Tunnel Effect versus Loss Aversion: Evidence from the Workplace*

Kerim Keskin †
ADA University

Tugba Zeydanli ‡
Martin Luther University Halle-Wittenberg

April 17, 2017

Abstract

Hirschman and Rothschild (1973) argue that individual subjective well-being may alter due to a change in *comparison* income through changes in individual's expectations and aspirations. This phenomenon is referred to as the tunnel effect. Although there is a number of empirical studies supporting the tunnel effect, there also are empirical findings against this phenomenon which can be justified referring to behavioral concerns such as envy/jealousy or loss aversion as in prospect theory [see Kahneman and Tversky (1979)]. This paper sheds light on the effect of comparison income on overall job satisfaction and investigate which effect (tunnel effect vs. loss aversion effect) is more dominant. We employ British firm level data called Workplace Employment Relations Survey 2004. Arguing that comparison income is a natural reference point for the workers, we define two groups: if workers earn more than their co-workers, we categorize them as *relatively rich* and if workers earn less than their co-workers, then they fall into the category of *relatively poor*. We observe a tunnel effect rather than a loss aversion effect for relatively poor workers; while a loss aversion effect outweighs a tunnel effect for relatively rich workers. The implication of this phenomenon has a different impact regarding firm type (private/public) and firm size.

JEL codes: D01, J28.

Keywords: Job Satisfaction; Hirschman Tunnel Effect; Prospect Theory; Loss Aversion; Workplace Employment Relations Survey 2004.

*We thank Semih Tumen, Christoph Wunder, and seminar participants at International Society for Quality-of-Life Studies for useful comments and suggestions. All errors are ours.

†kkeskin@ada.edu.az. School of Business, ADA University, Baku AZ1008, Azerbaijan.

‡tugba.zeydanli@wiwi.uni-halle.de. Department of Economics, Große Steinstraße 73, D - 06099 Halle (Saale), Germany.

1 Introduction

In a seminal paper, Hirschman and Rothschild (1973) introduce the *tunnel effect*. A common analogy is that if we drive through a two-lane tunnel and run into a traffic jam, and when the cars in the other lane start to move, (even though our lane is still jammed) we may feel better off because of the expectation that our lane will soon move. In their paper, Hirschman and Rothschild (1973) also provide an economic interpretation. For instance, the comparison income of an individual can be described as a *summary* of the others' income; and an increase in comparison income may positively affect the individual's happiness through future expectations. Following Hirschman and Rothschild (1973), a number of empirical papers find supporting evidence for the tunnel effect on job satisfaction [see Clark et al. (2009),Wunder and Schwarze (2009), D'Ambrosio and Frick (2012), FitzRoy et al. (2014), amog others].

In the relevant literature, there also are empirical findings against the tunnel effect, which are commonly justified referring to behavioural concerns such as envy or jealousy [see Ferrer-i-Carbonell (2005), Senik (2009), Clark et al. (2009), D'Ambrosio and Frick (2012) among others]. Such findings can also be supported by loss aversion as in prospect theory [see Kahneman and Tversky (1979); Tversky and Kahneman (1991)]: First, individual earnings are evaluated with respect to a reference point in such a way that if the earning is greater/lower than the reference point, then the individual experiences this earning as a gain/loss. Second, loss aversion stipulates that a certain amount of loss yields a higher disutility in comparison to the utility level the same amount of gain yields. Note that reference-dependent preferences is similar in essence to "comparison income – relative income" interpretation provided by Hirschman and Rothschild (1973). More precisely, one can argue that an individual employs his/her comparison income as his/her reference point.

Accordingly, one should expect to find two different and independent effects of comparison income on overall job satisfaction. If tunnel effect outweighs loss aversion, then we would observe an increase in utility as a response to an increase in the comparison income; and if otherwise, we would observe a decrease in utility as a response to an increase in the comparison

income. In this paper we investigate the effect of comparison income and/or relative income on overall job satisfaction and aim to understand which effect (tunnel effect vs. loss aversion effect) is more dominant.[1] We formulate a linear regression model in such a way that we distinguish the effect for relatively poor workers (who earn less than their reference group) from the effect for relatively rich workers (who earn more than their reference group).[2]

We perform our analyses with the establishment-level.[3] The data set is "Workplace Employment Relation Survey 2004". The reference group is set at the establishment-level in which workers have a daily interaction among each other. For relatively poor workers, we observe a tunnel effect rather than a loss aversion effect. In particular, relatively poor workers' overall job satisfaction increases 0.160 standard deviation when their co-workers' wage increases one log unit. By contrast, for relatively rich workers, we find a loss aversion effect. More specifically, relatively rich workers' overall job satisfaction decreases 0.40 standard deviation when their co-workers' wage increases one log unit. On top of these, we document some differences across gender. Although a tunnel effect is more pronounced for relatively poor male workers, none of these effects are observed for relatively poor female workers. As for relatively rich workers, a loss aversion effect is stronger than a tunnel effect for both male and female workers.

We further analyze the reference-dependent effects within establishments with different type and size. Regarding establishment type, we concentrate on public and private firms. The tunnel effect is more prominent in public sector for relatively poor workers. On the other hand, when there is an increase in comparison income, relatively rich workers' overall job satisfaction is more responsive in private sector compared to that in public sector. Regarding establishment size, we control for firms that have less than 100 employees (small/medium) and firms that have more than 100 employees (large). When there is an increase in comparison

[1] Our aim is not to establish causality. Such an aim would require unobserved factors to be either orthogonal to the observables or suitably controlled for (e.g., via an assumed structure) and would require a cardinality assumption for the ranking of measured job satisfaction requiring exceptionally rich data and simultaneous estimation with suitable instruments.

[2] Such a distinction between the effects for relatively poor and relatively rich workers is quite new in the literature. To the best of our knowledge, there is only one paper utilizing such a regression model and estimating different co-efficients for relatively poor and relatively rich managers [see Grund and Martin (2017)]. In that paper the authors refer to the value function as in prospect theory [Kahneman and Tversky (1979)].

[3] The terms "workplace", "firm", and "establishment" will be used interchangeably throughout the paper.

income, relatively poor workers' overall job satisfaction increases more if they work in large size establishments. Relatively rich workers working in large size establishments are more satisfied jobwise when there is a decrease in comparison income compared to those working in small/medium size establishment.

