across devices, often exceeding 100. Despite these differences, search intensity remains a method for understanding public engagement with the New Year's Resolution tradition across cultures.

The trends can be graphed through search intensity figures, offering insights into behavioural differences between the UK and China:



Figure 2.1: Google search trend of healthy foods

Figure 2.1 illustrates the search trends for the keyword "healthy foods" in the UK from 2018 to 2022, as captured by Google Trends. A consistent pattern emerges: search intensity spikes sharply every January before gradually declining throughout the year. This January peak aligns with the tradition of New Year's Resolutions, as people plan to adopt healthier lifestyles at the start of the calendar year. However, a pronounced "valley" in December, coinciding with the Christmas holiday, suggests a period of indulgence preceding these resolutions. This cycle underscores a distinct pattern of self control in the UK—marked by strong intentions in January that often taper off over the year. While the January peak reflects high levels of self control, the steady decline reveals the challenges in maintaining these resolutions in the long term.

By contrast, search trends in China, captured by the Baidu Index, display a markedly different pattern:

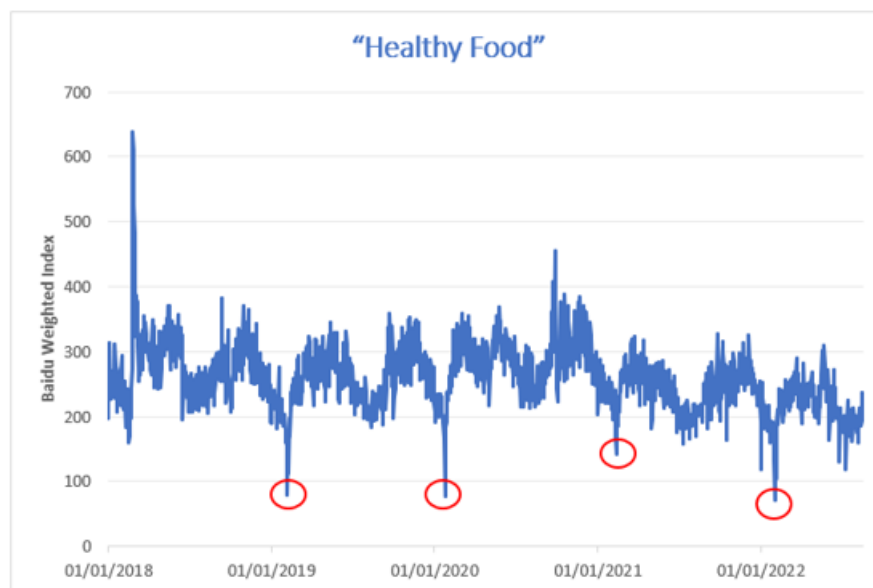


Figure 2.2: Baidu search trend of healthy foods in China (2018–2022)

Figure 2.2 presents the search intensity for "healthy foods" in China, where regular "valleys" rather than peaks characterize the trend (shown as red circles). These valleys typically occur shortly after January, aligning with the Spring Festival, which marks the beginning of the Chinese New Year. Unlike the UK's fixed calendar new year, the timing of the Spring Festival varies annually according to the lunar calendar, resulting in irregular intervals between valleys. Each valley likely reflects a period of indulgence during the Spring Festival, comparable to the Christmas holiday in the UK. However, unlike in the UK, no significant rise in search intensity follows this period. Instead, search trends gradually return to an average level without the sharp peaks indicative of New Year's Resolutions.

This divergence suggests that while the concept of self control through resolutions is deeply embedded in Western culture, it is less prominent in China. The absence of a comparable rise in search intensity implies that the New Year's Resolution framework does not translate directly to Chinese culture or the timing of the Spring Festival. These observations raise broader questions about how cultural contexts shape attitudes toward self control and whether Eastern countries exhibit alternative mechanisms for behavioural regulation.

The rest of this paper is structured as follows. In the next section, we will introduce a

detailed data description for different festival dummy variables and control variables and plunge them together as an empirical model. Then, regression results are revealed and analyzed in section 3 with future conjectures and extensions. Finally, the principal results and contributions will be stated in section four, which will include some limitations and extensions of this paper.

2.3. Data Description

In our research, we use search trends to explore New Year’s Resolutions and their connection to self control. The data comes from Google Trends and Baidu Index, which analyze how frequently people search for specific topics across different regions. To account for possible factors that might affect search trends during traditional holidays—like fewer searches during Christmas or the Spring Festival—we include the monthly active users of Google and Baidu as a control variable to reduce external influences (see Appendix B). Table 2.1 shows the average values and standard deviations for the search trends of ”healthy foods” (st_hf) and ”stop smoking” (st_s).

Country and Variable	Mean	Std. Dev.
st_hf (UK)	40.61	21.76
st_hf (China)	95.83	33.04
st_s (UK)	34.86	21.50
st_s (China)	292.87	145.38

Table 2.1: Statistics summary of search trends.

2.3.1. Data Sources

The data for this study were collected from Google Trends and Baidu Index, focusing on the UK and China between 2018 and 2022. Both platforms analyze keyword popularity, where Google Trends measures search intensity on a scale from 0 to 100, and Baidu Index calculates search intensity across PC, mobile, and other platforms, allowing values to exceed 100. For the UK, the analysis covers search trends for ”healthy foods,” ”stop

smoking,” ”gym,” and ”diet” across four regions: England, Scotland, Wales, and Northern Ireland. In China, the study focuses on eight economically developed provinces: Beijing, Shandong, Henan, Shanghai, Jiangsu, Zhejiang, Guangdong, and Chongqing. These provinces were chosen because they account for over 39% of China’s population and have relatively fewer missing values in Baidu Index data. Since Baidu Index does not support direct data downloads, we employed a web crawler to collect and reorganize the data into a long-form format for further analysis.

2.3.2. Dependent and Explanatory Variables

This study examines the effect of New Year’s Resolutions and self control through search trends, using search intensity as the primary continuous dependent variable. Search intensity provides a suitable measure for understanding how different explanatory variables influence self control. Search trends are collected for four keywords: ”healthy foods,” ”stop smoking,” ”gym,” and ”diet.” According to existing studies about the New Year’s Resolution, people, especially from Western countries, are reckoned to have incentives to start implementing better lives right after the beginning of the calendar new year, bringing about a higher level of self control (Oscarsson et al., 2020). In order to capture the effects of New Year’s Resolution in China, this paper focuses more on the first two keywords: ”Healthy foods,” and ”stop smoking.” Existing literature usually focuses on the keyword ”diet” for Western countries; however, the translation of ”diet” in the Chinese language is not a commonly used word, which provides a rationale for using the keyword ”healthy foods” as the main focus of interest. Another keyword associated with a healthy lifestyle is ”stop smoking,” which has been studied for Western countries by Kan (2007). We collect search trends of this keyword as another comparable variable to reveal self control after prominent festivals in the UK and China.

We include festival dummy variables as explanatory variables to capture the effects of festive periods. For the UK, we use the Christmas holiday, defined as a 14-day period, as the dummy variable ”chr.” This duration aligns with the 2 days of bank holiday for Christmas and allows us to account for the tendency of individuals to start indulging

shortly before the holiday officially begins. Furthermore, a longer period selection can ensure including the calendar new year, leading to a better understanding of the New Year's Resolution.

Additionally, we construct dummy variables for the periods before and after Christmas, labeled "bfchr" and "afchr," respectively. Each period spans 14 days, offering a consistent framework for observing changes in behaviour, including pre-holiday indulgence and post-holiday New Year's Resolutions. To ensure clarity in the timeframes, we carefully define the start and end dates for each period. Notably, the "chr" period ends before January 1st, ensuring that the beginning of the new year is included in the "afchr" period to better capture the effects of New Year's Resolutions.

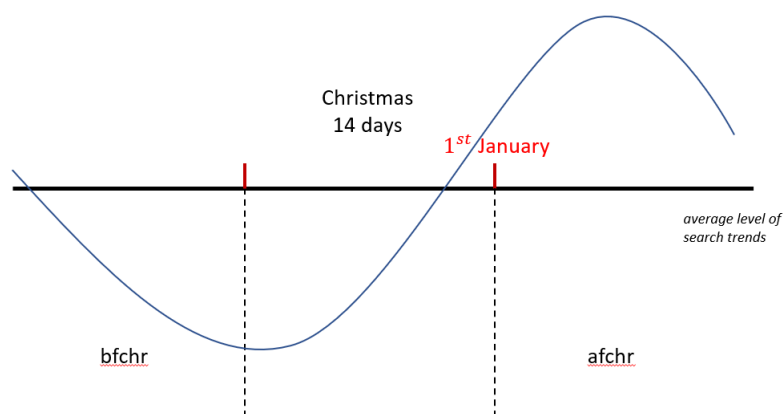


Figure 2.3: Festival Dummies for Christmas

For the Chinese context, the dates of the Spring Festival and Mid-Autumn Festival vary each year because traditional Chinese festivals follow the Chinese calendar, a lunisolar system based on astronomical phenomena to determine years, months, and days. As a result, these festivals do not fall on fixed dates in the Gregorian calendar. For example, the Spring Festival typically occurs between January and February, while the Mid-Autumn Festival usually takes place between September and October.

To define the holiday periods for these traditional festivals, we set the Spring Festival period ("spr") to span 14 days. This length allows for a more direct comparison with the 14-day Christmas break. The "spr" period includes the eight official public holidays for the Spring Festival and six additional days before these holidays. Similarly, we define

periods before and after the Spring Festival, labeled as "bfspr" and "afspr," each lasting 14 days, to analyze behavioural patterns leading up to and following the festival.

In addition to the Spring Festival, the Mid-Autumn Festival is represented by dummies "mid," "bfmid," and "afmid," following a similar structure to the Spring Festival dummies. However, the Mid-Autumn Festival periods are shorter, with each dummy covering ten days instead of 14. This distinction accounts for the shorter duration of the Mid-Autumn holiday compared to the Spring Festival.

