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I present my thesis, titled “The Importance of Colleagues as a Reference Group in Income Comparison”, as part of the requirements for the completion of my Master’s degree in Economics at the University of Bonn.

Please note that this thesis is currently undergoing review and has not yet been submitted to the examination office for evaluation. After revision, the final version of this thesis will be submitted to the examination office by the stipulated deadline.

The Importance of Colleagues as a Reference Group in Income Comparison

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Supervisor:
Prof. Dr. Thomas Dohmen

Submitted in [month and year] by:
Xinyue WANG
Matriculation Number: 3504357

Abstract

This paper advances the understanding of one key critical question in income comparison: how are reference groups formed? Using panel data from the German SOEP-IS *Income Comparison* module, we add innovative empirical evidence on the endogenous origins of reference groups and the differential importance of colleagues. Our results highlight the significant role of colleagues, especially among specific demographic groups and in workplace contexts. We also distinguish between two types of colleagues by analyzing how adequate respondents feel about their income when compared with their colleagues. We find that “same occupation colleagues” have a stronger impact, while respondents have overly moderate perceptions toward “workplace colleagues”.

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1 Introduction

It is a consensus in research on social comparison that besides absolute income, individuals' income relative to others holds significant importance. Early analysis began with the relative income model of consumption by Duesenberry (1949). More recently, abundant studies have documented that relative income comparisons affect individuals' subjective well-being, such as job satisfaction (Card et al., 2012; Godechot & Senik, 2015), life satisfaction (Goerke & Pannenberg, 2015), happiness (Ferrer-i-Carbonell, 2005; Luttmer, 2005; Senik, 2004), and brain activity related to reward processing (Dohmen et al., 2011; Fliessbach et al., 2007). Economics studies also have unveiled the influence of relative income comparisons on a range of labor market behaviors, including individuals' decisions to exert effort (Breza et al., 2017; Cullen & Perez-Truglia, 2022) and to quit their jobs (Dube et al., 2019).

The body of literature on relative income comparison maintains that individuals tend to compare themselves to other people in specific reference groups (Clark & Senik, 2010). Hence, the identification of reference groups, which generally represent a source of norms, attitudes, values, tastes, and preferences (Clark & D'Ambrosio, 2015), is crucial. Although reference peers can be directly controlled in experimental designs (Breza et al., 2017; Clark et al., 2010; Cohn et al., 2014; Falk & Ichino, 2006; Ferrer-i-Carbonell, 2005). Outside of the laboratory or hyper-experimental environment, direct empirical evidence on the formation of reference groups is scarce.

This paper analyzes panel data from a survey module in Germany, which is tailored to investigate individuals' choices among multiple reference groups in the context of income comparison. The main purpose is to provide comprehensive empirical evidence on how people choose reference groups, both in general scenarios and especially, in the workplace. The relative literature and our main findings of this paper are explained as follows.

Formation of Reference Groups from an Endogenous Origin

Approaches to studying reference groups focus on the origin, that is, whether reference standards are exogenously defined by researchers or endogenously selected by subjects of the study. Some scholars argue that forming referents is restricted by contextual factors, such as the social environment where individuals live (Katz et al., 2001), availability of information (Diener & Fujita, 2013), or inter-generational transmission from parents to children (Leites et al., 2022). Most research defines reference standards from an exogenous origin, including assuming individuals compare themselves with others living in the same region (Easterlin, 1995),

belonging to similar age groups (McBride, 2001), working in the same establishment (Card et al., 2012; Dube et al., 2019), or based on education level, job position and professional status (Ferrer-i-Carbonell, 2005; van de Stadt et al., 1985). However, some theories also acknowledge the active role of individuals in choosing their reference groups. For instance, Falk and Knell (2000) introduce a social comparison model where the reference groups are endogenously determined. Their empirical results confirm that choosing “optimal Joneses” - the optimally chosen reference standard - depends on the goals of comparison and individual characteristics such as abilities.

This paper provides empirical evidence on the formation patterns of multiple reference groups, by analyzing the endogeneity of referents in two scopes. Firstly, we focus on typical reference groups in general scenarios, and analyze individuals’ direct responses on the importance of these groups. Our result reveals that, from this endogenous perspective of all respondents, “colleagues” generally have higher importance than other domains such as “neighbors” or “parents”, which is in line with assumptions of most existing research that define co-workers as reference standards from an exogenous perspective. However, we also find heterogeneity in these importance patterns among demographic characteristics. For instance, “colleague” is a significant reference group especially among respondents who are 25-45 years old, or who are white-collar workers. The importance of “neighbors” as a reference group is mostly attributed to young respondents who are in the 16-24 age group or work as apprentices. Although both genders consider “colleagues” as the most important reference group and “parents” the least, females tend to evaluate their colleagues with higher importance, while more male respondents assign the highest importance only to their parents.