The plan of the paper is as follows. Section 2 reviews the related literature. Section 3 includes an overview of the dataset, justifies the construction of dependent and independent variables, and explains the details of the theoretical and empirical models. Section 4 presents the estimates, discusses the results summarized above, and provides sensitivity analyses. Section 5 concludes.

2 Literature Review

There is a vast literature on the importance of relative wages in determining workers' job or pay satisfaction [see Cappelli and Sherer (1988), Clark and Oswald (1996), Law and Wong (1998), Ferrer-i-Carbonell (2005) among others]. This literature strongly appeals to Manski's preference interactions: what happens to others directly affects one's own utility [see Manski (2000)]. Some empirical approaches have been undertaken to study the tunnel effect with different methodologies and reference groups.

Clark et al. (2009) provide some of the first evidence that workers are more satisfied jobwise when co-workers are better paid by utilizing matched employer-employee panel data. To put it differently, information effects are found to be stronger than comparison effects. Their conclusion supports the Hirschman tunnel effect: An individual's co-workers' wages give an idea about his/her own future prospects to outweigh jealousy. Senik (2004, 2008) also supports the tunnel effect in transition economies of Russia. These papers provide positive effects of comparison income on life-satisfaction of financial well-being. On the other hand, Drichoutis et al. (2010) find insignificant effects of comparison income in transition economies of Eastern Europe.

Senik (2009) and D'Ambrosio and Frick (2012) utilize a dynamic approach to understand the

tunnel effect. More precisely, Senik (2009) analyzes a dynamic model and compares various comparison incomes for transition countries, including own past income. She finds negative effects of relative decline to be higher than positive effects of relative gain. D'Ambrosio and Frick (2012) add lagged income in a dynamic context to identify the status relative deprivation effect of comparison income from the signalling effect. They find negative status effect of income-distance from richer individuals and positive status effect of income-distance from poorer individuals.

By utilizing different reference groups, the recent studies end up with mixed results. FitzRoy et al. (2014) consider different age groups in the West Germany and the UK. They find positive effects of wage comparison for the under 45s and negative effects for the over 45s. Goerke and Pannenberg (2015) utilize novelty of German data on self-reported comparison intensity and perceived relative income to draw a better conclusion about reference groups. They find negative correlations between comparison intensity and subjective well-being for colleagues, people in the same occupation, and friends; but positive correlations between the same for neighbors. By addressing Manski's reflection problem, Tumen and Zeydanli (2016) find that working in a group with a higher fraction of workers earning more than the median wage reduces individual job satisfaction. Their paper provides evidence in favor of envy instead of the Hirschman tunnel effect.

To sum up, the take home messages of this literature are:

1. There is a clear impact of comparison income on job satisfaction.
2. The effects of reference points depend on the selection of the reference group.
3. The tunnel effect exists, but it produces conflicting results regarding methodology.
4. Individuals perceive a lower utility in most cases when their wage is below a comparison wage.

To the best of our knowledge, there is no explicit comparison between a tunnel effect and a loss aversion effect on individual's job satisfaction in small social interaction groups.

3 Data and Methodology

3.1 Data

This section provides information about the dataset and empirical framework that we utilize for analyzing the theoretical framework. We choose 2004 Workplace Employment Relations Survey (WERS 2004), because it yields information for workers who are working in the same establishment.[4] It is a national survey of British employees, which takes place with five or more employees in the same establishment. The survey provides information about workers, working conditions, and industrial relations from all industry sectors except primary industries and private households with domestic staff.

Following the current wisdom of the literature,[5] we derive the overall job satisfaction from the seven questions of the WERS 2004. How satisfied are you with ...

1. the sense of achievement you get from work?
2. the scope for using your own initiative?
3. the amount of influence you have over the job?
4. the training you receive?
5. the amount of pay you receive?
6. the job security?
7. the work itself?

The responses are based on five point scale with 1 representing "very satisfied"; 3 "neither satisfied nor dissatisfied"; and 5 "very dissatisfied". In each question we construct a binary measure for the positive responses ("satisfied" or "very satisfied"), and summing them form a scaled index with values from 0 to 7.[6] This is the dependent variable in our analysis, so called

[4] This is the fifth of the series. The previous studies were conducted in 1980, 1984, 1990 and 1998.

[5] See Jones et al. (2009) and Jones and Sloane (2010).

[6] Mumford and Smith (2015) use the six facets of job satisfaction in the WERS, neglecting the training. On the other hand, Jones and Sloane (2010) use all of them following Jones et al. (2009)'s argument that training is also an important component of job satisfaction.

"Overall Job Satisfaction". This is a direct measure of individuals' utility derived from their current job [see Clark and Oswald (1996)]. The average overall job satisfaction of the sample is 4.22 and the standard deviation of the sample is 2.12.[7,8]

For the individual- and job-related characteristics, we group our controls into three categories: (i) individual characteristics: age, education level, marital status, and having a child; (ii) job characteristics: working hours, occupation, and being a member of trade/labor union; (iii) workplace characteristics: workplace size, workplace type, industry, and region. After excluding missing information on our control variables and dropping workplaces with less than two employees, the dataset includes 1,659 workplaces/establishments. Among approximately 20,000 employees, the mean age of employees is 41. We observe that 32% of them are currently a trade/ labor union member. Regarding marital status, 67% of employees are either married or living with a partner.[9] Only 15% of employees have a child under 18. The education variables start reporting from secondary school to post graduate. GCSE variable refers to the "General Certificate of Secondary Education"; "gscse25" refers to the same certificate in grades 2 to 5; and "gcse1" refers to the 'O'-level. GCE refers to the "General Certificate of Education"; whereas "gceae" and "gce2ae" respectively refer to 'A-level' in grades 1-2 and 3+. In addition to these, first degree refers to college education and higher degree refers to postgraduate education. As for workplace characteristics, the dataset considers twelve industries and eleven regions. We create a dummy variable for the establishment size. It is equal to 1 if the establishment has less than 100 employees (small/medium size), which corresponds to approximately 50% of establishments; and to 0 if it has more than 100 employees (large size). Moreover, 65% of employees are working more than the median hours of working in the workplace. Finally, approximately 43% of workplaces are private and 49% of them are publicly owned. The data is weighted in all analyses to allow for stratified and clustered survey design, so that it represents the sampling population.