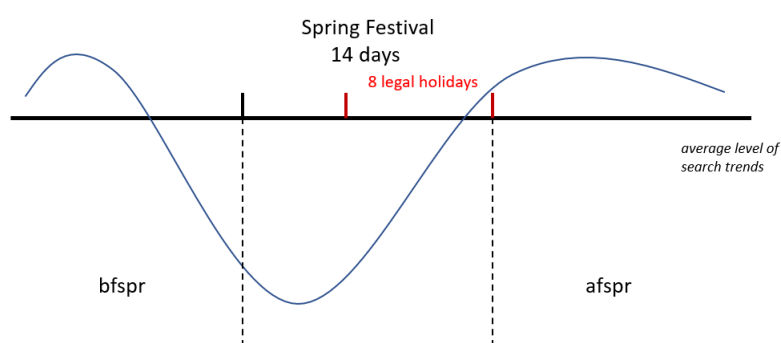


Figure 2.4: Festival Dummies for the Spring Festival

2.3.3. Control Variables

Although festival periods are defined separately for the UK and China, there are also possible discrepancies in search trends. Interference can be reckoned with three dimensions: length of holidays, economic factors, and cultural differences. This study controls for the economic and cultural background of different provinces in China. Beginning with constructed dummy variables, for instance, seaside province or not (1 = seaside province, 0 = otherwise). The "seaside" dummy is reckoned as an index to consider the economic background since seaside provinces are more developed. Besides of economic factors, seaside provinces are also recognized to be more "open", meaning Chinese culture plays much less rule than in more inland provinces (Zhou and Lin, 2013). People there might treat traditional festivals as less essential. To control cultural effects more specifically, we use another dummy variable as a control variable: Southern dummy (1 = Southern province, 0 = Northern province). Existing literature also points out that people in the

southern province are more traditional, which also complies with the cultural background of China, see, e.g., Ma et al. (2016). Finally, since the dummy variables "spr" and "chr" are set as 14 days, it is not easy to see whether the time length of holidays can affect the number of search trends. However, the Mid-Autumn Festival can perfectly solve this problem since the length of the Mid-Autumn Festival can be different every year. The background reason to explain this fact is that the date of the Mid-Autumn Festival flows every year due to the Chinese calendar; however, the Chinese national day is constant as October first. In some years, the Mid-Autumn Festival is too close to the Chinese National Day, then two periods of holidays will be combined as a long one, Hence here we construct a dummy "inb" to represent the in-between period between the Mid-Autumn and the Chinese National Day to see whether a "longer holiday" can affect human behaviour on search intensity.

2.3.4. Empirical Framework

Data used in this paper are estimated over distinct levels (province levels in China); Festival dummies estimate periods of important festivals in the UK and China, which covers a relatively small period of the observation window. Hence, we used the OLS method with control variables to estimate the correlation between search trends and festival dummies for the UK and China, respectively. The basic regression model is as follows:

$$st_{i,t} = \alpha + FestivalDummies'_{i,t}\beta + X' \delta + \varepsilon_{i,t}, \quad (2.1)$$

where α stands for the constant value of the search intensity without the influence of any explanatory variable, resulting in a baseline value of search trends. Festival dummies refer to periods before, during, and after Christmas (as "bfchr," "chr," and "afchr") in UK part, while including periods around the Spring and Mid-Autumn Festival (as "bfspr," "spr," "afspr," "bfmid," "mid," and "afmid"). Moreover, the matrix X represents all control variables ("sea," "S," and "inb"). Finally, ε captures the error term. Empirical results for the UK and China parts are discussed in the next section.

2.4. Empirical Results

2.4.1. UK

Search trends for keywords are divided into four districts by Google trends for the UK: England, Scotland, Wales, and Northern Ireland. Empirical results for each district can be figured out in the Appendix part where all coefficients related to periods "Christmas" and "after Christmas" are significant. Furthermore, by pooling them together, we get search trends for the whole of the UK, and estimation results are shown in Table 2.2. Festival dummies as explanatory variables used for UK trends mainly focus on Christmas since it is not only the most common festival in the Western world but also meets the date of January first which is the beginning of the calendar new year. To better reveal the effects of New Year's Resolution, festival dummy variable "Christmas" representing the Christmas period is defined as a two-week-period right before January first so that the start of the calendar new year can reasonably flow to the dummy variable "after Christmas" (14-day-period after the Christmas). Therefore, the coefficient assigned to "after Christmas" should reflect the New Year's Resolution.

	healthy foods (1)	stop smoking (2)	gym (3)	diet (4)
before the Christmas	-0.519*** (0.117)	-0.0301 (0.120)	-0.150 (0.120)	-0.745*** (0.120)
the Christmas	-0.894*** (0.118)	0.183 (0.121)	0.702*** (0.121)	-0.214 (0.120)
after the Christmas	1.111*** (0.131)	0.951*** (0.134)	0.562*** (0.134)	0.812*** (0.133)
constant	0.0196 (0.0238)	-0.0349 (0.0244)	-0.0380 (0.0244)	0.0117 (0.0242)
R^2	0.078	0.028	0.028	0.043

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.2: Regression results of the UK

Regarding Table 2.2, the coefficients associated with festival periods ("Christmas" and "before Christmas") are significantly negative for the keywords "healthy foods" and "diet." The coefficient for "before Christmas" is more negative than that for "Christmas,"

suggesting that the decline in health-conscious behaviour begins even before the holiday itself. This pattern reflects anticipatory indulgence—consistent with the idea that people begin relaxing health routines in preparation for festive celebrations. These negative effects illustrate a broader seasonal shift in behaviour and align with the empirical trend observed in previous data, including average monthly search volumes, where health-related search interest tends to wane during the Christmas period.

In contrast, the coefficients for the “after Christmas” dummy show strong and significant positive values across all four behavioural categories. The largest rebound is observed for “healthy foods” (1.111), followed by “diet” (0.812), “stop smoking” (0.951), and “gym” (0.562). These results reflect a sharp reversal in search behaviour immediately following the holiday, consistent with the influence of New Year’s Resolutions. Notably, this post-festival surge suggests a widespread recommitment to health goals, with individuals focusing on eating habits, smoking cessation, and physical fitness.

While the variables “healthy foods” and “diet” show significant negative trends before the holiday, “gym” exhibits a slightly different trajectory: there is already a significant increase in search activity during the Christmas period itself, possibly indicating early planning or anticipation of fitness-related goals or searchers searcher may be interested in buying gift certificates. Meanwhile, search intensity for “stop smoking” rises notably after the Christmas period, reinforcing its role as a common New Year goal. Compared to dietary concerns, indulgence in smoking appears less influenced by the holiday period itself, possibly because smoking is less culturally tied to the festivities. These post-Christmas behavioural shifts reinforce the hypothesis that health-oriented New Year’s Resolutions exert a measurable and immediate impact on online search behaviour across multiple lifestyle domains. Conversely, the data for China reveals a different pattern, where New Year’s Resolutions are less prominent and do not significantly influence search behaviour.

2.4.2. China

In the Chinese data analysis, this paper uses the Spring Festival and the Mid-Autumn Festival as two key traditional festival dummy variables. The dummy variable for the Spring

Festival spans 14 days, including eight legal holidays and six additional days after the start of the holiday. This approach captures the long break and the early preparation effects as people tend to indulge in anticipation of the festivities. Using a 14-day window instead of only eight legal holidays also facilitates a more direct comparison with Christmas in the UK. Additionally, two separate dummy variables, "before the Spring Festival" and "after the Spring Festival," are defined as the 14-day periods preceding and following the Spring Festival, respectively. This is similar with the definitions of "before Christmas" and "after Christmas" in the UK dataset, enabling a straightforward comparison of festival effects between the two cultural contexts. Similarly, for the Mid-Autumn Festival, a 10-day window is selected due to its shorter duration of only three legal holidays. The variables "before the Mid-Autumn Festival" and "after the Mid-Autumn Festival" are also defined as 10-day periods. Empirical results by province, detailed in the Appendix, reveal consistent trends in how festival dummies affect search intensity across most provinces. By pooling province data, regression results are shown in Table 2.3.

	healthy foods (1)	stop smoking (2)	gym (3)	diet (4)
before the Spring Festival	-0.606*** (0.113)	-0.423*** (0.120)	-0.443*** (0.120)	-0.734*** (0.118)
the Spring Festival	-1.906*** (0.113)	-0.825*** (0.120)	-0.940*** (0.120)	-1.009*** (0.118)
after the Spring Festival	0.0648 (0.113)	-0.0400 (0.120)	0.0925 (0.120)	0.229 (0.118)
before the Mid-Autumn Festival	-0.0175 (0.133)	-0.173 (0.142)	-0.251 (0.141)	-0.318* (0.139)
the Mid-Autumn Festival	-0.315* (0.133)	-0.371** (0.142)	-0.512*** (0.141)	-0.605*** (0.139)
after the Mid-Autumn Festival	0.245 (0.133)	-0.273 (0.142)	-0.402** (0.141)	-0.414** (0.139)
constant	0.0962*** (0.0241)	0.0717** (0.0257)	0.0814** (0.0255)	0.0947*** (0.0252)
R^2	0.149	0.035	0.048	0.070

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.3: Regression results of China

To begin with the keyword healthy foods, the regression results reveal a pronounced pattern of indulgence surrounding the Spring Festival in China. Both the "before the Spring Festival" and "the Spring Festival" periods show significantly negative coefficients, with the magnitude reaching -0.606 and -1.906 respectively. These values indicate

that search interest in healthy eating habits drops sharply as the holiday approaches and continues to decline during the festival itself. In terms of relative scale, the impact of the Spring Festival accounts for over 21% of the average search intensity in China, suggesting a widespread suspension of health-oriented behavior. In contrast to Western patterns, the post-festival period (“after the Spring Festival”) does not display a statistically significant recovery in healthy food searches. This implies that the notion of a health-related resolution following the Spring Festival is largely absent in Chinese behavioural trends.

For the Mid-Autumn Festival, the effects are more moderate. While the “before” and “during” periods show only mild declines in search activity—with the “during” coefficient at -0.315 , significant at the 5% level—the “after” period shows a small positive coefficient (0.245), though it is statistically insignificant. This limited rebound may be partially influenced by seasonal government campaigns promoting dietary awareness during September and October, when the Mid-Autumn Festival occurs. Nevertheless, the observed post-festival change remains much smaller than the resolution effects seen in Western countries.

Regarding the keyword stop smoking, the trend closely mirrors that of healthy foods. Significant negative coefficients are observed both before (-0.423) and during (-0.825) the Spring Festival. The stronger decline before the festival once again highlights the early onset of indulgent behaviour in traditional Chinese celebrations. More notably, there is no significant positive rebound in the “after” period (-0.040), further supporting the idea that post-festival resolutions related to smoking cessation are minimal or absent in China. The Mid-Autumn Festival presents a similar dynamic: a negative and significant coefficient during the festival (-0.371) and no meaningful recovery afterward.

Turning to gym and diet, similar patterns emerge. For gym, both the “before Spring Festival” (-0.443) and “Spring Festival” (-0.940) periods are significantly negative, and although the “after Spring Festival” dummy turns positive (0.0925), the change is negligible and statistically insignificant. For diet, the coefficients follow the same order: strong negative shifts before (-0.734) and during (-1.009) the Spring Festival, and only a minor, statistically insignificant rebound afterward (0.229). Interestingly, the “after Mid-Autumn

Festival” dummy for both gym (−0.402) and diet (−0.414) is negative and significant, indicating that not only is there no post-festival resolution, but search activity continues to drop even after the holiday. This suggests that recovery in health-focused behaviour is delayed or discouraged, possibly due to the absence of any resolution culture or institutional encouragement during this period.