Secondly, we focus on the workplace environment, and analyze the unique information on characteristics of individuals’ two colleagues whom they choose to have closest contact with. We find convergence exists in these endogenous choice patterns. Specifically, people have a tendency to interact with their workplace colleagues who share similar characteristics such as gender, age, seniority, professional level, or education. However, aside from the majority (around 52%) who have close contact with colleagues at the same professional level, more of the rest respondents choose to connect with colleagues of higher professional levels and fewer choose the opposite. Additionally, relatively more males are at a higher level or supervise their close colleagues, while more females are at a lower occupational level.

Different Importance Roles of Two Types of Colleagues

Our initial findings confirm that the significant reference standard is from “colleagues” when concerning income comparison. However, the definition of “colleagues” is not universal and can be diverse. Studies that examine various relative income notions have indicated diverse or contradicting results when colleagues are constructed differently. Specifically, the income of similar others from broader social categories (e.g., same occupation, outside organization, or inter-firm) is a more important reference standard for workers’ satisfaction, rather than those from closer social groups (e.g., same workplace, same organization, or intra-firm) (Bygren, 2004; Dornstein, 1988; Moore, 1991). Regarding individuals’ subjective well-being and behavior, studies generally find negative effects caused by co-workers’ higher wages, such as lower job and life satisfaction, lower happiness, lower effort provision, or higher job search intentions (Ferrer-i-Carbonell, 2005; Goerke & Pannenberg, 2015). However, some positive results have also been found, such as job satisfaction rising with co-workers’ wages, or more effort provision when disclosing higher wages of managers (Clark et al., 2010; Cullen & Perez-Truglia, 2022).

Main studies agree on two types of comparison effect and corresponding strategies to explain this contradiction¹. Nevertheless, one key condition of these explanations is the perceived wages of individuals’ reference groups, which has a high possibility of being misperceived (Cullen & Perez-Truglia, 2022). Specifically, a concept called “center bias” exists in a wide range, whereby people with higher incomes tend to overestimate others’ incomes, while people with lower incomes tend to underestimate others’ incomes and position their self-income level higher (Fehr et al., 2022; Hvidberg et al., 2020; Kiatpongsan & Norton, 2014).

Our subsequent results focus on verifying the importance of multiple reference groups, with a specific emphasis on distinguishing the different importance when two types of colleagues are defined as the reference group. To achieve this, we perform statistical regressions by utilizing responses that gauge how individuals feel about their own income as well as their income relative to multiple reference groups.

Firstly, our results confirm that typical reference groups jointly have an impact on how respondents perceive their own income adequacy. In particular, colleagues with the same occupation have a greater average impact than respondents’ colleagues in the workplace. Secondly, we confirm the importance of each reference group separately, for the majority refer-

¹First, workers apply a “downward comparison” strategy to achieve self-enhancement, according to the “status effect”, i.e. people have an aversion to relative deprivation and feel better when compared to others who are inferior or less fortunate (Falk & Knell, 2000; Wood & Taylor, 1991). Second, holding the goal as self-enhancement, workers engage in “upwards comparison” by setting superior reference standards, which related to the “signal effects”, i.e. workers use other people’s wages as a signal of their own future prospects (Falk & Knell, 2000; Hirschman & Rothschild, 1973). Overall, the net effect of workplace income comparison may be negative, zero, or positive. Clark et al. (2010) and Clark and Senik (2010) found within firms, signal effects outweigh status effects.

ence groups (“same occupation colleagues”, “neighbors”, “friends”, and “partners”), except for “parents” and “workplace colleagues” including the two closest contact workplace colleagues. Our results suggest that when respondents prioritize the importance of “colleagues” in income comparison, their definition might favor “same occupation colleagues” over “workplace colleagues”. Additionally, gender discrepancy exists regarding these two types of colleagues, with male respondents being more affected by the comparison to colleagues in the same occupation, while comparison to colleagues in the same workplace has a higher probability of affecting female cohorts.

At last, we investigate the overly moderate perceptions that lead to the distinct influence roles between these two types of colleagues, as well as discuss potential reasons including upwards comparison, self-protection, and misconceptions. Further research that focuses on tackling misconceptions can be studied, by linking the *Income Comparison* module with administrative data, or previous wave panel data.