[7] See Table (1).

[8] We also consider alternative measures to this index: (a) simply aggregating across the satisfaction measures, so that the variable is ranged from 7 to 35; (b) using work satisfaction alone, either as a binary variable or as a variable ranging from 1 to 5. We estimate these via probit/ordered probit and OLS. Our main results are in line with those under these alternative specifications. The results are available upon request.

[9] Marital union is a dummy variable, which takes 0 if the individual is single/widowed/divorced and 1 if the individual is either married or living together with partner.

Reference group. Our reference group is formed as an establishment-level. All workers in a given establishment constitute the reference group for each of the workers in the same establishment. There are 1,659 establishments in the WERS dataset, and accordingly we have 1,659 reference groups. The average group size is 12 workers per establishment.[10] It is a narrowly defined group, thereby workers are exposed to similar work-specific conditions and have similar expectations and aspirations towards wages, which shape their overall job satisfaction perceptions. Finally, we determine the *comparison income* by averaging the wage level[11] within the same establishment, and we define the *relative income* as the ratio of individual income to the comparison income. All income values are logged to account for the usual nonlinear relation between income and satisfaction. In other words, relative income is defined as the difference between the logarithm individual income and logarithm comparison income.

3.2 Theoretical Framework

Reference-dependent preferences: As it is reported by several experimental studies on individual decision making, observed individual behaviour might violate the axioms of expected utility theory [see Camerer (1995) for a detailed review]. Stemming from these observations, Kahneman and Tversky (1979) argue that such experimental findings invalidate expected utility theory as a descriptive model. These authors further propose *prospect theory* as an alternative representation of preferences. According to prospect theory, individual preferences can be represented by a pair of functions: probability weighting function and value function. These capture four key aspects: subjective probability weighting (captured by the former function) and diminishing sensitivity, reference dependence, and loss aversion (captured by the latter function).

Reference dependence stipulates that an outcome is evaluated with respect to a *reference point* in such a way that the outcome is realized as a loss if it is less than the reference point and as a gain if it is greater than the reference point. Coupled with loss aversion, the respective value function is formulated in such a way that a certain amount of loss yields a disutility

[10] In each workplace up to 25 randomly-chosen employee took the questionnaire.
[11] We note that our results are not sensitive to median of the wage-level.

higher than the utility level the same amount of gain yields. A reference point is commonly described as expected earnings. For instance, it can be given ex-ante as in Kahneman and Tversky (1979) or can be determined endogenously by individuals' expectations, which are formed on the basis of past outcomes as in Shalev (2000) and Kőszegi and Rabin (2006, 2007). We also see that a reference point can be described as an anchor which naturally arises within the framework. For example, in sequential bargaining, the reference point can be defined as the pre-commitment level [see Muthoo (1992)]; or in an alternating offers bargaining game, it can be formulated as the previous offer received by the agent [see Driesen et al. (2012)]; or in a correlated equilibrium framework, it can be described as the expected return of the correlation device [see Keskin (2016)].

In this paper we argue that the *comparison income* arises to be a natural reference point such that an individual gets reference-dependent utility if his/her wage is higher than the average of his/her colleagues' wages, whereas he/she gets reference-dependent disutility if otherwise. We accordingly incorporate the following value function $v : \mathbb{R}^2 \to \mathbb{R}$ into our regression model:

$$v(x, r) = \begin{cases} (x - r)^{\alpha} & , \quad x \geq r \\ \lambda(x - r)^{\alpha} & , \quad x < r \end{cases} \tag{3.1}$$

where $x \in \mathbb{R}$ denotes the monetary payoff, $r \in \mathbb{R}$ denotes the *reference point*, and $\lambda \geq 1$ denotes the loss aversion coefficient. This functional form is borrowed from Tversky and Kahneman (1991, 1992).[12] In this context, r and λ are related to the two key aspects of prospect theory: reference dependence and loss aversion. As the remaining key aspect, diminishing sensitivity is captured by $0 < \alpha < 1$. Accordingly, as $x - r$ increases in the positive domain, the effect of a unit increase in $x - r$ decreases. Similarly, as $x - r$ decreases in the negative domain, the effect of a unit decrease in $x - r$ decreases.[13]

In our model, individual wages have two effects on overall utility:
(i) absolute effect (captured by a linear utility function $u : \mathbb{R} \to \mathbb{R}$); and

[12] Tversky and Kahneman (1992) propose this function so as to make it consistent with their experimental observations.

[13] The fourth key aspect, subjective probability weighting, is irrelevant to our analysis. The reason is that there exists no *risk* in the current framework. That is the reason why we are only interested in the value function and why we use the term reference-dependent preferences instead of prospect theory preferences.

(ii) relative effect (captured by the value function $v : \mathbb{R}^2 \to \mathbb{R}$).

Accordingly, overall utility of an individual can be written as: $u(x) + v(x, r)$.[14]

3.3 Empirical Framework

The theoretical framework above leads us to estimate the following equation:

$$JS_i = \beta_0 + \beta_1 \log w_i + \beta_2 g(\log w_i - \log \bar{w}_{f_i}) + \beta_3 D_i g(\log w_i - \log \bar{w}_{f_i}) + \beta_4 X_i + \beta_5 Y_{f_i} + \epsilon_i \quad (3.2)$$

where the dependent variable JS_i is the individual-level overall job satisfaction for person i; w_i is the wage of person i; $\bar{w}_{f_i}$ is the reference point which is set to be the average wage in the establishment f_i where person i is working; D_i is a dummy variable such that $D_i = 1$ if $w_i \geq \bar{w}_{f_i}$ and $D_i = 0$ if otherwise; X_i is a vector of individual-level observed characteristics of person i; Y_{f_i} is a vector of establishment-level observed characteristics of person i in the establishment f_i; and ϵ_i is a random error term. We estimate the equation by using ordinary least squares.