Altogether, these findings reinforce a consistent pattern across different behavioural dimensions: Chinese festivals, especially the Spring Festival, are associated with strong declines in health-related search behaviour, but lack the rebound commonly observed in Western New Year traditions. Government-driven dietary campaigns around the Mid-Autumn Festival may provide temporary boosts, but there is limited evidence that Chinese users adopt structured resolutions following holiday indulgence. This cultural distinction underscores the importance of examining behavioural patterns within their societal context. The next object is to find whether the above relationships result from cultural differences or other factors. Because of the province level of our data, this paper does not need to concentrate on any controls on a micro level, for instance, education, wage, and so on. Instead, three control variables are picked to estimate three dimensions influencing regression results. Firstly, in order to consider the effect of the length of the festival on indulgence and self control, this paper picks a control variable, ”inb” to record the time period between the Mid-Autumn Festival and the Chinese national holiday since the length of the Spring Festival is constant without any other holidays can be combined with. However, the Mid-Autumn Festival can sometimes be lengthened by combining it with the national holiday so that we pick ”inb” to control the time length of traditional festivals (especially for the Mid-Autumn Festival). Secondly, considering economic factors, this paper adds another control variable, ”sea” measuring whether the province is seaside or not (1= seaside province, 0= not seaside). Based on previous studies, seaside cities or provinces are often considered much wealthier in China (Felice et al., 2023). Therefore, seaside province or not as a dummy control variable is useful and essential to recognize economic factors behind correlations. Finally, the last control variable labeled as ”S” in this paper is to define whether the province is a southern province or not (1= southern

province, 0= northern province). This control variable captures the cultural difference within mainland China since southern provinces are more likely to be traditional. Due to the data limitation, we only focus on the keywords "Healthy Foods" and "Stop Smoking" in China under controls.

	(1)	(2)	(3)	(4)	(5)	(6)
	Healthy Foods	Healthy Foods	Healthy Foods	Stop Smoking	Stop Smoking	Stop Smoking
Before the Spring Festival	-0.606*** (0.113)	-0.355*** (0.024)		-0.423*** (0.120)	-0.382*** (0.030)	
The Spring Festival	-1.906*** (0.113)	-0.308*** (0.024)		-0.825*** (0.120)	-0.304*** (0.030)	
After the Spring Festival	0.0648 (0.113)	0.059 (0.024)		-0.0400 (0.120)	-0.016 (0.030)	
Before the Mid-Autumn Festival	-0.0175 (0.133)	-0.064 (0.034)		-0.173 (0.142)	-0.164 (0.043)	
The Mid-Autumn Festival	-0.315* (0.133)	0.060 (0.034)		-0.371*** (0.142)	-0.138 (0.043)	
After the Mid-Autumn Festival	0.245 (0.133)	0.132* (0.034)		-0.273 (0.142)	-0.039 (0.043)	
inb		0.0068 (0.031)			-0.152** (0.040)	
sea		0.395*** (0.009)			0.606*** (0.012)	
S		-0.127*** (0.009)			-0.128*** (0.012)	
Gdp per capita × bfspr			0.00550 (0.0500)			0.00939 (0.0500)
Gdp per capita × spr			-0.0162 (0.0500)			-0.0179 (0.0500)
Gdp per capita × afspr			0.242*** (0.0500)			-0.0326 (0.0500)
Constant	0.0962*** (0.0241)	0.0015*** (0.0004)	-0.000000698 (0.00828)	0.0717*** (0.0257)	0.0003*** (0.0001)	2.39e-09 (0.00829)
R ²	0.149	0.138	0.002	0.035	0.183	0.000

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.4: Regression Results of China

Empirical results of "healthy foods" and "stop smoking" with control variables can be found in column two and five of Table 2.4, respectively. Compared to the previous model, the correlations between festival dummies and the intensity of search trends remain generally consistent: people in China still show a clear indulgent pattern during the Spring Festival, with little evidence of meaningful recovery or New Year's Resolution immediately after it. In contrast, a mild but significant increase in healthy behavior emerges after the Mid-Autumn Festival, especially in the healthy foods category. The coefficient of "after the Mid-Autumn Festival" reaches approximately 0.13 and is statistically sig-

nificant, suggesting that although the Mid-Autumn holiday is shorter and culturally less central than the Spring Festival, it may still serve as a moment for behavioral adjustment or moderation.

As for control variables, the variable “inb” shows an insignificant effect on healthy foods and a significant negative coefficient on stop smoking, implying that internet-related behavioral pressure may influence smoking resolution more than dietary behaviors. The variable “sea” remains positively significant in both models, especially strong in stop smoking, suggesting that residents in seaside provinces demonstrate consistently higher baseline levels of health-related search behavior. This could be attributed to regional openness or a higher exposure to health promotion efforts. On the other hand, the variable “S” (representing southern provinces) shows a strong and negative correlation with both healthy food and stop smoking search trends, indicating a regional culture that may resist health messaging or place less emphasis on public health in lifestyle choices.

Turning to economic indicators, the standardized GDP per capita interacted with festival dummies allows us to examine whether wealthier provinces exhibit stronger self-control responses during holiday periods. As shown in column three, Table 2.4, only the interaction between GDP per capita and “after the Spring Festival” is statistically significant in the healthy food model. The coefficient is approximately 0.24, meaning that a one-standard-deviation increase in GDP per capita leads to a 0.24 unit increase in healthy foods search intensity after the Spring Festival. This suggests that higher economic resources may marginally facilitate a stronger post-holiday recovery in dietary self-control, although the absolute effect size remains low. Other interactions, including GDP \times after Mid-Autumn Festival, are statistically insignificant in both models, especially in stop smoking.

Overall, these results suggest that cultural and economic factors partially shape the search behavior of Chinese internet users around major holidays. The Spring Festival continues to represent a period of indulgence with limited recovery, while the Mid-Autumn Festival may present a more balanced pattern, potentially due to its shorter duration and weaker cultural pressure. Wealthier provinces appear slightly more likely to resume

healthy behaviors after indulgence, particularly in diet, but not in smoking behavior. The negligible impact of GDP per capita on stop smoking further supports the conclusion that Chinese people tend to return to their baseline level of self-control, rather than make strong resolutions during the New Year or traditional festivals.

2.5. Discussion

self control, which is concerned to be the decision for the decision-making process, plays a vital role in daily life (Boureau et al., 2015). The New Year's Resolution is a way for people to go against their instinct of indulgence by implementing self control shortly but intensely. However, due to cultural differences, manifestations of the New Year's Resolution in Western and Eastern countries are entirely different. From the main results of this paper, the effect of New Year's Resolution in China is highly insignificant, bringing about the fact that Chinese people prefer to raise back their level of self control to average intensity rather than implement a resolution. Root causes can be considered in two dimensions:

Firstly, the Chinese calendar breaks the basic rule of the definition of the New Year's Resolution since people need to work at the beginning of the new year. Then, the scale of indulgence during the Spring Festival is similar to the one for the Christmas holiday in the UK; however, Chinese people tend not to have a plan for their life in the new year, even in the Chinese new year, which is contradictory to the common saying in China "New year new self."

Additionally, there is a small-scale resolution probably resulting from the Chinese Dietary Guidelines after the Mid-Autumn Festival that is only for healthy foods. In contrast, the level of indulgences during the Mid-Autumn Festival (whether for "healthy foods" or "smoking") is much lower than during the Spring Festival. In recent decades, the Chinese government has paid attention to health policy with a large cost while the obesity rate is still rising (Ramesh and Wu, 2009). Hence, the Chinese government should shift the healthy policy or guideline to some periods right after the Spring Festival resisting indulgence.

A possible extension of this paper is to extend the time length to an enormous amount with plenty of festival dummies. In that case, we can use survival analysis to estimate the last of each event or each festival period. Furthermore, this paper can be extended to focus more on health policies in different provinces in China: Testing the continuous effect of health policies and guidelines to see how long resolutions can be insisted after the different traditional festivals, which should be worthwhile for the government to settle periods to make policies.

3. Chapter 3: The Effect of Personality Traits and self control on Wages

3.1. abstract

This paper delves into the relationships between personality traits, self control, and economic outcomes, focusing on their impact on individual wages. We explore how distinct personality traits and self control abilities influence wage levels by drawing upon the Big Five and utilizing data from the Household, Income, and Labour Dynamics in Australia (HILDA) Survey. We employ factor analysis to identify personality traits and self control dimensions, which are then integrated into regression analysis alongside demographic and economic variables. This paper finds some dimensions of personality, such as Neuroticism, Conscientiousness, and Extroversion, that lead to positive relationships on the wage level, while Agreeableness brings about a negative one. The ability of self control shows a significantly positive impact on wages.

Keywords: Personality traits, self control, income

3.2. Introduction

Wage determination is a central topic in labor economics, with economists focusing on key factors such as education, age, and gender to explain earnings differences. For instance, higher educational attainment is strongly associated with higher wages, see, e.g., Card (1999), while wages tend to increase with age, albeit such effects diminish as individuals approach retirement, see, e.g., De Araujo and Lagos (2013). Despite similar qualifications, significant gender pay gaps persist, often attributed to discrimination (Black et al., 2008).

In recent decades, there has been growing interest in incorporating psychological factors into the study of wage determination. This approach focuses on understanding how individual characteristics, beyond traditional economic variables, influence labor market outcomes. Among these, personality traits have received significant attention due to their potential to explain variations in behaviour and performance. The framework of personality trait proposed by Allport (1937) offers a systematic way to study personality, focusing on stable patterns of behaviour, thoughts, and emotions that shape individual differences. These traits are thought to influence workplace performance and decision-making, making them a relevant consideration in wage analysis.

This paper examines how personality traits affect wages while accounting for traditional factors such as education, age, and gender. It adopts the Big Five personality traits model due to Costa and McCrae (1992)'s work, which categorizes personality into five key dimensions: Openness to Experience, Conscientiousness, Extroversion, Agreeableness, and Neuroticism. This framework provides a structured way to analyze how differences in personality may influence wages. Previous studies have explored related themes using various approaches. For example, Nyhus and Pons (2012) analyzed how Locus of Control and time preferences contribute to gender wage gaps, while Zhao (2022) studied the impact of HEXACO traits on Chinese labor market outcomes. Similarly, Mangiavacchi et al. (2021) investigated the role of personality traits in shaping household consumption behaviour.

In addition to personality traits, this study incorporates self control as another key

psychological factor. self control refers to an individual's ability to regulate emotions, thoughts, and behaviours when facing temptations, see, e.g., Diamond (2013). Studying self control in an economic context is viewed as a challenge. However, research such as Yang et al. (2022) has demonstrated a positive relationship between self control and wages in China. Adding to these insights, this paper uses factor analysis to evaluate self control based on responses to 13 survey items from the Household, Income, and Labour Dynamics in Australia (HILDA) Survey, thus providing a deeper understanding of its role in wage determination.

Furthermore, our study explores how personality traits and self control interact, integrating these psychological dimensions into regression models to analyze their combined effects on wages. By highlighting the role of self control, this approach complements prior studies such as Alderotti et al. (2023), which have focused on alternative personality traits.

The empirical analysis is based on data from the HILDA Survey. This dataset includes detailed questions of personality traits, self control, demographic characteristics, and economic variables, allowing for a comprehensive investigation of the relationships between psychological traits and wages. Factor analysis is applied to identify the key dimensions of personality and self control, which are then incorporated into regression models to explore their effects on individual wages.