The structure of this thesis is as follows. Section 2 describes the research design, including key contents of the questionnaire, the methodology of survey data, and descriptive statistics of respondents. Section 3 presents our results, focusing on the endogenous formation of reference groups which are represented by importance patterns (Section 3.1) and choice patterns (Section 3.2), then verifies the importance of reference groups and discusses the difference between two types of colleagues (Section 3.3). Conclusions and further research are discussed in Section 4.

2 Module and Data

2.1 SOEP-IS *Income Comparison* Module

Data for this thesis is collected from the *Income Comparison* survey module of the German Socio-Economic Panel Study Innovation Sample (SOEP-IS) conducted in the year 2022¹. As part of a representative longitudinal household survey in Germany, the *Income Comparison* module is conducted to tackle on essential questions concerning social comparison. The methodological design of this module consists of two parts: Reference Groups and Wage Transparency. In this thesis, we focus on the responses to questions in the Reference Groups segment, which provide innovative information focusing on the importance and income adequacy perceptions of multiple reference groups. In this part, we introduce key questions that relate to our results².

The Reference Groups segment of the SOEP-IS *Income Comparison* module starts with a gross income question: *What did you earn monthly from your work last month / from your last work within the last two years?* This filter question serves three purposes: First, it allows us to focus on 769 respondents among the sample who are currently employed or have been employed in the past two years; Second, this question is designed to set the context for subsequent questions by prompting respondents to recall their gross income; And third, this income information will help to explain associations in the following analyses.

Next, the module presents a set of general income comparison questions with an initial focus on five typical reference groups in general scenarios: neighbors, friends, colleagues at their workplace, parents when they were of the respondent's age, and the respondent's partner. Respondents are asked to rate these five groups separately for questions: *How important is it for you to compare your own gross job earnings to these five groups?*, on a seven-point Likert scale ranging from 1 as "completely unimportant" to 7 as "extremely important". Responses to these questions are analyzed to investigate the importance patterns of five typical reference groups.

Subsequent questions delve deeper into workplace-related income comparison, with a shifting focus toward the respondents' two closest colleagues. In order to elicit valid information that helps understand the formation of reference groups in the workplace, respondents are asked

¹See more information about SOEP (<http://www.diw.de/soep>) and SOEP-IS (<http://www.diw.de/soep-is>) in links. The German Socio-Economic Panel Study (SOEP) is established by the German Institute for Economic Research (DIW Berlin). As one of the largest and longest-running multidisciplinary household surveys worldwide, SOEP provides representative longitudinal survey data of approximately 30,000 people in 15,000 private households in Germany. The subsequently launched SOEP Innovation Sample (SOEP-IS) is conducted annually to provide a longitudinal sample tailored for innovative survey methods and behavioral experiments.

²See the complete Reference Groups segment questionnaire in Appendix A.1.

a pretest question: *Without counting yourself, how many employees work in the company where you work/worked last?* This filter question restricts the sample to 732 respondents who have more than one co-employee, and 720 respondents with more than two co-employees. Valid respondents are led to answer questions about the demographics of their closest connected colleagues. Specifically, the module asks respondents to *think about two colleagues at their workplace whom they have the most contact with, including contact at work as well as contact outside the workplace*. Respondents are requested to objectively characterize these two closest contact colleagues along various dimensions such as gender, age, seniority, professional position, education, and professional relationship. These questions allow for descriptive analyses to explore respondents' subjective choice patterns of workplace colleagues.

To further gauge respondents' subjective perceptions of income adequacy, the module proceeds with the following questions: *In general: How appropriate do you think your income from employment is? And how appropriate do you think are your own job earnings compared to the job earnings of the following six groups?* and *In the workplace: How do you estimate your own work earnings relative to those of your two closest contact colleagues?* Notably, respondents are asked to self-assess the adequacy of their income *per se*, as well as compared to each of these eight groups - the same five groups as in previous questions, plus individuals with the same occupation in general, and the two closest contact workplace colleagues - on a Likert scale of seven-category spanning from "much too low" to "much too high". These questions allow for confirmatory analyses to verify the importance of multiple reference groups, by examining how much the individuals' income adequacy perception relative to others will reflect on that of their own income.

2.2 Ordinal Scale Data in Likert-type Questions

Within all responses collected from the SOEP-IS *Income Comparison* module and analyzed in this thesis, we have nominal scale data such as gender, age group, and educational background; and interval scale data like gross income; and besides, ordinal scale data, collected from questions using the Likert scale as response measures (Kya et al., 2006). The Likert scale is commonly used in survey research from social science to measure respondents' attitudes (Likert, 1932). There are two types of questions that use Likert scale responses - Likert scales and Likert-type items (Clason & Dormody, 1994). The analysis approach for Likert scales is to create a measurement scale by combining response scores from a series of questions that represent one single attitude. However, the questions in the *Income Comparison* module are Likert-type

items, a single question that adopts the Likert answer scale. While multiple Likert-type items may be presented in a survey¹, their responses should not be combined into a composite scale.