The function $g : \mathbb{R} \to \mathbb{R}$ aims to capture diminishing sensitivity. As diminishing sensitivity is not compatible with a linear regression model, we assume that $g(\alpha) = |\alpha|^{0.88}$ for every $\alpha \in \mathbb{R}$. This assumption is taken from the estimation by Tversky and Kahneman (1992), $\alpha \approx 0.88$. By utilizing β_2 and β_3, we are able to capture several strictly concave functional forms while having a linear regression model. The dummy variable D_i provides that if a worker has a positive relative income, then the effect of a unit increase in his/her relative income will be summarized by $\beta_2 + \beta_3$, whereas if he/she has a negative relative income, then the same effect will be summarized by β_2.

In the next section we explain how our regression results are translated: A negative $\beta_2 + \beta_3$ means that the Hirschman tunnel effect is more dominant for individuals with a positive relative income. If $\beta_2 + \beta_3$ is positive, however, then it would be more in line with standard preferences as well as loss aversion. As for individuals with a negative relative income, we

[14] In that we are similar to the models proposed by Shalev (2000) and Kőszegi and Rabin (2006, 2007).

refer to β_2 only. For instance, if β_2 is positive, then a tunnel effect dominates a loss aversion effect. If otherwise, the converse would be true.

4 Results and Discussion

In this section we present the estimation results, provide a detailed interpretation of the estimates, and perform robustness checks. We interpret our results based on two terms: *relatively rich* and *relatively poor* workers. The former refers to workers who earn more than the average wage of their reference group, and the latter refers to those earning less than the average wage of their reference group.

4.1 Main Results

Our main focus in this paper is on income-related variables, but we are interested in other coefficients as well. Thereby, we categorize our estimates under three categories: income-level coefficients, individual-level coefficients, and establishment-level coefficients across gender. Below we discuss our estimates in detail. All specifications include industry, region, and survey round dummies. The regressions are weighted and the standard errors are clustered at the establishment-level.

$\diamond$ *Effects of income-level variables.* Regarding income level variables we control for the logarithm income, with a co-efficient β_1; the value of relative income, with a co-efficient β_2; and the interaction between value of relative income and dummy variable of relative income,[15] with a co-efficient β_3. The coefficient of β_2 refers to relatively poor workers and $\beta_2 + \beta_3$ refers to relatively rich workers. The results are documented in Table (2).

The logarithm income is positively and statistically significantly related to overall job satisfaction across all gender. Male workers' overall job satisfaction increases more than female workers' overall job satisfaction does when there is an increase in absolute wages. These findings are in line with the literature [Clark (1997, 1999)].

[15] Recall that the dummy variable is 1 if the wage of a worker is higher than his/her comparison income, and 0 otherwise.

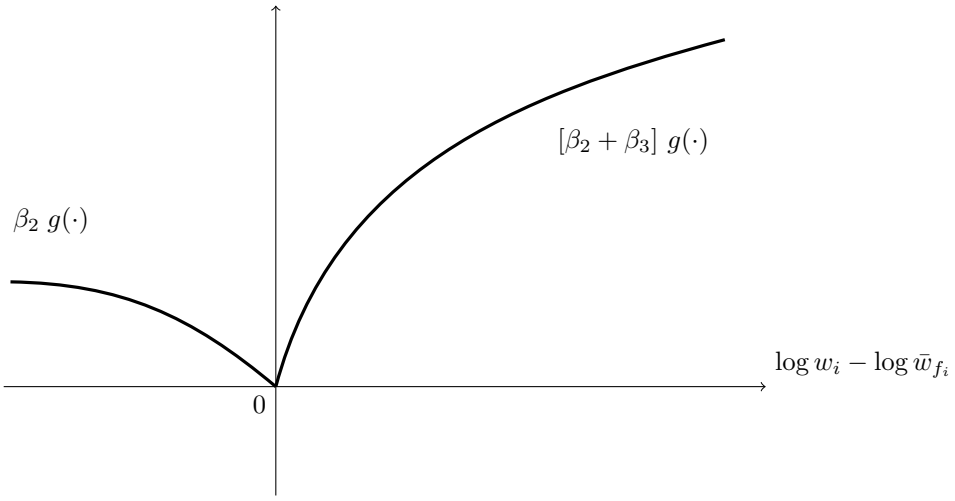

Figure 4.1: A Graphical Illustration of the g Function

We refer to Figure 4.1 for the following analysis. When there is an increase in comparison income, relatively rich workers' overall job satisfaction diminishes whereas relatively poor workers' overall job satisfaction increases. More precisely, relatively poor workers' overall job satisfaction increases $\beta_2 = 0.160$ standard deviation when their co-workers' wage increases one log unit. In the figure, this corresponds to a one-unit movement leftwards in the negative domain which increases job satisfaction. This finding supports signaling and/or the Hirschman tunnel effect. To put it differently, for relatively poor workers we observe that a tunnel effect dominates a loss aversion effect. On the other hand, relatively rich workers' overall job satisfaction decreases $\beta_2 + \beta_3 = 0.40$ standard deviation when their co-workers' wage increases one log unit. In the figure, this corresponds to a one-unit movement leftwards in the positive domain which decreases job satisfaction. Accordingly, we can say that we do not observe a tunnel effect for relatively rich workers. In fact, this finding is in line with standard preferences as well as loss aversion, which indicate that utility decreases if the relative income decreases. All of these effects are statistically significant.[16]

The effect of reference-dependent income variables is different across gender. Relatively poor male workers' overall job satisfaction increases when their co-workers' wages increase. Specifi-

[16]For the significance of $\beta_2 + \beta_3$, we write the hypotheses $H_0 : \beta_2 + \beta_3 = 0$ and $H_1 : \beta_2 + \beta_3 \neq 0$. As the standard error of $\beta_2 + \beta_3$ is not computable, we set $\beta_2 + \beta_3$ to be θ and plug θ into the regression equation:

$$JS_i = \beta_0 + \beta_1 \log w_i + \theta D_i g(\log w_i - \log \bar{w}_{f_i}) + \beta_2[g(\log w_i - \log \bar{w}_{f_i}) - D_i g(\log w_i - \log \bar{w}_{f_i})] + \beta_4 X_i + \beta_5 Y_{f_i} + \epsilon_i$$

One can check the significance of θ in this new equation for $\beta_2 + \beta_3$. The results are documented in Table (6).

cally, they experience 0.34 standard deviation increase in their overall job satisfaction. On the other hand, relatively poor female workers' overall job satisfaction is not significantly affected by the changes in the co-workers' wage. When female workers earn more than their reference group, then there is a significant change in overall job satisfaction following a change in their relative income. Specifically, relatively rich female workers experience 0.33 standard deviation decrease in their overall job satisfaction whereas relatively rich male workers experience 0.46 standard deviation decrease. To sum up, we observe that a tunnel effect is more dominant for relatively poor male workers, but it is suppressed by a loss aversion effect for relatively rich male/female workers. Moreover, it seems that these effects cancel each other out for relatively poor female workers.