The results reveal several important findings. Neuroticism is associated with a wage premium, while agreeableness has a negative relationship with wages, possibly reflecting an undervaluation of this trait in labor markets. Conscientiousness and extroversion positively correlate with higher wages, whereas openness shows no significant effect. When control variables are included, the analysis confirms the significant roles of education and gender in wage determination, highlighting persistent gender-based disparities. self control also emerges as a key factor, positively associated with conscientiousness and agreeableness, yet showing varied effects on wages. These findings underscore the complex interplay between psychological and traditional economic factors in determining wages.

3.3. Data Description

This paper uses the dataset from the Household, Income, and Labour Dynamics in Australia (HILDA) Survey in 2021, which is designed as a household-based annual survey collecting information about economic and personal well-being, labor market dynamics, and family life. The HILDA Survey follows more than 17,000 Australian participants each year, constructing questionnaires about household and family relationships, income and employment, educational level, and health. The most essential aspect for our research is the B25 part of wave 13: self-completion questionnaire (see Appendix B). B25 asks, "How well do the following words describe you?" giving thirty-six personality dimensions under the Likert Scale method. Each participant is requested to pick an integer score between one and seven, measuring the conformance of words and personalities. "One" means the word does not describe the participant at all, while "seven" refers to the word that describes the participant very well. For instance, participants are asked to pick a value measuring how well the word "talkative" describes themselves. Such comprehensive surveys on personality lead to specifying personality traits by grouping up those dimensions, forming personality trait variables.

In addition to personality questions, the HILDA Survey gathers detailed information on participants' income and employment situations in Part G, including the income structure (wage or salary, family income, and other incomes), number of jobs, and the gross amount of recent pay, which we use to form the dependent economic variables. Furthermore, participants are asked to fill in the B26 part (see Appendix B), a typical Likert scale form of questions about self control. Thirteen statements are answered by participants from one to five, where "one" means the statement does not describe at all, and "five" regards the statement very well. In this way, we assemble materials for revealed aspects of self control in addition to the Big Five personality traits and economic variables.

3.3.1. Explanatory Variables

Personality Traits

This paper captures personality types under the Big Five Personality Traits by implementing factor analysis for thirty-six personality traits from the HILDA Survey. The reason for conducting factor analysis is to reduce complexity for explanatory variables since we have 36 personality traits which can give rise to high autocorrelation in regression models. Factor analysis can aggregate multiple highly correlated observed variables into a few unobservable latent factors, thus reducing data dimensionality to avoid multicollinearity problems. Additionally, For instance, in economic studies, variables like "Transport Network Density," "Power Supply Capacity," and "ICT Penetration Rate" can be grouped under a broader factor such as "Infrastructure Development." While factor analysis is used more common in psychological researches. A famous application can be found in the Big Five Personality Model, which extracts five core dimensions from thousands of personality descriptors, explaining the cross-cultural universality of personality traits, see, e.g., Ashton et al. (2004). Moreover, identifying underlying factors provides better results to compare with existing literature.

The appropriateness of factor analysis was evaluated using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. A high KMO value (above 0.6) indicates adequate sampling adequacy, suggesting that correlations among variables are sufficiently large for factor analysis (Kaiser, 1974). Additionally, Bartlett's test confirmed the presence of significant correlations, validating the factorability of the dataset (test results in Appendix B). These statistical measures provide a strong foundation for applying factor analysis to uncover underlying personality structures.

The number of factors retained was determined using the scree plot, which visually displays the eigenvalues of the factors. As shown in Figure 3.1, the scree plot shows a clear "elbow" at the point where eigenvalues start to level off, consistent with the Kaiser criterion of retaining factors with eigenvalues greater than one (Cattell, 1966). This means that the retained factors explain more variance than individual original variables, making

factor analysis an effective tool for reducing the dimensions of the dataset.

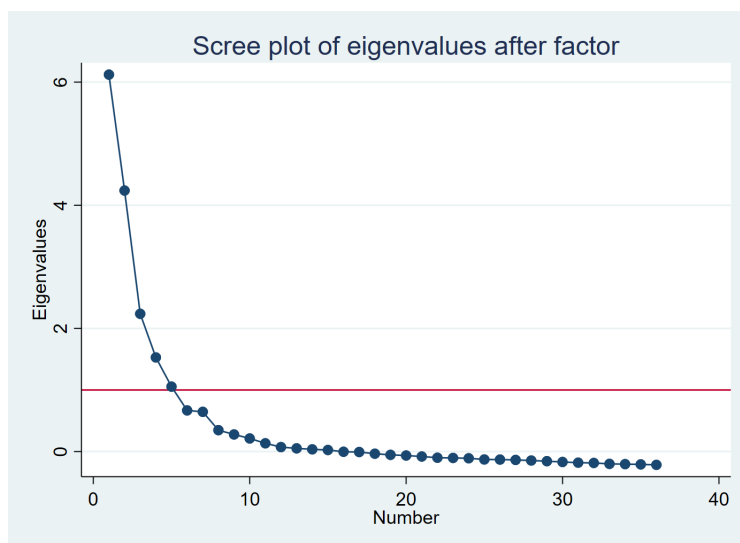


Figure 3.1: Factor Screeplot Graph with the line of Eigenvalue =1

After extracting the factors, a rotated pattern matrix was used to redistribute the factor loadings to ensure each variable loads strongly on the variable. Through this process, thirty-two personality dimensions from the original survey were grouped into five main factors. The detailed contents of each factor are shown in Figure 3.2. For example, the dimensions "withdrawn" and "bashful" have slightly significant loadings, with values just above 0.4 in the rotated pattern matrix. The term "bashful," because of its similarity to "shy," represents overlapping dimensions, both of which are categorized under Factor Five. Meanwhile, "withdrawn" appears slightly significant for both Factors One and Five, likely reflecting its dual meanings: a preference for solitude (Factor Five) or socially detached and emotionally quiet behaviour (Factor One). Since "withdrawn" has a stronger loading on Factor Five, it is ultimately grouped under this factor.

	Factor1	Factor2	Factor3	Factor4	Factor5
talkative					√-
sympathetic		√+			
orderly				√-	
envious	√+				
deep			√+		
withdrawn					√+
harsh	√+				
systematic				√-	
moody	√+				
philosophical			√+		
bashful					√+
kind		√+			
inefficient				√+	
touchy	√+				
creative			√+		
quiet					√+
cooperative		√+			
sloppy				√+	
jealous	√+				
intelliectual			√+		
extroverted					√-
cold		√-			
disorganised				√+	
temperamental	√+				
complex			√+		
shy					√+
warm		√+			
efficient				√-	
fretful	√+				
imaginative			√+		
enthusiastic		√+			
selfish	√+				
careless					
calm					
traditional					
lively					√-

Figure 3.2: Factor Contents

*Personality traits with ticks are significantly included in the five main factors under the factor analysis, while positive and negative signs represent the correlations between the personality traits and main factors.

*Factors in red (Factor 4& 5) are reversed to the Big Five main factors.

So far, we have a complete form of content of five factors. Surprisingly, five factors perfectly coincide with the Big Five Personality Traits Theory. The Big Five is a

suggested taxonomy or grouping for personality traits that are popular in fields of psychology study and job searching (Rothmann and Coetzer, 2003). Up to the twentieth century, the Big Five Theory has concluded five factors by labels: Neuroticism, Agreeableness, Openness to experience, Conscientiousness, and Extroversion. In order to check the meaningfulness of the five factors used in this paper, we first focus on the detailed content of each factor. Factor one contains eight variables: envious, harsh, moody, touchy, jealous, temperamental, fretful, and selfish. Despite the factor with most variables, factor one is concerned as Neuroticism under the Big Five personality traits theory, where variables can be divided into six main dimensions of Neuroticism. "Fretful" is related to the first dimension, "anxiety," to examine how frequent and how easy it is for a person to feel anxious. "Envy," "Jealous," and "Harsh" are grouped as "hostility," standing for the tendency to feel anger, frustration, or bitterness. The variable "withdrawn" represents the ability to feel loneliness, called "depression." (even if "withdrawn" is finally assigned to factor five) While "selfish" measures how easily an individual experiences social anxiety, which can be viewed as "self-consciousness." Furthermore, "moody" and "temperamental" consider the aspect of "impulsiveness," measuring the tendency to give in to cravings and the ability to delay gratification. Finally, "touchy" explains how well someone can handle stress, as the last dimension, "vulnerability." Specifically, according to the Big Five Inventory (BFI), promoted by John, Donahue, and Kentle since 1991 (see Appendix B), there are eight statements under the Likert Scale measuring the extent of Neuroticism. The statement "Often feels blue" coincided with the keywords in factor one, "withdrawn" and "touchy." Meanwhile, "selfish" is revealed by the statement, "Is not easily bothered by things." "Fretful" is represented by the single aspect "Becomes stressed out easily." Furthermore, since Neuroticism includes the field of emotions, "moody" and "temperamental" are regarded as "Becoming overwhelmed by emotions" and "Doing things I later regret" in the BFI. However, BFI also contains a statement, "Is calm, even in tense situations." where the keyword "calm" is not selected in our principle component analysis. Although BFI does not mention the aggressive emotions related to the keywords "envious" or "jealous," Neuroticism does include such an aspect; in some renewed questionnaires,

there can be a statement such as "I get irritated easily."

The high similarity rate between factor one and Neuroticism brings about a conjecture that the questionnaire designed by HILDA is based on keywords of the Big Five or personality traits theory. Under the research by Cattell in 1945, words used to describe personalities can be grouped as 12 source traits and four other traits, which summed up the famous 16PF, leading to instructions for further investigation on personality. Factor two verifies such suspicion. Agreeableness is represented by factor 2. The keyword "cooperative" is the main field of agreeableness, which can be related to the statements in BFI as "Trusts others." "Contradicts others.", and "Values cooperation over competition." Other keywords related to altruism, "sympathetic," kind," and "warm/cold" are revealed by "Thinks highly of myself." and "Is concerned about others." Besides, factor three figures out another main factor in the Big Five, "Openness to Experience." This factor mainly concentrates on creativity and intelligence, so that contains critical descriptions such as "creative," "intelligence," "imaginative," and so on. Relative statements also appear in BFI as "Does not have a good imagination." "Is interested in many things.", "Believes in the importance of art.", and "Prefers to stick with things that I know." On the other hand, the keywords "complex" and "deep" are mentioned by "Tries to understand myself." and "Is not interested in abstract ideas."