Researchers have some criticisms of the limitations of Likert scale data. For instance, respondents may avoid using extreme response categories, causing central tendency bias (Chakrabartty & Chakrabartty, 2019). Another criticism related more to this thesis is, whether it is realistic to assume the equidistant in the assigned numbers represents the equidistant in the corresponding alternative. To be specific, in a question using the Likert scale response, successive integer numbers like 1, 2, 3, 4, and 5 are usually assigned to the alternatives to capture altitudes. In most scenarios, those number values express a "greater than" relationship but do not imply how greater. Take the *relative-income-adequacy* perceptions question in the module as an example, there is an inherent order among the seven alternatives, but the distance between "a little too low" and "reasonable" is not necessarily the same as the distance between "too high" and "much too high". The debate on diverse statistical methods for Likert scale data focuses on treating the Likert scale as an ordinal scale or interval scale. One property of the interval scale is the distance between any pair of response alternatives must be the same, and without equidistant alternatives, responses to Likert-type items fall into the ordinal measurement scale. Therefore, we treat responses to Likert-type questions in the *Income Comparison* module as ordinal scale data, and perform non-parametric statistical analyses including descriptive frequency and median, Kruskal-Wallis test, Mann-Whitney test, and ordered logistic regression.

2.3 Incomes and Demographics of Respondents

The SOEP-2022 survey contains questions on all respondents' gross income, as well as three demographic information: gender, age, and occupational position, which allows us to investigate whether these demographic characteristics influence respondents' formation patterns of reference groups. In this initial part, we present a descriptive summary of respondents' three demographic variables and check their associations.

Firstly, we perform Pearson's χ^2 test to investigate associations between three demographic characteristics². As shown in Table 1, with p-values of χ^2 less than 0.05, we can reject the null hypothesis of independence between the variables in the rows and columns. Therefore, within 769 respondents, their gender and age are mutually independent, while both gender and age are significantly correlated with respondents' occupational positions.

¹For instance, see the six Likert-type questions (QIS_221) on relative-income-adequacy perceptions in the *Income Comparison* module.

²Because gender, age, and occupational position are nominal variables without ordered categorical data.

Table 1: Pearson's χ^2 Test on Associations of Respondents' Demographics

	Gender	Age	Occupational Position
Gender	-		
Age	0.175	-	
Occupational Position	0.000***	0.000***	-

Note: Values in table are the p-value of χ^2 , with $p < 0.05$ to reject that rows and columns are independent. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Obs. = 769. Source: SOEP-IS 2022.

To illustrate the detailed associations of respondents' occupational positions with their gender and age, Figure 1 shows the count distribution. We find the majority of 758 valid respondents¹ are white-collar workers. The numerical values assigned to each bar signify the percentage of both male and female respondents in different age groups, within the specific occupational positions, and the position of labels indicates the gender group on the corresponding side has a higher percentage within that occupational status category. For instance, within the cohort of blue-collar workers, the predominant gender is male, and approximately 46% of these 91 respondents are aged 55+, encompassing both genders. The bars with a deeper outline color pinpoint the age group with the highest percentage within the specific status group. It shows that respondents aged 55+ dominate all occupational positions except apprentices, which may be attributed to the substantial large number (245) of this age group in our sample. The more noticeable bars with a deeper fill color highlight the position of different age groups with the highest percentage among all five status groups, which accentuates the pronounced association between respondents' age and occupational position. To illustrate, respondents working as apprentices, trainees, or interns are predominantly between the ages of 16 and 24 (70%), while 46% of blue-collar workers (also in agriculture) are comprised of respondents aged 55 or older. Meanwhile, the association between respondents' gender and occupational position can be revealed by comparing the left and right sides. White-collar workers and apprentices consisted of more females, while the difference is not substantial. Professional positions such as blue-collar work or self-employed work are primarily undertaken by male respondents, with their observation number being nearly twice that of females in the same position.

Subsequently, we combine respondents' gross income, demographics, and *absolute rank group* choice². The descriptive statistics for each characteristic group and their average income are shown in Table 2. We find that respondents' average gross income differs across their characteristics. For instance, among 704 respondents with valid gross income data, males have

¹Excluding the 11 respondents who provided "no answer" to their professional position.

²This variable is introduced in Section 3.1 as one representation of respondents' importance patterns.