◇ *Effects of individual-level characteristics.* The result of our individual level characteristics are in line with the literature. Married and old workers are highly satisfied jobwise. We also observe that having an education has a statistically significant negative impact and that as the education level increases the magnitude of this negative impact increases as well. This is directly related to workers' expectations and aspirations towards their job increasing in their education level.[17]

◇ *Effects of establishment-level characteristics.* Regarding establishment-level characteristics, we control for the establishment size, the ownership type of the establishment, and individuals' trade (labor) union statue and working hours. We observe that working in a medium size establishment has a statistically significant positive impact on overall job satisfaction across all gender. Working in public sector is negatively and significantly correlated with male workers' overall job satisfaction. Being a member of a trade union is negatively related with workers' overall job satisfaction due to having more expectations and aspirations towards the union's bargaining power. Finally, working more than usual hours has a negative and significant effect on overall job satisfaction.

[17] An exception is having a higher degree education: Its impact on overall job satisfaction is still negative, but it is not as high as that of having a first degree education.

4.2 Sensitivity Analyses

This sub-section presents three extensions to our basic results. The first is simply a different specification of the establishment type, whether they are private or public; the second is about the establishment size, either small/medium or large scale establishments; and the third is to test the baseline specification by using an ordered probit model.

4.2.1 Establishment Type

Column 1 and 2 of Table (3) estimate our baseline model for the public and private establishments, respectively. In both sectors absolute wage has a positive and statistically significant impact on workers' overall job satisfaction. The reference-dependent effects are not homogeneous across different establishment type. We observe that as a response to an increase in the comparison income, the increase in relatively poor workers' overall job satisfaction in the public sector is higher in comparison to that in the private sector. In other words, for relatively poor workers, a tunnel effect is stronger than a loss aversion effect in public sector. This could be due to perfect information about wages and lower competition among co-workers in public sector. Furthermore, in public sector, a wage increase is more transparent and equally distributed among workers than it is in private sector. As for relatively rich workers' overall job satisfaction, we see that it responds more in private sector than it does in public sector. In other words, a loss aversion effect is stronger than a tunnel effect in private sector for relatively rich workers. This can also be related to high competition in private sector.

Absolute wages surprisingly do not have a significant impact on the overall job satisfaction for female workers working in private sector. Yet, the reference-dependent effects for male and female workers are in line with those for all workers.

4.2.2 Establishment Size

We re-estimate our baseline model regarding establishment size: (i) small/medium size establishments that have less than 100 employees and (ii) large size establishments that have more than 100 employees. The results are presented in Table (4). In general, the impact is

higher and significant in large size establishments than it is in small/medium establishments for relatively poor workers. That is, when there is an increase in comparison income, relatively poor workers are more satisfied jobwise when they work in large size establishments. This implies that a tunnel effect is present for relatively poor workers in large size establishments. Relatively rich workers working in large size establishments are more satisfied jobwise when there is a decrease in comparison income compared to those working in small/medium size establishment. In other words, a loss aversion effect is present for relatively rich workers in large establishments.

When there is a decrease in comparison income, both female and male workers are more satisfied jobwise in large size establishments if they are relatively rich. These are in line with our observations for all relatively rich workers. We also see that overall job satisfaction of relatively poor male workers increases in comparison income, but the establishment size does not have an impact on the amount of this increase. Finally, changes in comparison income do not have a significant impact on relatively poor female workers' overall job satisfaction if they are classified based on the establishment size.

4.2.3 Ordered Probit Model

Ferrer-i-Carbonell (2005) demonstrates that the results from cardinal analysis using OLS is very similar to those from ordinal analysis. For ease of interpretation, our baseline model is estimated by OLS. We would like to note here that we re-estimate our baseline model controls and specifications by using an ordered probit model, since the job satisfaction is indeed an ordinal variable. Table (5) summarizes the results on income-related variables from the ordered probit model. The signs and magnitudes of the coefficients are in parallel with our baseline model. This yields the same conclusion that an increase in comparison income leads to having higher job satisfaction for relatively poor workers and lower job satisfaction for relatively rich workers. To put it differently, a tunnel effect is more dominant than a loss aversion effect for relatively poor workers, but the opposite is true for relatively rich workers. It is also worth mentioning that the magnitudes in the ordered probit model are slightly higher than their OLS

counterparts. This indicates that the above-mentioned dominance relationships are relatively more pronounced in this ordered probit model.

5 Concluding Remarks

There is a vast literature arguing that the tunnel effect exists in the income comparison on job satisfaction. We contribute to this literature in two ways. Firstly, we compare two independent effects of comparison income and/or relative income on overall job satisfaction. These effects are the Hirschman tunnel effect (see Hirschman and Rothschild (1973)) and loss aversion effect as in prospect theory (see Kahneman and Tversky (1979)). Using a well-known value function, we formulate a linear regression model which captures different co-efficients for relatively poor and relatively rich workers. On top of that, referring to the estimation results of Tversky and Kahneman (1992), we incorporate a concave utility function into our linear regression model, thereby capturing an important concept in economics: diminishing sensitivity. Secondly, we report that a tunnel effect outweighs a loss aversion effect for relatively poor workers, whereas the converse is true for relatively rich workers. Afterwards, bringing gender into the picture, we further report that a loss aversion effect is more dominant for relatively rich male and female workers, that a tunnel effect is more dominant for relatively poor male workers, and that these effects cancel each other out for relatively poor female workers.