The next factor is linked with the "Conscientiousness" of the Big Five, including the keywords "orderly," "sloppy," "systematically," and "disorganized." The keywords above reckon the attitude of doing tasks, while factor four also considers the aspect of efficiency with the keywords "efficient" and "inefficient." All keywords are comprehensively related to statements of BFI with "Completes tasks successfully." "Often forgets to put things back in their proper place.", "Pays my bills on time.", "Postpones decisions." "Often makes last-minute plans.", and "Doesn't see the consequences of things." Factor four is the most convincing factor under the BFI since keywords and statements are almost one-to-one mapped perfectly. However, the HILDA Survey treats many negative statements in this area, which means the higher the number you pick, the lower your Conscientiousness ability. Thus, factor analysis automatically defines a reverse factor of Conscientiousness

which means the rotate factor matrix is reversed to the meaning of "Conscientiousness"; psychological studies about the Big Five personality traits theory concentrate on keywords of each main factor rather than the "positive" or "negative" relationships between them. For instance, both "efficient" and "inefficient" are included in factor four. Since the number of keywords with "negative" meaning exceeds the "positive" one, factor four here is counted as reversed "Conscientiousness." Similarly, The last factor stands for reversed "Extroversion," which is quite clear since it even has the keyword "extroverted." Besides extroverted, "talkative," "quiet," "shy," "bashful (same as shy)," and "lively" constructs factor five. Those words that describe external characters are reflected by statements such as "Prefers to be alone." "Can talk others into doing things." "Seeks quiet.", and "Enjoys being part of a group."

self control

Analogously, a factor analysis is undertaken on the B26 section of the HILDA Survey, yielding a unique factor to elucidate the construct of self control; the survey statements are provided in Appendix B. Within the thirteen survey queries, respondents assign a numerical value ranging from one to five. A rating of one signifies that the statement does not align with its characteristics, whereas five denotes a complete alignment with its veracity. Five statements express a "positive" affirmation of the participant's commendable self control abilities, while the remaining eight statements convey a "negative" orientation. Consequently, the outcome of the factor analysis reaffirms the identification of a factor synonymous with reversed self control. In order to simplify the empirical analysis, all reversed factors were converted into their "positive" counterparts before regression analyses were conducted.

3.3.2. Economic Dependent Variables

Regarding the dependent variables, the HILDA Survey incorporates comprehensive questions on participants' income. Participants are tasked with delineating various aspects of their income, encompassing categorization of income types, specifying the number of

employments held, and disclosing the gross amount of their most recent pre-tax earnings. To investigate how personality traits and self control influence wages, the natural logarithm of wages (`log_wage`) is used as the dependent variable. The log transformation of wages allows for a more normalized distribution of the dependent variable, which is often right-skewed, and facilitates an elasticity interpretation of the coefficients. This approach, consistent with Mincer (1974)'s classical wage equation, enables a deeper understanding of how both cognitive and non-cognitive factors contribute to wage variation.

3.3.3. Control Variables

Since economic factors can be affected by many variables in different areas, in this paper, we incorporate "age," "education," and "sex" as crucial control variables to mitigate potential confounding effects and enhance the precision of our findings. By including "age" as a control variable, we aim to account for any potential age-related variations that may influence the observed relationships within our research. This ensures that any effects we detect are not solely attributable to age disparities among our subjects. The control variable "age" can also catch the influences caused by seniority. Moreover, integrating "education" as a control variable allows us to isolate the specific impact of the variables of interest, independent of educational background, which can significantly shape individual perspectives and behaviours. Finally, considering "sex" as a control variable (where 0 = female and 1 = male) enables us to disentangle gender-related influences, ensuring that differences in male and female cohorts do not skew our conclusions. By carefully incorporating these control variables, we aim to enhance the validity and robustness of our study's findings, offering a more accurate representation of the relationships under investigation.

3.3.4. Empirical Framework

This paper concerns the main factors of the Big Five Personality traits as explanatory variables. Apart from personality aspects, questions about the ability of self control are also clustered as one factor that has been plunged into the regression correlated to wages.

Combining with control variables, the general regression model is revealed as follows:

$$\text{Log}(wage)_i = \alpha + \text{BigFive}'_i\beta + \text{SelfControl}'_i\delta + X' \gamma + \varepsilon_i, \quad (3.1)$$

where α represents the constant value of individual wages without any influence of the explanatory variable, giving rise to a baseline value of individual wages. The explanatory variable *BigFive* stands for five main factors after the principle components analysis of personality traits, including Neuroticism, Agreeableness, Openness, Conscientiousness, and Extroversion. On the other hand, *SelfControl* regards the factor associated with all of the thirteen questions on self control. Additionally, the vector X refers to the control variables, which are "Education," "Age," and "Sex." Finally, ε captures the error term.

Besides of the general regression with individual wages, this paper also deals with the regression between individual self control, which is revealed by the main factor of all self control-related questions and the Big Five factors with control variables:

$$\text{SelfControl}_i = \alpha + \text{BigFive}'_i\beta + X' \gamma + \varepsilon_i, \quad (3.2)$$

empirical results are displayed in the next part.

3.4. Empirical Results

The results in Table 3.1 highlight the significant effects of the Big Five personality traits on wages. Neuroticism, typically associated with emotional instability, exhibits a positive and statistically significant relationship with wages. Specifically, a one-unit increase in Neuroticism is associated with a 2.3%–2.9% increase in wages, depending on the model specification. Counterintuitively, this finding suggests that traits related to heightened emotional vigilance may align with specific occupational requirements or workplace environments where risk sensitivity or stress management plays a role in performance.

On the contrary, Agreeableness demonstrates a consistent and significant negative relationship with wages, with coefficients around -3%. Individuals with higher Agreeableness may prioritize social harmony and cooperation over assertiveness or competitive be-

haviour, often rewarded in labour markets. This aligns with existing evidence suggesting that lower levels of Agreeableness are often correlated with more substantial bargaining power and higher wages in competitive roles (Judge et al., 2012).

Conscientiousness and Extroversion show robust positive associations with wages. A one-unit increase in Conscientiousness increases wages by approximately 2.7%–3.5%. As Conscientiousness reflects traits such as diligence, reliability, and organization, it is well-suited to the demands of most professional roles where productivity and goal-oriented behaviour are highly valued. Extroversion, with coefficients between 3.2% and 3.5%, similarly enhances wages, likely due to its association with strong interpersonal skills, assertiveness, and leadership capabilities. These traits are often rewarded in roles that require communication, collaboration, or client-facing interactions.

While Openness to Experience is generally associated with creativity and curiosity, it does not yield significant effects on wages, whether with or without controls. This suggests that although Openness may contribute to innovative thinking, it does not appear to translate directly into measurable wage premiums in a broad labour market context.

The control variables included in the regression provide additional insights. The quadratic relationship between age and wages reflects a common pattern where earnings increase with age but at a decreasing rate. The negative coefficient for Age^2 indicates diminishing returns to experience, consistent with the standard human capital framework. Additionally, the significant negative coefficient for sex underscores the persistent gender wage gap, with women earning approximately 9% less than men after controlling for other factors. Education remains a key determinant of wages, as each additional unit of education increases wages by roughly 2.6%, reflecting the substantial returns to human capital investment. By comparing the scale of impacts through parameters, the marginal effect raised by personality traits can be even higher than the absolute value of the one by educational level. Neuroticism, Extroversion, and Conscientiousness play significant positive roles in earnings, while higher Agreeableness leads to lower feedback on money.

The inclusion of self control in the regression further underscores its importance in wage determination. In column (3), self control shows a positive and significant relation-

ship with wages, where a one-unit increase raises wages by approximately 3.5%. This result emphasizes the value of self-discipline and goal-directed behaviour, supporting the growing body of literature highlighting non-cognitive skills' role in shaping labour market outcomes. Individuals with greater self control are more likely to exhibit productivity-enhancing behaviours, such as perseverance, time management, and delayed gratification, which are critical for career advancement and wage growth. On the other hand, self control, as a psychological factor, can be formed or explained by personality traits, which can give rise to multicollinearity for the regression model. In order to check this phenomenon, we first implement the VIF test, while the VIF value is 1.06, meaning we can ignore that multicollinearity. However, this gives a another rationale for us to check the correlation between self control and personality traits, finding out whether we can use some dimension of personalities (which are relatively easier to be collected by the Big Five Inventory) as instrumental variable to measure self control.

	(1)	(2)	(3)	(4)	(5)
	log_wage	log_wage	log_wage	log_wage	log_wage
Neuroticism	0.0230** (0.0112)	0.0296*** (0.0108)			0.0290*** (0.0108)
Agreeableness	-0.0314*** (0.0121)	-0.0299** (0.0117)			-0.0308*** (0.0117)
Openness	0.0121 (0.0115)	0.00793 (0.0111)			0.00962 (0.0111)
Conscientiousness	0.0352*** (0.0109)	0.0300*** (0.0106)			0.0267** (0.0106)
Extroversion	0.0328*** (0.0104)	0.0321*** (0.0102)			0.0347*** (0.0102)
Age		0.0776*** (0.00348)		0.0772*** (0.00348)	0.0774*** (0.00347)
Age ²		-0.000907*** (0.0000395)		-0.000906*** (0.0000395)	-0.000906*** (0.0000395)
Sex		0.0900*** (0.0158)		0.0901*** (0.0158)	0.0892*** (0.0158)
Education		0.0260*** (0.00271)		0.0256*** (0.00271)	0.0258*** (0.00271)
Self Control			0.0358*** (0.0100)	0.0314*** (0.00973)	0.0326*** (0.00981)
_cons	7.253*** (0.00809)	5.504*** (0.0750)	7.254*** (0.00808)	5.526*** (0.0750)	5.513*** (0.0750)

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

Table 3.1: Regression Results for Log(Wage)

Table 3.2 focuses on the relationship between self control and personality traits, providing further insights into wage determination mechanisms. Conscientiousness exhibits the strongest positive correlation with self control, with coefficients around 0.1. This result is intuitive, as Conscientiousness captures traits such as organization, responsibility, and persistence, which are closely aligned with self-regulatory abilities. Neuroticism, while often associated with emotional instability, also shows a small but positive effect on self control, suggesting that individuals who experience higher levels of stress or anxiety may develop compensatory strategies to regulate their behaviour. In contrast, Openness and Extroversion demonstrate significant negative associations with self control. The negative coefficient for Openness, suggests that individuals who are more open to novelty and exploration may be less inclined to adhere to rigid routines or long-term planning. Similarly, the negative effect of Extroversion, ranging between -0.074 and -0.085, indicates that extroverted individuals, while sociable and assertive, may exhibit more impulsivity or a preference for immediate rewards, which can undermine self regulation. Hence, Extroversion has an indirect negative impact on wages where higher Extroversion leads to lower self control, and self control has its significant positive effect on wages. Conversely, agreeableness has a modest positive effect on self control, suggesting that agreeable individuals motivated by social expectations and cooperation may demonstrate greater behavioural discipline.

The control variables in Table 3.2 further validate these findings. Age and its quadratic term indicate that self control increases with age but at a diminishing rate, reflecting the natural maturation process where individuals develop better self-regulation skills over time. The significant positive coefficient for sex suggests that men may exhibit higher levels of self control compared to women, while education is positively associated with self control, underscoring the role of cognitive skills and learning environments in fostering self-discipline. Among the Big Five personality traits, we can find out that Openness is not significantly correlated with wages, while it is significantly positive for self control. Hence, we also checked whether Openness can be treated as an instrumental variable for self control, since self control is relatively complex to be revealed. After testing the weak-

ness of the instrumental variable, even if Openness can be treated as a strong instrument, results by 2SLS are still not significant, which means Openness cannot be used as an instrument for self control. Implied reason is the ability of self control cannot be mainly explained by personalities. As the large amount of constant shown in Table 3.2, genetic values (Willems et al., 2019) may explain self control better.