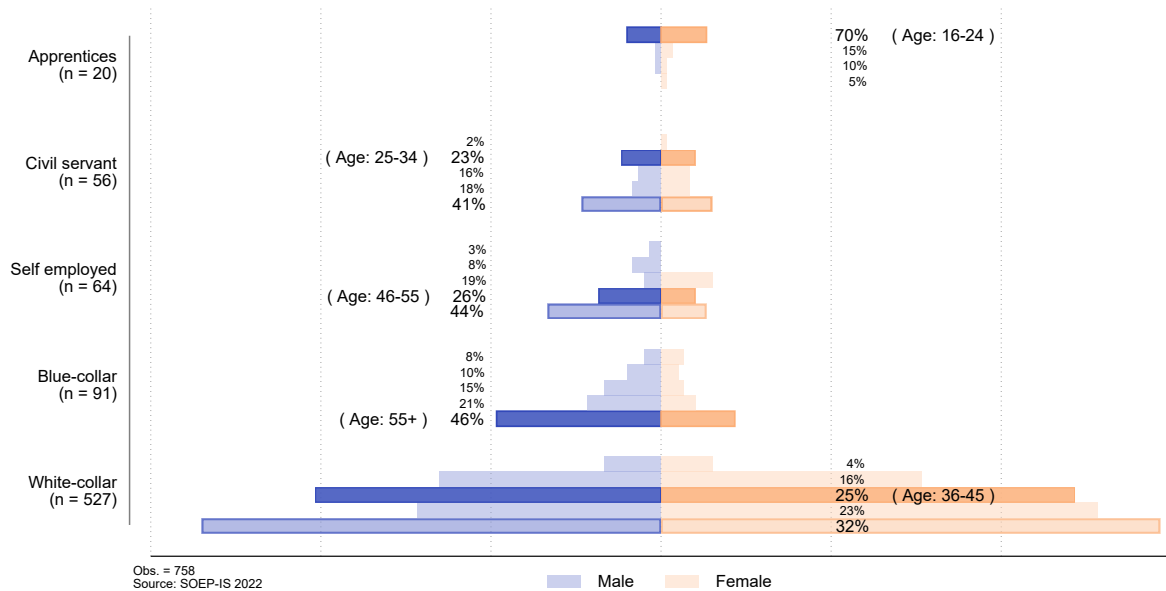


Figure 1: Distribution of Respondents' Occupational Position over Gender and Age

a higher average gross income than their female counterparts. Moreover, respondents in the youngest age group, as well as those who work as apprentices or interns, display the lowest average income compared to their middle-aged or civil servant cohorts. Regarding respondents' choice of the *absolute rank group*, although the majority chose colleagues as their most important reference group, the highest mean gross income value is attributed to 16 respondents who think their parents are exclusively the most important reference group in income comparison. These significant diversions in gross income distribution¹ might serve as part of the underlying explanation for the correlation between these characteristics, and for the effect of income adequacy perceptions which will be analyzed in Section 3.

¹To statistically prove the distinctions, we conduct the Kruskal–Wallis test for gross income among the two gender groups, five age groups, six occupational position groups, and seven categories of *absolute rank group*, separately. The resulting p-values are smaller than 0.01 in all cases. This is significant evidence to prove that the distribution of gross income varies across respondents with diverse characteristics.

Table 2: Descriptive Statistics of Respondents' Gross Income by Characteristics (Euro/Month)

	Mean	(SD)	N	(%)		Mean	(SD)	N	(%)
<i>by: Gender</i>					<i>by: Age</i>				
Male	4204	(3242)	348	(49%)	36-45	3943	(2498)	159	(23%)
Female	2811	(2504)	356	(51%)	46-55	3904	(3546)	152	(22%)
<i>by: Absolute Rank Group</i>					55+	3404	(2792)	245	(35%)
Parents	4584	(3638)	16	(2%)	25-35	3264	(3260)	108	(15%)
Colleagues	3829	(2545)	259	(37%)	16-24	1415	(1159)	40	(6%)
Multiple	3495	(3297)	149	(21%)	<i>by: Occupational Position</i>				
No-IC	3244	(3684)	166	(24%)	Civil servant	4682	(1470)	53	(8%)
Partner	3020	(1951)	81	(12%)	White-collar	3649	(3052)	487	(70%)
Friends	2886	(1862)	15	(2%)	Self-employed	3577	(4353)	56	(8%)
Neighbors	2848	(1760)	18	(3%)	No answer	3004	(2248)	11	(2%)
<i>Total</i>					Blue-collar	2325	(1526)	79	(11%)
	3499	(2973)	704	(100%)	Apprentices	1174	(603)	18	(3%)

Note: Sorted by mean values of gross income in descending order for each characteristic group. Standard deviations in parentheses after Mean. Count percentages in parentheses after N. 65 respondents with "No Answer" to the gross income question are not included in the table. Source: SOEP-IS 2022.