References

Camerer, C. F. (1995). *The Handbook of Experimental Economics. Ch. 7.* J. H. Kagel and A. E. Roth.

Cappelli, P. and P. D. Sherer (1988). Satisfaction, market wages, & labor relations: An airline study. *Industrial Relations: A Journal of Economy and Society 27*(1), 56–73.

Clark, A., N. Kristensen, and N. Westergrd-Nielsen (2009, 03). Job Satisfaction and Co-worker Wages: Status or Signal? *Economic Journal 119*(536), 430–447.

Clark, A. E. (1997). Job satisfaction and gender: Why are women so happy at work? *Labour Economics 4*, 341–372.

Clark, A. E. (1999). Are wages habit-forming? Evidence from micro data. *Journal of Economic Behavior and Organization 39*(2), 179 – 200.

Clark, A. E. and A. J. Oswald (1996). Satisfaction and comparison income. *Journal of Public Economics 61*, 359–381.

D'Ambrosio, C. and J. R. Frick (2012, 04). Individual Wellbeing in a Dynamic Perspective. *Economica 79*(314), 284–302.

Drichoutis, A. C., R. Nayga, and P. Lazaridis (2010). Do reference values matter? Some notes and extensions on income and happiness across Europe. *Journal of Economic Psychology 31*(4), 479 – 486.

Driesen, B., A. Perea, and H. Peters (2012). Alternating Offers Bargaining with Loss Aversion. *Mathematical Social Sciences 64*(2), 103–118.

Ferrer-i-Carbonell, A. (2005). Income and well-being: An empirical analysis of the comparison income effect. *Journal of Public Economics 89*, 997–1019.

FitzRoy, F. R., M. A. Nolan, M. F. Steinhardt, and D. Ulph (2014). Testing the tunnel effect: comparison, age and happiness in uk and german panels. *IZA Journal of European Labor Studies 3*(1), 1–30.

Goerke, L. and M. Pannenberg (2015). Direct evidence for income comparisons and subjective well-being across reference groups. *Economics Letters 137*, 95 – 101.

Grund, C. and J. Martin (2017). Monetary reference points of managers ? empirical evidence of status quo preferences and social comparisons. *Scottish Journal of Political Economy 64*(1), 70–87.

Hirschman, A. O. and M. Rothschild (1973). The Changing Tolerance for Income Inequality in the Course of Economic DevelopmentWith A Mathematical Appendix. *The Quarterly Journal of Economics 87*(4), 544–566.

Jones, M. K., R. J. Jones, P. L. Latreille, and P. J. Sloane (2009, 03). Training, job satisfaction, and workplace performance in britain: Evidence from wers 2004. *LABOUR 23*(s1), 139–175.

Jones, M. K. and P. J. Sloane (2010, 09). Disability and skill mismatch. *The Economic Record 86*(s1), 101–114.

Kahneman, D. and A. Tversky (1979). Prospect Theory: An Analysis of Decision Under Risk. *Econometrica 47*(2), 263–291.

Keskin, K. (2016). Equilibrium Notions for Agents with Cumulative Prospect Theory Preferences. *Decision Analysis 13*(3), 192–208.

Kőszegi, B. and M. Rabin (2006). A Model of Reference-dependent Preferences. *The Quarterly Journal of Economics 121*, 1133–1165.

Kőszegi, B. and M. Rabin (2007). Reference-dependent Risk Attitudes. *The American Economic Review 97*, 1047–1073.

Law, K. S. and C.-S. Wong (1998). Relative importance of referents on pay satisfaction: A review and test of a new policy-capturing approach. *Journal of Occupational and Organizational Psychology 71*(1), 47–60.

Manski, C. F. (2000). Economic analysis of social interactions. *Journal of Economic Perspectives 14*, 115–136.

Mumford, K. and P. N. Smith (2015). Peer salaries and gender differences in job satisfaction in the workplace. *The Manchester School 83*(3), 307–313.

Muthoo, A. (1992). Revocable Commitment and Sequential Bargaining. *The Economic Journal 102*(411), 378–387.

Senik, C. (2004, August). When information dominates comparison: Learning from Russian subjective panel data. *Journal of Public Economics 88*(9-10), 2099–2123.

Senik, C. (2008, 08). Ambition and Jealousy: Income Interactions in the 'Old' Europe versus the 'New' Europe and the United States. *Economica 75*(299), 495–513.

Senik, C. (2009, October). Direct evidence on income comparisons and their welfare effects. *Journal of Economic Behavior & Organization 72*(1), 408–424.

Shalev, J. (2000). Loss Aversion Equilibrium. *International Journal of Game Theory 29*, 269–287.

Tumen, S. and T. Zeydanli (2016, June). Social interactions in job satisfaction. *International Journal of Manpower 37*(3), 426–455.

Tversky, A. and D. Kahneman (1991). Loss Aversion in Riskless Choice: A Reference-dependent Model. *The Quarterly Journal of Economics 106*(4), 1039–1061.

Tversky, A. and D. Kahneman (1992). Advances in Prospect Theory: A Cumulative Representation of Uncertainty. *Journal of Risk and Uncertainty 5*, 297–323.

Wunder, C. and J. Schwarze (2009). Income inequality and job satisfaction of full-time employees in germany. *Journal of Income Distribution 18*(2), 70–91.