	(1) Self Control	(2) Self Control
Neuroticism	0.0181* (0.00983)	0.0182* (0.00979)
Agreeableness	0.0245** (0.0104)	0.0221** (0.0104)
Openness	-0.0491*** (0.0100)	-0.0468*** (0.0100)
Conscientiousness	0.0992*** (0.00955)	0.0994*** (0.00951)
Extroversion	-0.0858*** (0.00909)	-0.0743*** (0.00915)
Age		0.0137*** (0.00256)
Age ²		-0.000104*** (0.0000266)
Sex		0.0431*** (0.0141)
Education		0.00909*** (0.00244)
_cons	3.47e-17 (0.00702)	-0.467*** (0.0596)

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

Table 3.2: Regression Results between Self Control and Personality Traits

3.5. Discussion

The empirical results derived from regression analyses reveal intricate relationships between wages and personality traits. Specifically, Neuroticism, Conscientiousness, and Extroversion are found to have significant positive effects on earning potential. In contrast, Agreeableness demonstrates a negative association with wages, while Openness shows

no meaningful impact. Sarcastically, the results suggest a penalizing effect on wages for individuals exhibiting higher levels of cooperation and kindness associated with Agreeableness. Furthermore, the intellectual and creative attributes linked to Openness do not correlate significantly with wage outcomes.

The implications of these findings highlight a utilitarian dynamic in modern labor markets, where individuals exhibiting traits such as popularity, diligence, and self-interest tend to command higher wages compared to those defined primarily by intellectual or creative abilities. This suggests that contemporary economic systems place greater value on what might be termed "refined self-interest" over qualities like creativity and kindness.

Previous economic research has explored the connections between self control, the Big Five personality traits, and economic outcomes such as wage disparities and labor market entry. A comprehensive analytical approach that considers personality traits and self control is essential for capturing these dynamics. Grouping individuals based on their levels of self control and personality traits can provide a more nuanced understanding of how specific characteristics influence economic outcomes. Such rigor enhances confidence in the robustness and validity of these findings.

This study can be extended from different dimensions: Since self control cannot be notably explained by only personality traits and controls, it is better to consider other factors (such as genetic factor) to reveal self control better empirically. On the other hand, causality can be explored more by keeping collecting HILDA data, leading to a panel version for further possible researches.

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Appendix A: Extensions

A.1. Sequential game among selves

We proceed to identify the subgame perfect equilibria using backwards induction. In the last stage the hot system will choose a best response, as characterized in (1.9). Now consider the cold system which can anticipate Hot's best response.

First, consider the case where $\phi \geq \bar{\phi}(p)$. In this case Cold can buy $\hat{X}_B^C(p) = \bar{\phi}(p)$ units of good B and spend the remainder to buy $\frac{\phi - \hat{X}_B^C(p)}{p}$ units of good A . Now the hot system will simply spend all of her money on good A and buy $\frac{1-\phi}{p}$ units of it. It follows that total consumption is $X(p) = (\hat{X}_B^C(p), \hat{X}_B^C(p))$ which is the same bundle Cold would choose if it had unilateral purchasing power, $\phi = 1$. Note that choosing a bundle that contains more of good B would result in a final bundle with $X_B^C(p) > \hat{X}_B^C(p)$ and choosing a bundle that contains less of good B would result in a final bundle with $X_B^C(p) < \hat{X}_B^C(p)$. Neither is optimal for the Cold system. Thus, for $\phi \geq \bar{\phi}$ the equilibrium in the sub-game among selves is unique with

$$x^C = (0, \phi) \text{ and } x^H = \left(\frac{1-\phi}{p}, 0 \right). \quad (3)$$

Second, consider the case where $\phi \leq \underline{\phi}(p)$. Assume that the cold system chooses some bundle that fulfills its budget constraint $px_A^C + x_B^C = \phi$. Note that $x_B^C \leq \phi \leq \underline{\phi}(p)$. If the hot system chooses the bundle $(\hat{X}_A^H - x_A^C, \hat{X}_B^H - x_B^C)$, it can assure itself the same payoff as if it had unilateral purchasing power $\phi = 0$. Note that the hot system can afford this bundle since $p(\hat{X}_A^H - x_A^C) + \hat{X}_B^H - x_B^C = 1 - \phi$. So, no matter the choice of the cold system, the hot system has the budget to ensure the final bundle $(\hat{X}_B^H(p), \hat{X}_B^H(p))$ where it obtains the maximal level of utility. It follows that for $\phi \leq \underline{\phi}$ there exists a continuum of subgame

perfect Nash equilibria characterized by

$$x^C \in \left\{ (x_A^C, x_B^C) \mid px_A^C + x_B^C = \phi \right\} \text{ and } x^H = \left(\hat{X}_A^H - x_A^C, \hat{X}_B^H - x_B^C \right) \quad (4)$$

Finally, consider the case $\underline{\phi} < \phi < \bar{\phi}$. Consider the cold system and assume that it only buys its preferred good, $x^C = (0, \phi)$. Since $\phi > \underline{\phi}$ we have $p\hat{X}_A^H = 1 - \underline{\phi}(p) > 1 - \phi$, the hot system will only buy its temptation good A, $x^H = (\frac{1-\phi}{p}, 0)$. By choosing less of good B and buying a positive amount of good A, the cold system would strictly decrease its own payoff. It follows that for $\underline{\phi} < \phi < \bar{\phi}$

$$x^C = (0, \phi) \text{ and } x^H = \left(\frac{1-\phi}{p}, 0 \right) \quad (5)$$

is the only subgame perfect NE.

It follows that equilibrium payoffs and, thus, also the payoffs of the ego are the same as in the simultaneous move game. Consequently, ego choice of ϕ will again have to lie between $\underline{\phi}$ and $\bar{\phi}$.

A.2. Subgame under Perfect Substitutes

Relaxing Assumption one and two, we consider the case in which both sub-selves have linear (perfect substitutes) preferences over the same two goods, A and B. Let the utility functions for the Cold and Hot selves be given by:

$$U^j(X_A, X_B) = a^j X_A + b^j X_B \quad (6)$$

where $a^j, b^j > 0$ for $j \in \{C, H\}$. The prices of goods A and B are p and 1, respectively. The Cold self receives budget ϕ and the Hot self receives $1 - \phi$.

Each sub-self solves a linear utility maximization problem. Since preferences are linear, the optimal bundle is a corner solution:

- If $\frac{a^j}{b^j} > p$, self j purchases only goods A: $x_A^j = \frac{\text{budget}^j}{p}$, $x_B^j = 0$

- If $\frac{a^j}{b^j} < p$, self j purchases only goods B : $x_A^j = 0$, $x_B^j = budget^j$
- If $\frac{a^j}{b^j} = p$, any bundle satisfying the budget constraint is optimal

Accordingly, the utility for each sub-self is:

$$U^C(\phi) = \begin{cases} \frac{a^C \phi}{p}, & \text{if } \frac{a^C}{b^C} > p \\ b^C \phi, & \text{if } \frac{a^C}{b^C} \leq p \end{cases} \quad (7)$$

$$U^H(\phi) = \begin{cases} \frac{a^H(1-\phi)}{p}, & \text{if } \frac{a^H}{b^H} > p \\ b^H(1-\phi), & \text{if } \frac{a^H}{b^H} \leq p \end{cases} \quad (8)$$

Assume goods A is the temptation as defined: $MRS^H(X_A, X_B) > MRS^C(X_A, X_B) \Rightarrow \frac{a^H}{b^H} > \frac{a^C}{b^C}$, then only two cases occurred while $\frac{a^H}{b^H} > \frac{a^C}{b^C} > p$ or $\frac{a^H}{b^H} > p > \frac{a^C}{b^C}$.

Ego's payoffs under two cases are:

$$U^E(\phi) = \frac{1}{p} \left[\gamma a^C \phi + (1-\gamma) a^H (1-\phi) \right], \quad (9)$$

$$U^E(\phi) = \gamma b^C \phi + \frac{(1-\gamma) a^H}{p} (1-\phi) \quad (10)$$

Since both payoff functions are linear in ϕ , the optimal value ϕ^* must lie on the boundary of $[0, 1]$, depending on Hot and Cold's preferences and price. Hence, under perfect substitutes, Ego will always choose full allocation to one of the sub-selves which eliminates all interior equilibrium.

A.3. Subgame under Leontief Preferences

Consider another case when both sub-selves possess Leontief (perfect complements) preferences. Specifically, we assume that both the Cold and Hot selves require goods A and B

in fixed proportions, with utility functions:

$$U^j(X_A, X_B) = \min \{a^j X_A, b^j X_B\}, \quad j \in \{C, H\} \quad (11)$$

Here, a^j and b^j denote the fixed weight parameters for goods A and B , respectively. Again let prices be normalized to p for goods A and 1 for goods B . The Cold and Hot selves receive budgets ϕ and $1 - \phi$, respectively.

Each sub-self maximizes their utility by maintaining their required consumption ratio. The optimal bundle satisfies:

$$a^j X_A = b^j X_B \quad \Rightarrow \quad X_B = \frac{a^j}{b^j} X_A$$

Substituting back into the budget constraint yields, we can get the utility for both sub-selves are:

$$U^C(\phi) = \frac{a^C b^C \cdot \phi}{p b^C + a^C}, \quad (12)$$

$$U^H(\phi) = \frac{a^H b^H \cdot (1 - \phi)}{p b^H + a^H} \quad (13)$$

Hence Ego chooses ϕ to maximize:

$$U^E(\phi) = \gamma \frac{a^C b^C \phi}{p b^C + a^C} + (1 - \gamma) \frac{a^H b^H (1 - \phi)}{p b^H + a^H} \quad (14)$$

Taking the derivative, we also find that Ego's payoff is linear in ϕ which means the optimal value of ϕ will either be zero or one, giving rise to zero interior specialization when sub-selves possess Leontif preferences.