3 Results

To present our result in this paper, our primary focus centers on respondents' formation of reference groups from an endogenous perspective. The formation patterns are represented by importance patterns of five typical reference groups in general (section 3.1), and choice patterns of two closest colleagues in the workplace (section 3.2). We also check whether these patterns differ for respondents with different demographic characteristics. Then, we conduct regressions that reflect importance roles of reference groups on influencing income adequacy perceptions (section 3.3), through which we distinguish the difference between two types of colleagues as a reference group.

3.1 Importance Patterns of Typical Reference Groups

As introduced in section 2.1, our study cohort consists of 769 respondents who either are currently employed or have been employed within the last two years, deriving from a broader population of participants who participated in the SOEP-IS questionnaire in the year 2022. To represent the importance patterns assigned by respondents, we define two variables - *importance rank* and *absolute rank group* in this part, which are primarily depicted from respondents' attribution of importance grade to five typical reference groups in income comparison¹.

3.1.1 Importance Rank

769 respondents rate their opinion by employing a discrete integer scale from 1 as “completely unimportant” to 7 as “extremely important”. To document the significant degree of the five reference groups from an individual perspective, we transform the seven-point numerical responses into a five-category ordinal rank for each respondent, with the spectrum from “least important” to “most important”. This *importance rank* variable reflects a hierarchical assessment of the importance of these five reference groups from an individual's perspective. Specifically, the higher the importance grade an individual gives to one group, the higher the importance rank this group is accordingly assigned when the individual considers the importance of different reference groups for income comparison. For instance, if a respondent assigns importance grades as follows: a grade of 1 to her neighbors, 2 to her friends, 3 to her parents, 5 to her partner, and 5 to her colleagues, then the ensuing *importance rank* responses is that her colleagues and partner are her most important reference groups simultaneously, whereas she regards her parents, friends, and neighbors sequentially as her third, fourth and least important reference group

¹See questionnaire items (QIS.218) in Appendix.

when comparing her gross job earnings.

Notably, respondents may ascribe identical importance grades to multiple reference groups, thereby resulting in an identical *importance rank* for multiple groups from an individual perspective, as in the exemplified scenario above. Hence, it's crucial to discern the ranks denoted as “most important - absolute” and “most important - simultaneous”. Specifically, among all responses with “most important” as the *importance rank*, we distinguish respondents who give and only give one specific reference group the most important rank, from those who simultaneously attribute this most importance to more than two groups. This demarcation identifies 161 respondents who simultaneously assign the highest importance to multiple reference groups when engaging in the income comparison.

Figure 2 shows the distribution of transformed six-category *importance rank* responses across all respondents concerning five typical reference groups. With the numerical value indicating the count of respondents, it reveals the varying significance of the five reference groups in income comparison. For instance, among 769 respondents, 505 of them rank their parents as the “least important” group among five reference groups, while only 228 respondents consider colleagues to be their “least important” reference group when comparing gross income. It is noteworthy that a majority of respondents perceive colleagues as a crucial existence when engaging in income comparison, with 281 “most important - absolute” answers in the bar of colleagues domain. Furthermore, within the 161 respondents who concurrently assign “most important” rank to multiple groups, a dominant majority include colleagues in their responses, with 128 “most important - simultaneous” responses showing in the Colleagues bar. Besides the conspicuous distribution depicted by the Colleagues bar, discernible respondents think their partner can't be ignored when comparing wages, while little acknowledgment is granted to the important role of parental comparison in the context of income comparison.

3.1.2 Absolute Rank Group

Subsequent to the *importance rank* from all respondents' perspectives, we proceed to define the *absolute rank group* variable to represent the respondents' choice of their “most important - absolute” reference group in income comparison. To be specific, due to the fact that respondents may give the same importance rank to multiple groups, we classify each respondent's *absolute rank group* choice into seven categories: “colleagues”, “partner”, “friends”, “neighbors”, and “parents” for those who regard the corresponding domain as their solely most important reference group in income comparison; “multiple” for respondents who simultaneously attribute