Table 1: Summary Statistics

WERS 2004 (1,659 Establishments)

	All	Male	Female
Dependent Variable			
Overall Job Satisfaction	4.222	4.062	4.379
	(2.121)	(2.161)	(2.069)
Income-related Variables			
Relative income	0.42	0.377	0.463
	(0.343)	(0.306)	(0.371)
Relative income × D	0.216	0.249	0.181
	(0.301)	(0.301)	(0.297)
Log wage	5.656	5.91	5.396
	(0.753)	(0.638)	(0.776)
Individual-level characteristics			
Male	0.51	-	-
	(0.5)	-	-
Age	40.97	41.76	40.51
	(12.337)	(12.412)	(12.313)
Age-squared/100	18.307	18.98	17.929
	(10.167)	(10.403)	(9.99)
Marital Status			
Marital Union	0.669	0. 678	0.659
	(0.471)	(0.467)	(0.474)
Having a child	0.15	0.17	0.13
	(0.36)	(0.38)	(0.34)
Education			
Cse 2-5	0.463	0.492	0.444
	(0.499)	(00.5)	(0.497)
Gcse a-c (o-level)	0.236	0.211	0.258
	(0.424)	(0.408)	(0.437)
Gce 1a-e (a-level)	0.173	0.163	0.181
	(0.379)	(0.369)	(0.385)
Gce 2a-e (a-level)	0.089	0.091	0.084
	(0.285)	(0.288)	(0.277)
First Degree	0.03	0.034	0.027
	(0.172)	(0.182)	(0.161)
Higher Degree	0.008	0.009	0.007
	(0.091)	(0.096)	(0.084)
Job-level characteristics			
Working Hours (above median)	0.658	0.842	0.471
	(0.474)	(0.365)	(0.499)
Occupation			
Managers and senior officials	0.152	0.143	0.162
	(0.359)	(0.35)	(0.369)
Professional occupations	0.208	0.156	0.263
	(0.406)	(0.363)	(0.44)
Associate professional and technical occupations	0.121	0.119	0.123
	(0.326)	0.323	(0.328)
Administrative and secretarial occupations	0.167	0.147	0.188
	(0.373)	(0.354)	(0.391)
Skilled trades occupations	0.109	0.158	0.057
	(0.311)	(0.364)	(0.232)
Caring, leisure and other personal service occupations	0.025	0.012	0.038
	(0.155)	(0.108)	(0.192)
Sales and customer service occupations	0.069	0.047	0.093
	(0.253)	(0.211)	(0.29)
Process, plant and machine operatives and drivers	0.105	0.161	0.045
	(0.307)	(0.368)	(0.207)
Routine unskilled occupations	0.045	0.058	0.031
	(0.208)	(0.235)	(0.173)
N	19,508	9,126	10,382

Table 1: Standard errors are in parentheses. "D" stands for a dummy variable, which is 1 if a worker earns more than her/his reference group does, and 0 otherwise.

Table 1: Summary Statistics cont.

	All	Male	Female
Member of a trade/labor union			
Yes	0.32	0.32	0.316
	(0.465)	(0.466)	(0.465)
No, in the past	0.172	0.202	0.143
	(0.378)	(0.402)	(0.35)
No, never been a member	0.511	0.48	0.541
	(0.5)	(0.5)	(0.498)
Workplace-level characteristics			
Small/Medium Establishment	0.499	0.458	0.54
	(0.5)	(0.498)	(0.498)
Establishment Type			
Private	0.427	0.496	0.357
	(0.495)	(0.5)	(0.479)
Public	0.489	0.439	0.54
	(0.5)	(0.496)	(0.498)
Other	0.084	0.065	0.103
	(0.277)	(0.247)	(0.305)
Industry			
Manufacturing	0.167	0.253	0.078
	(0.373)	(0.435)	(0.268)
Electricity, gas and water	0.004	0.005	0.003
	(0.064)	(0.073)	(0.003)
Construction	0.041	0.066	0.015
	(0.198)	(0.249)	(0.12)
Wholesale and retail	0.147	0.135	0.16
	(0.355)	(0.342)	(0.367)
Hotels and restaurants	0.034	0.029	0.04
	(0.182)	(0.169)	(0.195)
Transport and communication	0.062	0.087	0.036
	(0.241)	(0.282)	(0.186)
Financial services	0.065	0.056	0.074
	(0.247)	(0.231)	(0.262)
Other business services	0.141	0.147	0.134
	(0.348)	(0.355)	(0.341)
Public administration	0.064	0.062	0.066
	(0.245)	(0.242)	(0.248)
Education	0.089	0.049	0.13
	(0.284)	(0.215)	(0.336)
Health	0.139	0.061	0.219
	(0.346)	(0.239)	(0.414)
Other community services	0.047	0.048	0.046
	(0.212)	(0.214)	(0.21)
Region			
North East	0.038	0.04	0.036
	(0.19)	(0.195)	(0.0185)
North West	0.145	0.15	0.14
	(0.352)	(0.357)	(0.347)
Yorkshire and The Humber	0.096	0.096	0.096
	(0.295)	(0.295)	(0.294)
East Midlands	0.068	0.069	0.066
	(0.252)	(0.254)	(0.249)
West Midlands	0.096	0.098	0.094
	(0.295)	(0.298)	(0.292)
East of England	0.091	0.089	0.093
	(0.288)	(0.285)	(0.29)
London	0.101	0.098	0.104
	(0.301)	(0.298)	(0.305)
South East	0.13	0.123	0.138
	(0.337)	(0.328)	(0.345)
South West	0.083	0.082	0.085
	(0.276)	(0.274)	(0.278)
Scotland	0.113	0.116	0.111
	(0.317)	(0.32)	(0.314)
Wales	0.037	0.037	0.038
	(0.19)	(0.189)	(0.191)
N	19,508	9,126	10,382

Table 1: Standard errors are in parentheses.

Table 2: Estimation results (WERS-2004)