A.4. Subgame under Negative Externality

If the model allowed for negative externality where Hot's consumption of temptation goods causes disutility for Cold, and Cold's consumption of non-temptation goods imposes disutility on Hot. We can consider a Cobb-Douglas case with negative externalities

where utility functions for two sub-selves are:

$$U^C = (x_A^C)^{\alpha^C} (x_B^C)^{1-\alpha^C} - \delta^C x_A^H \quad (15)$$

$$U^H = (x_A^H)^{\alpha^H} (x_B^H)^{1-\alpha^H} - \delta^H x_B^C \quad (16)$$

δ^j stands for the weight parameter by each sub-self to the negative externality, and $j \in \{C, H\}$. Still let prices be normalized to p for goods A and 1 for goods B. Given the budget ϕ to Cold and $(1 - \phi)$ to Hot, NE payoffs for each sub-self are:

$$U^{C*} = \begin{cases} \left(\frac{\alpha^H}{p}\right)^{\alpha^C} (1 - \alpha^H)^{1-\alpha^C} - \delta^C \cdot \frac{\alpha^H}{p}, & \text{if } 0 \leq \phi < 1 - \alpha^H \\ \left(\frac{1 - \phi}{p}\right)^{\alpha^C} \phi^{1-\alpha^C} - \delta^C \cdot \frac{1 - \phi}{p}, & \text{if } 1 - \alpha^H \leq \phi \leq 1 - \alpha^C, \\ \left(\frac{\alpha^C}{p}\right)^{\alpha^C} (1 - \alpha^C)^{1-\alpha^C} - \delta^C \cdot \frac{1 - \phi}{p}, & \text{if } 1 - \alpha^C < \phi \leq 1 \end{cases} \quad (17)$$

$$U^{H*} = \begin{cases} \left(\frac{\alpha^H}{p}\right)^{\alpha^H} (1 - \alpha^H)^{1-\alpha^H} - \delta^H \cdot \phi, & \text{if } 0 \leq \phi < 1 - \alpha^H \\ \left(\frac{1 - \phi}{p}\right)^{\alpha^H} \phi^{1-\alpha^H} - \delta^H \cdot \phi, & \text{if } 1 - \alpha^H \leq \phi \leq 1 - \alpha^C \\ \left(\frac{\alpha^C}{p}\right)^{\alpha^H} (1 - \alpha^C)^{1-\alpha^H} - \delta^H \cdot (1 - \alpha^C), & \text{if } 1 - \alpha^C < \phi \leq 1 \end{cases} \quad (18)$$

Whether if there are negative externalities, the kink still occurs at the same threshold. However, NE payoffs are slightly different for sub-selves. When Cold picks the corner solution, Hot's utility is now monotonically decreasing in ϕ . And Cold's utility is monotonically increasing in ϕ while Hot picks the corner solution. Here we keep the settings from Figure 4 and let $\delta^C = \delta^H = 0.1$, we can then get Figure A.1.

Additionally, the presence of a kink may not be driven solely by the budget constraint—it can also arise from the tolerance levels of the two sub-selves, as captured by the values of δ . When the marginal utility loss caused by the externality exceeds the marginal utility gained from consuming the preferred good, either Cold or Hot will pick

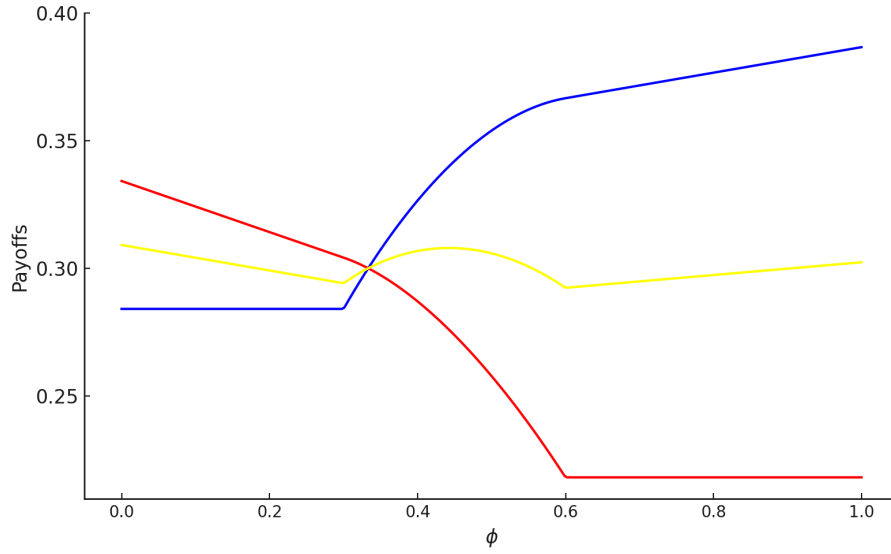


Figure 3: NE payoffs in Cobb-Douglas example (with negative externality) with $\alpha^C = 0.4$, $\alpha^H = 0.7$, $\delta^C = \delta^H = 0.1$, $\gamma = 0.5$ and $p = 2$. Red, blue and yellow lines respectively show payoffs for Hot, Cold and Ego.

the corner solution:

$$\delta^C \times \frac{dx_A^H(\phi)}{d\phi} \times \frac{d\phi}{dx_A^C} > MU_A^C(x_A^C) \Rightarrow \delta^C \times \frac{dx_A^H(\phi)}{d\phi} > MU_A^C(x_A^C), \quad (19)$$

$$\delta^H \times \frac{dx_B^C(\phi)}{d\phi} > MU_B^H(x_B^H) \quad (20)$$

As shown in Figure A.1, the optimal value of ϕ^* chosen by Ego is still occurs when $1 - \alpha^H \leq \phi \leq 1 - \alpha^C$. In fact, only when the externality parameters δ are sufficiently large and preferences are highly polarized (approaching linear utility), such that the interior Nash region yields lower utility than the boundary allocations, then the optimal ϕ^* fall outside the coordination region $[1 - \alpha^H, 1 - \alpha^C]$. Hence, for most cases, negative externality cannot change our main results.

Appendix B: Regressions Results and Survey Questions

B.1. Regression Results of China with Monthly Active Users

	(1) Healthy Foods	(2) Healthy Foods	(3) Stop Smoking	(4) Stop Smoking
Before the Spring Festival	-23.10*** (1.657)	-23.09*** (1.558)	-83.48*** (7.329)	-84.08*** (6.676)
The Spring Festival	-20.02*** (1.657)	-20.01*** (1.558)	-66.29*** (7.329)	-66.89*** (6.676)
After the Spring Festival	3.827* (1.657)	3.835* (1.558)	-3.018 (7.329)	-3.626 (6.676)
Before the Mid-Autumn Festival	-4.153 (2.326)	-4.145 (2.186)	-35.51*** (10.29)	-36.11*** (9.368)
The Mid-Autumn Festival	3.867 (2.326)	3.875 (2.186)	-29.77** (10.29)	-30.37** (9.368)
After the Mid-Autumn Festival	8.597*** (2.326)	8.605*** (2.186)	-7.986 (10.29)	-8.593 (9.368)
Inb		0.439 (2.032)		-33.43*** (8.709)
Sea		25.70*** (0.594)		133.4*** (2.543)
S		-8.258*** (0.594)		-28.06*** (2.543)
Monthly Active Users		0.00786*** (0.000605)		0.0686*** (0.00254)
Constant	96.80*** (0.289)	83.55*** (0.502)	298.1*** (2.111)	212.4*** (2.018)
R^2	0.024	0.148	0.015	0.222

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

Table 3: Regression Results of China with Monthly Active Users

B.2. Regression results of each province

	(1) hf_Beijing	(2) ss_Beijing	(3) hf_Shandong	(4) ss_Shandong	(5) hf_Henan	(6) ss_Henan
Before the Spring Festival	-35.24*** (4.935)	-69.05*** (10.76)	-20.88*** (4.386)	-77.31*** (16.08)	-13.80*** (4.013)	-46.00*** (8.491)
The Spring Festival	-40.18*** (4.935)	-57.35*** (10.76)	-17.54*** (4.386)	-41.75** (16.08)	-6.222 (4.013)	-26.24** (8.491)
After the Spring Festival	8.659 (4.935)	-6.372 (10.76)	12.50** (4.386)	15.95 (16.08)	-2.982 (4.013)	8.701 (8.491)
Before the Mid-Autumn Festival	-7.421 (6.926)	-30.51* (15.10)	-0.278 (6.155)	-51.53* (22.57)	-3.622 (5.632)	-24.98* (11.92)
The Mid-Autumn Festival	-3.501 (6.926)	-29.99* (15.10)	1.402 (6.155)	-44.05 (22.57)	8.058 (5.632)	-18.90 (11.92)
After the Mid-Autumn Festival	9.779 (6.926)	-18.71 (15.10)	5.202 (6.155)	-29.17 (22.57)	9.938 (5.632)	-11.62 (11.92)
Constant	101.7*** (0.860)	270.1*** (1.875)	97.72*** (0.764)	338.1*** (2.803)	83.94*** (0.699)	218.1*** (1.480)
R^2	0.063	0.040	0.026	0.021	0.011	0.025

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

Table 4: Regression Results: Beijing, Shandong, and Henan

	(1) hf_Shanghai	(2) ss_Shanghai	(3) hf_Zhejiang	(4) ss_Zhejiang	(5) hf_Jiangsu	(6) ss_Jiangsu
Before the Spring Festival	-20.92*** (4.106)	-56.08*** (9.420)	-25.14*** (4.008)	-103.4*** (18.28)	-27.11*** (4.160)	-87.49*** (17.10)
The Spring Festival	-14.50*** (4.106)	-57.64*** (9.420)	-24.74*** (4.008)	-80.43*** (18.28)	-17.87*** (4.160)	-63.67*** (17.10)
After the Spring Festival	3.996 (4.106)	-15.46 (9.420)	2.260 (4.008)	-11.49 (18.28)	4.894 (4.160)	-5.667 (17.10)
Before the Mid-Autumn Festival	-12.78* (5.763)	-17.00 (13.22)	-10.58 (5.624)	-32.61 (25.65)	2.794 (5.839)	-33.11 (24.00)
The Mid-Autumn Festival	-7.344 (5.763)	-20.64 (13.22)	6.900 (5.624)	-30.81 (25.65)	6.434 (5.839)	-30.55 (24.00)
After the Mid-Autumn Festival	9.856 (5.763)	4.677 (13.22)	14.94** (5.624)	-9.773 (25.65)	3.954 (5.839)	-3.787 (24.00)
Constant	92.90*** (0.716)	227.9*** (1.642)	105.5*** (0.698)	322.4*** (3.186)	103.4*** (0.725)	334.7*** (2.980)
R^2	0.026	0.040	0.047	0.028	0.034	0.022

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

Table 5: Regression Results: Shanghai, Zhejiang, and Jiangsu

	(1) hf_Guangdong	(2) ss_Guangdong	(3) hf_Chongqing	(4) ss_Chongqing
Before the Spring Festival	-36.93*** (3.439)	-192.7*** (28.89)	-4.755 (2.854)	-35.79*** (6.325)
The Spring Festival	-32.83*** (3.439)	-169.4*** (28.89)	-6.275* (2.854)	-33.85*** (6.325)
After the Spring Festival	0.685 (3.439)	-16.03 (28.89)	0.605 (2.854)	6.232 (6.325)
Before the Mid-Autumn Festival	-0.135 (4.826)	-72.11 (40.55)	-1.195 (4.005)	-22.19* (8.877)
The Mid-Autumn Festival	21.83*** (4.826)	-53.71 (40.55)	-2.835 (4.005)	-9.468 (8.877)
After the Mid-Autumn Festival	9.305 (4.826)	6.567 (40.55)	5.805 (4.005)	-2.068 (8.877)
Constant	125.7*** (0.599)	499.1*** (5.036)	63.40*** (0.497)	174.2*** (1.102)
R^2	0.113	0.042	0.006	0.035