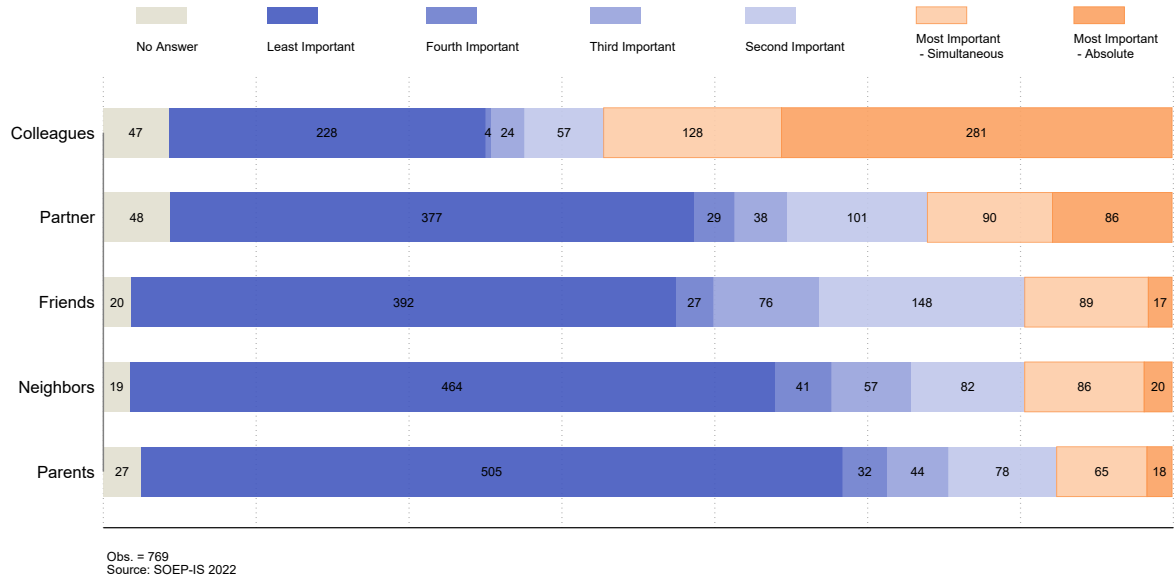


Figure 2: Distributions of *Importance Rank*

the highest importance to more than two domains; and “No-IC” as the category for respondents who do not participate in income comparison, as recognized by their *importance rank* towards all five reference groups are either “least important” or “no answer”. Both *importance rank* and *absolute rank group* serve as indicators of respondents’ importance patterns in the context of income comparison, and will be employed in the subsequent part to analyze the heterogeneity across respondents’ demographic characteristics.

3.1.3 Heterogeneity in Importance Patterns

In this part, we investigate whether respondents’ importance patterns - represented by the transmutated *importance rank* and subsequent *absolute rank group* - differ among respondents’ three demographics. First, we perform statistical tests on the distribution of *importance rank* and *absolute rank group*¹. As presented in Table 3, a significant test result, i.e. a p-value smaller than 0.05, indicates that distributions of the importance pattern variable differ among respondents’ one characteristic. Hence, our results show that, respondents with different genders or occupational positions do NOT exhibit different distributions toward majority importance patterns, except for the *importance rank* of colleagues and *absolute rank group*. However, regarding respondents with different age groups, the distributions of importance patterns differ for all variables except the *importance rank* of neighbors. Then, we present detailed distributions as follows to gain a deeper understanding of how respondents’ importance patterns vary in their three demographics.

¹To check the robustness of test results on *importance rank*, we also use the original importance grade data for each reference group as the row variables. The results are similar.

Table 3: Test on *Importance Patterns* over Respondents' Demographics

	Gender	Age	Occupational Position
<i>Kruskal-Wallis test</i>			
Colleagues	0.01*	0.00***	0.00***
Partner	0.42	0.00**	0.33
Friends	0.78	0.00***	0.12
Neighbors	0.96	0.27	0.63
Parents	0.22	0.01**	0.34
<i>Pearson's χ^2 test</i>			
Absolute Rank Group	0.01*	0.00***	0.00***

Note: *Importance rank* are ordinal variables with ordered degree categories data, so perform the Kruskal-Wallis test to examine the distribution across different gender, age, and occupational position groups. *Absolute rank group* is nominal variable, so perform Pearson's χ^2 test across three characteristics. Values in table are p-values of χ^2 , with $p < 0.05$ to reject that row variable originates from the same distribution within the groups of column variable. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Obs. = 769. Source: SOEP-IS 2022.

Gender

Figure 3 shows percentage distributions of *importance rank* and *absolute rank group* for each reference group by their gender, which elucidates significant test results of column “gender” in Table 3. We find that in comparison to male respondents, females tend to assign higher *importance rank* to their colleagues, with “most important - simultaneous” as the median rank in the female cohort but “second important” median rank in male respondents. Aligning with the *importance rank* distributions among genders, the *absolute rank group* distributions reveal that both females and males predominantly choose colleagues as their most important reference group. The significant test result shown in *absolute rank group* variable might be that among 18 respondents who attribute “most important - absolute” to their parents, a larger proportion are males. Hence, for both female and male respondents, the heterogeneity of their importance patterns is negligible.