Dependent variable: std. overall job satisfaction score	All	Male	Female
Income-related variables			
Relative income	0.160***	0.339***	0.0356
	(0.0446)	(0.0808)	(0.0501)
Relative income × D	0.249***	0.117	0.304***
	(0.0628)	(0.0962)	(0.0746)
Log wage	0.164***	0.272***	0.0773**
	(0.0319)	(0.0472)	(0.0360)
Individual-level characteristics			
Male	-0.138***	-	-
	(0.0213)	-	-
Age	-0.0249***	-0.0424***	-0.00928
	(0.00555)	(0.00800)	(0.00723)
Age-squared/100	0.0345***	0.0537***	0.0165*
	(0.00653)	(0.00922)	(0.00876)
Marital union	0.0842***	0.113***	0.0509*
	(0.0203)	(0.0308)	(0.0270)
Having a child	0.0338	0.0148	0.0371
	(0.0258)	(0.0359)	(0.0357)
	(0.00626)	(0.00911)	(0.00832)
Education			
Cse 2-5(ref. category)			
Gcse a-c (o-level)	-0.145***	-0.217***	-0.0811***
	(0.0229)	(0.0351)	(0.0292)
Gce 1a-e (a-level)	-0.153***	-0.209***	-0.0972***
	(0.0260)	(0.0374)	(0.0339)
Gce 2a-e (a-level)	-0.153***	-0.177***	-0.140***
	(0.0364)	(0.0517)	(0.0451)
First Degree	-0.263***	-0.325***	-0.191***
	(0.0484)	(0.0721)	(0.0604)
Higher Degree	-0.192**	-0.316**	-0.0640
	(0.0935)	(0.127)	(0.120)
Job-level characteristics			
Member of a trade/labor union			
Yes	-0.209***	-0.240***	-0.161***
	(0.0258)	(0.0360)	(0.0337)
No, in the past	-0.0942***	-0.0996***	-0.0800**
	(0.0260)	(0.0373)	(0.0362)
No, never been a member (ref. category)			
Working hours (above median)	-0.0968***	-0.0792*	-0.0794***
	(0.0240)	(0.0408)	(0.0294)
Workplace-level characteristics			
Small/Medium Establishment	0.112***	0.121***	0.111***
	(0.0242)	(0.0325)	(0.0293)
Large Establishment (ref. category)			
Firm Type			
Private (ref. category)			
Public	-0.0605**	-0.0761**	-0.0331
	(0.0275)	(0.0378)	(0.0349)
Other	-0.00711	0.00804	-0.00565
	(0.0408)	(0.0642)	(0.0471)
N	19,508	9,126	10,382

Table 2: *, **, *** indicate the 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered at the establishment level and reported in parentheses. Region, industry and occupation are controlled for. "D" stands for a dummy variable, which is 1 if a worker earns more than her/his reference group does, and 0 otherwise. In this setup, relatively poor workers take into consideration the co-efficient of "relative income" and relatively rich workers take into consideration the sum of the co-efficients of "relative income" and "relative income × D".

Table 3: Establishment type-Estimation results (WERS-2004)

Dependent variable: std. overall job satisfaction score

	Public			Private		
	All	**Male**	**Female**	**All**	**Male**	**Female**
Income-related variables						
Relative income	0.274***	0.513***	0.147**	0.124	0.274**	-0.0262
	(0.0589)	(0.116)	(0.0695)	(0.0780)	(0.127)	(0.0830)
Relative income × D	0.0330	-0.156	0.0983	0.363***	0.287*	0.393***
	(0.0860)	(0.146)	(0.105)	(0.103)	(0.146)	(0.124)
Log wage	0.254***	0.388***	0.164***	0.122**	0.200***	0.0443
	(0.0432)	(0.0704)	(0.0496)	(0.0522)	(0.0697)	(0.0604)
N						

Table 3: *, **, *** indicate the 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered at the establishment level and reported in parentheses. Region, industry and occupation are controlled for. "D" stands for a dummy variable, which is 1 if a worker earns more than her/his reference group does, and 0 otherwise. In this setup, relatively poor workers take into consideration the co-efficient of "relative income" and relatively rich workers take into consideration the sum of the co-efficients of "relative income" and "relative income × D".

Table 4: Establishment size-Estimation results (WERS-2004)

Dependent variable: std. overall job satisfaction score

	Small-Medium			Large		
	All	**Male**	**Female**	**All**	**Male**	**Female**
Income-related variables						
Relative income	0.140**	0.335***	0.0315	0.184***	0.331***	0.0994
	(0.0552)	(0.103)	(0.0596)	(0.0684)	(0.123)	(0.0889)
Relative income × D	0.252***	0.0891	0.282***	0.285***	0.217	0.261*
	(0.0752)	(0.121)	(0.0868)	(0.104)	(0.152)	(0.138)
Log wage	0.136***	0.262***	0.0657	0.169***	0.241***	0.118*
	(0.0503)	(0.0786)	(0.0544)	(0.0538)	(0.0753)	(0.0659)
N						

Table 4: *, **, *** indicate the 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered at the establishment level and reported in parentheses. Region, industry and occupation are controlled for. "D" stands for a dummy variable, which is 1 if a worker earns more than her/his reference group does, and 0 otherwise. In this setup, relatively poor workers take into consideration the co-efficient of "relative income" and relatively rich workers take into consideration the sum of the co-efficients of "relative income" and "relative income × D".

Table 5: Ordered Probit Model (WERS-2004)

Dependent variable: std. overall job satisfaction score			
	All	**Male**	**Female**
Income-related variables			
Relative income	0.145***	0.314***	0.0275
	(0.0553)	(0.103)	(0.0637)
Relative income × D	0.315***	0.237*	0.336***
	(0.0832)	(0.126)	(0.100)
Log wage	0.160***	0.245***	0.0948**
	(0.0415)	(0.0628)	(0.0459)
N			

Table 5: *, **, *** indicate the 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered at the establishment level and reported in parentheses. Region, industry and occupation are controlled for. "D" stands for a dummy variable, which is 1 if a worker earns more than her/his reference group does, and 0 otherwise. In this setup, relatively poor workers take into consideration the co-efficient of "relative income" and relatively rich workers take into consideration the sum of the co-efficients of "relative income" and "relative income × D".

Table 6: New Regression Equation for significance test of $\beta_2 + \beta_3$ (WERS-2004)

Dependent variable: std. overall job satisfaction score			
	All	**Male**	**Female**
Income-related variables			
Relative income × D (θ)	0.409***	0.456***	0.340***
	(0.0388)	(0.0567)	(0.0509)
Relative income−Relative income × D	0.160***	0.339***	0.0356
	(0.0446)	(0.0808)	(0.0501)
Log wage	0.164***	0.272***	0.0773**
	(0.0319)	(0.0472)	(0.0360)
N			

Table 6: *, **, *** indicate the 10%, 5%, and 1% significance levels, respectively. Standard errors are clustered at the establishment level and reported in parentheses. Region, industry and occupation are controlled for. "D" stands for a dummy variable, which is 1 if a worker earns more than her/his reference group does, and 0 otherwise. In this setup, relatively poor workers take into consideration the co-efficient of "relative income" and relatively rich workers take into consideration the sum of the co-efficients of "relative income" and "relative income × D".