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

Table 6: Regression Results: Guangdong and Chongqing

B.3. The Big Five Inventory Questionnaire

Table A.1 Big Five Inventory (with Six Factors)

I see myself as someone who:					
Factor I					
1. Warms up quickly to others.	1	2	3	4	5
2. Prefers to be alone.	1	2	3	4	5
3. Is always on the go.	1	2	3	4	5
4. Can talk others into doing things.	1	2	3	4	5
5. Seeks quiet.	1	2	3	4	5
6. Is assertive and takes charge.	1	2	3	4	5
7. Holds back from expressing my opinions.	1	2	3	4	5
8. Enjoys being part of a group.	1	2	3	4	5
9. Lets things proceed at their own pace.	1	2	3	4	5
Factor II					
10. Often feels blue.	1	2	3	4	5
11. Is not easily bothered by things.	1	2	3	4	5
12. Becomes stressed out easily.	1	2	3	4	5
13. Becomes overwhelmed by emotions.	1	2	3	4	5
14. Is calm, even in tense situations.	1	2	3	4	5
15. Is afraid that I will do the wrong thing.	1	2	3	4	5
16. Keeps my cool.	1	2	3	4	5
17. Does things I later regret.	1	2	3	4	5
Factor III					
18. Does not have a good imagination.	1	2	3	4	5
19. Loves to read challenging material.	1	2	3	4	5
20. Is interested in many things.	1	2	3	4	5
21. Tries to understand myself.	1	2	3	4	5
22. Is not interested in abstract ideas.	1	2	3	4	5
23. Believes in the importance of art.	1	2	3	4	5
24. Prefers to stick with things that I know.	1	2	3	4	5
25. Tends to vote for conservative political candidates.	1	2	3	4	5
Factor IV					
26. Suspects hidden motives in others.	1	2	3	4	5
27. Trusts others.	1	2	3	4	5
28. Contradicts others.	1	2	3	4	5
29. Values cooperation over competition.	1	2	3	4	5
30. Is easy to satisfy.	1	2	3	4	5
31. Thinks highly of myself.	1	2	3	4	5
32. Is concerned about others.	1	2	3	4	5
33. Puts people under pressure.	1	2	3	4	5
Factor V					
34. Completes tasks successfully.	1	2	3	4	5
35. Often makes last-minute plans.	1	2	3	4	5
36. Excels in what I do.	1	2	3	4	5
37. Often forgets to put things back in their proper place.	1	2	3	4	5
38. Postpones decisions.	1	2	3	4	5
39. Works hard.	1	2	3	4	5
40. Pays my bills on time.	1	2	3	4	5
41. Doesn't see the consequences of things.	1	2	3	4	5

Source: Adapted from the International Personality Item Pool: A Scientific Collaboratory for the Development of Advanced Measures of Personality Traits and Other Individual Differences.²

Figure 4: The Big Five Inventory

B.4. Existing recognized questions for revealing self control by Yang in China

1. Even if my body is a little uncomfortable, or if there are other reasons to rest, I try to do what I should do every day, including all jobs, studies, and daily life,
2. Even if it is something I do not like to do but need to do, I try my best to do it, and

3. Even if it takes me a long time to get something done, I try my best to do it.

B.5. HILDA Survey Questions

+

+

+

B25 How well do the following words describe you? For each word, cross one box to indicate how well that word describes you. There are no right or wrong answers.

(Cross **ONE** box for **EACH** word.)

Does not describe me at all

Does describe me very well

1 2 3 4 5 6 7

Does not describe me at all

Does describe me very well

1 2 3 4 5 6 7

mpntalk	talkative	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnsymp	sympathetic	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnorder	orderly	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnenvy	envious	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpndeep	deep	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnwd	withdrawn	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnharsh	harsh	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnsyst	systematic	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnmoody	moody	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnphil	philosophical	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnbful	bashful	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnkind	kind	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnineff	inefficient	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpntouch	touchy	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpncreat	creative	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnquiet	quiet	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpncoop	cooperative	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
mpnsoppy	sloppy	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					
	jealous	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnjeal
	intellectual	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnintel
	extroverted	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnextro
	cold	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpncold
	disorganised	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpndorg
	temperamental	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpntemp
	complex	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpncomp
	shy	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnshy
	warm	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnwarm
	efficient	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpneff
	fretful	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnfret
	imaginative	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnimag
	enthusiastic	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnenth
	selfish	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnself
	careless	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpncless
	calm	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpncalm
	traditional	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpntrad
	lively	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7					mpnlivly

Figure 5: B25: Personality Traits

G. INCOME

I am now going to ask you some questions about your income from different sources. This is a very important part of this survey. Your answers will assist in better understanding the way Australians live.

I will also ask some questions about your income last financial year. These questions are designed to help understand changes that are occurring among Australians.

Remember that everything you tell me will remain confidential and NO information that would identify you will be used in any analysis of these data.

G1 INTERVIEWER RECORD

Does respondent *currently* receive income from wages or salary?

Yes1
 No.....2 →G11
 Don't know.....9 →G11

awschave G1 Currently receive income from wages/salary

G2 INTERVIEWER CONFIRM

Just to confirm, you are currently working in [.....number of jobs] job/s?

Enter number of jobs Check this is consistent with FG1

awscnjb G2 No of jobs from which you currently receive wages/salary

G3 For your [job / main job] what was the total gross amount of your most recent pay *before* tax or anything else was taken out?

It will help to answer this question if you can refer to your last payslip.

If respondent does not know his/her last pay, but does know his/her annual salary, accept the annual amount.

Enter amount (whole \$) \$ →G5a

awscmga G3 Total gross amount of most recent pay before deductions

Nil999997 →G5b
 Don't know.....999999 →G4a

Figure 6: G: Income and Employment

G8a Do you know what your income from wages and salaries in [your other job / all your other jobs] is *after* tax and other deductions are taken out?

Yes 1
 No 2 → G9b

awskonk G8a Do you know what your income from wages and salaries in all other jobs is after deductions

G8b What was the total amount of your most recent pay from [your other job / all your other jobs] *after* these deductions?

Enter amount (whole \$)
 Nil 999997

awscona G8b What was the total amount of your most recent gross pay after deductions for all other jobs

G8c And what were these deductions?

MULTI RESPONSE

Taxation 1
 Superannuation contributions (employee) 2
 Union dues 3
 Health fund contributions 4
 Insurance premium 5
 Other (specify) 8
 Don't know 9

awscotax G8c Deductions - current other jobs - Taxation

awscosup G8c Deductions - current other jobs - Superannuation contributions

awscouni G8c Deductions - current other jobs - Union dues

awascohea G8c Deductions - current other jobs - Health fund contributions

awscoins G8c Deductions - current other jobs - Insurance premium

awscooth G8c Deductions - current other jobs - Other

awscodk G8c Deductions - current other jobs - Dont know

awscosof G8c Deductions - current other jobs - Social club/staff club

awscohec G8c Deductions - current other jobs - HECS

G9a Is that your *usual* pay from [your other job / all your other jobs]?

Yes 1 → G9c
 No 2

awscou G9a Is that your usual pay from all other jobs

G9b How much do you *usually* receive each pay for [your other job / all your other jobs]?

Enter amount (whole \$)
 Nil 999997 → G10a
 Don't know 999999 → G10a

awscouga G9b How much do you usually receive each pay for all other jobs

G9c And what period does that cover?

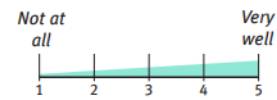
Week 1
 Fortnight 2
 Month 3
 Year 4

awscof G9c And what period does that cover

Figure 7: G: Income and Employment (cont.)

B26 How well do the following statements describe how you usually are?
For each statement cross one box to indicate how well that statement describes you.

(Please cross **ONE** box for **EACH** statement)



a	I am good at resisting temptation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscrt
b	I have a hard time breaking bad habits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsccbh
c	I am lazy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscslz
d	I say inappropriate things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscsci
e	I do certain things that are bad for me, if they are fun	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscdbt
f	I refuse things that are bad for me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscrtb
g	I wish I had more self-discipline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscwsd
h	People would say I have iron self-discipline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsscisd
i	Pleasure and fun sometimes keep me from getting work done	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsckwd
j	I have trouble concentrating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slsctc
k	I can work effectively towards long-term goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slscwtl
l	Sometimes I cannot stop myself from doing something, even if I know it is wrong	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slscsdw
m	I often act without thinking through all the alternatives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slscawt

Figure 8: B26: self control

B.6. Tests for Personality Traits

Determinant of the correlation matrix
Det = **0.000**

Bartlett test of sphericity

Chi-square = **1.52e+05**
Degrees of freedom = **630**
p-value = **0.000**
H0: variables are not intercorrelated

Kaiser-Meyer-Olkin Measure of Sampling Adequacy
KMO = **0.894**

Figure 9: KMO & Bartlett's Test for Factor Analysis

Variable	VIF	1/VIF
f1	1.70	0.589957
f4	1.59	0.630675
f2	1.49	0.670480
f3	1.25	0.798372
f5	1.13	0.881263
ihgage1	1.04	0.961425
ihhed10	1.04	0.962375
ihgsex1	1.01	0.985748
Mean VIF	1.28	

Figure 10: VIF Test for Colinearity

B.7. Existing Literature of Meta-analysis

Table 6: Personal earnings & Big Five - Meta-regression (Journal field and ranking)

	(1) Openness	(2) Conscientiousness	(3) Extraversion	(4) Agreeableness	(5) Neuroticism
Constant	0.0243 (0.0211)	0.0452*** (0.0100)	0.0011 (0.0121)	-0.0142 (0.0153)	-0.0089 (0.0145)
Economics	0.0057 (0.0174)	-0.0159* (0.0084)	0.0074 (0.0100)	-0.0078 (0.0124)	0.0037 (0.0120)
Psychology	-0.0286 (0.0196)	-0.0204** (0.0092)	0.0167 (0.0113)	0.0104 (0.0133)	-0.0259** (0.0129)
Social sciences	-0.0187 (0.0165)	-0.0309*** (0.0079)	0.0079 (0.0096)	-0.0071 (0.0120)	-0.0158 (0.0112)
Business & Management	0.0032 (0.0199)	-0.0297*** (0.0100)	0.0090 (0.0118)	0.0027 (0.0147)	-0.0347** (0.0141)
Scimago Q1	0.0099 (0.0174)	0.0278*** (0.0086)	0.0118 (0.0102)	-0.0355*** (0.0126)	-0.0044 (0.0122)
N	88	92	90	88	93
τ^2	0.00320	0.000396	0.000745	0.00137	0.00127
$I^2(\%)$	93.96	64.90	78.49	86.97	85.55

Notes. For each trait, the table reports the results of the random effect meta-regression for journal ranking and academic fields. Academic fields are not mutually exclusive. The results are based on the effect sizes from reference models only (cf. Section 2.2). Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 11: Meta-analysis Results