Age and Occupational Position

Due to the association between respondents' age and occupational position, as explained in Figure 1, we explain how respondents' importance patterns differ among age and status by combining distributions of their *absolute rank group*¹. As shown in Figure 4, we find that respondents aged 25-35 and 36-45, or who worked as white-collar most likely to assign the highest importance to “colleagues” in income comparison, while the self-employed workers are least likely to do so. Besides, young respondents aged 16-25, as well as in apprentice status exhibit the highest ratio of choosing “neighbors” as their *absolute rank group*, compared to other

¹Due to the length of this paper, see distributions of *importance rank* by respondents' age and occupational position in Appendix A.2.

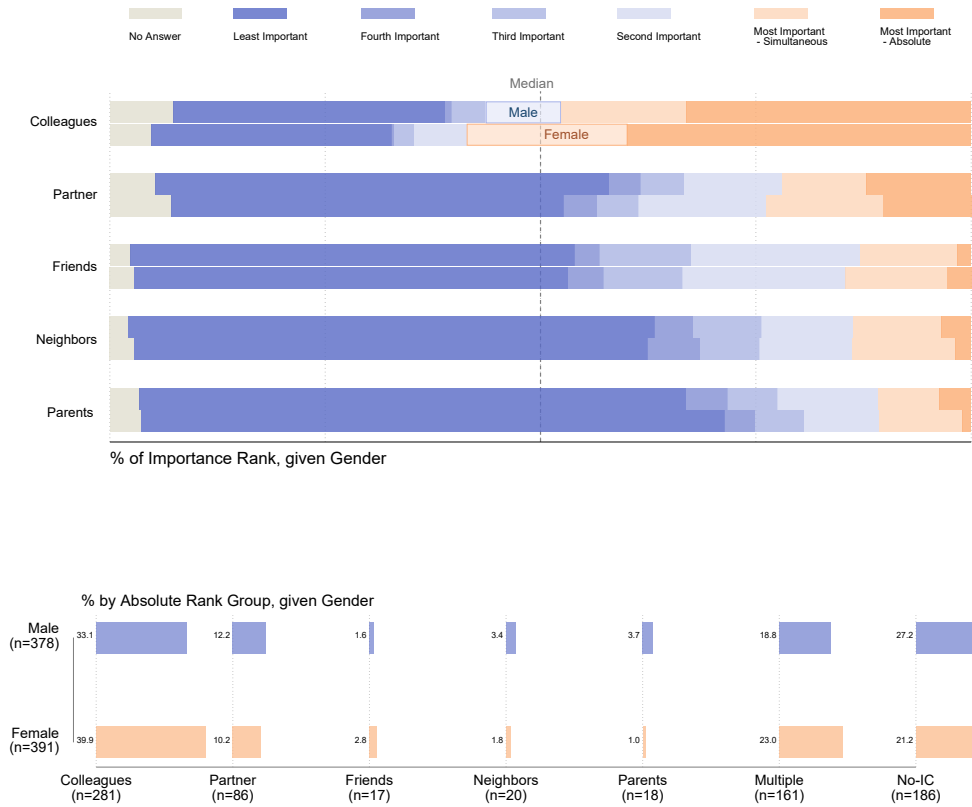


Figure 3: Distributions of *Importance Patterns* - by Gender

age or status groups. Regarding the 186 respondents who do not engage in income comparison, the fewest are 25-35 years old, instead, more tend to be older.

In this section, we analyze 769 respondents' importance patterns of five typical reference groups, as one representation of how reference groups are formed in general for income comparison. It is evident that the majority of people indeed consider their colleagues to be an important reference group, and consider their parents low importance to compare income to. However, these patterns exhibit variations across respondents' demographics. More 25-45 aged respondents or white-collar workers assign the highest importance to "colleagues", and more 16-24 aged respondents or apprentices assign *absolute rank group* to "neighbors". Although these patterns have no significant gender disparities, but compared to cohorts with another gender, more females tend to assign high *importance rank* to their colleagues, and more males tend to consider their *absolute rank group* to be parents.

Our results align with previous studies. For instance, there is no significant gender difference in social comparison (Dohmen et al., 2011) and intensity of income comparisons (Clark & Senik, 2010). Besides, Clark and Senik (2010) found almost all employees (except those in

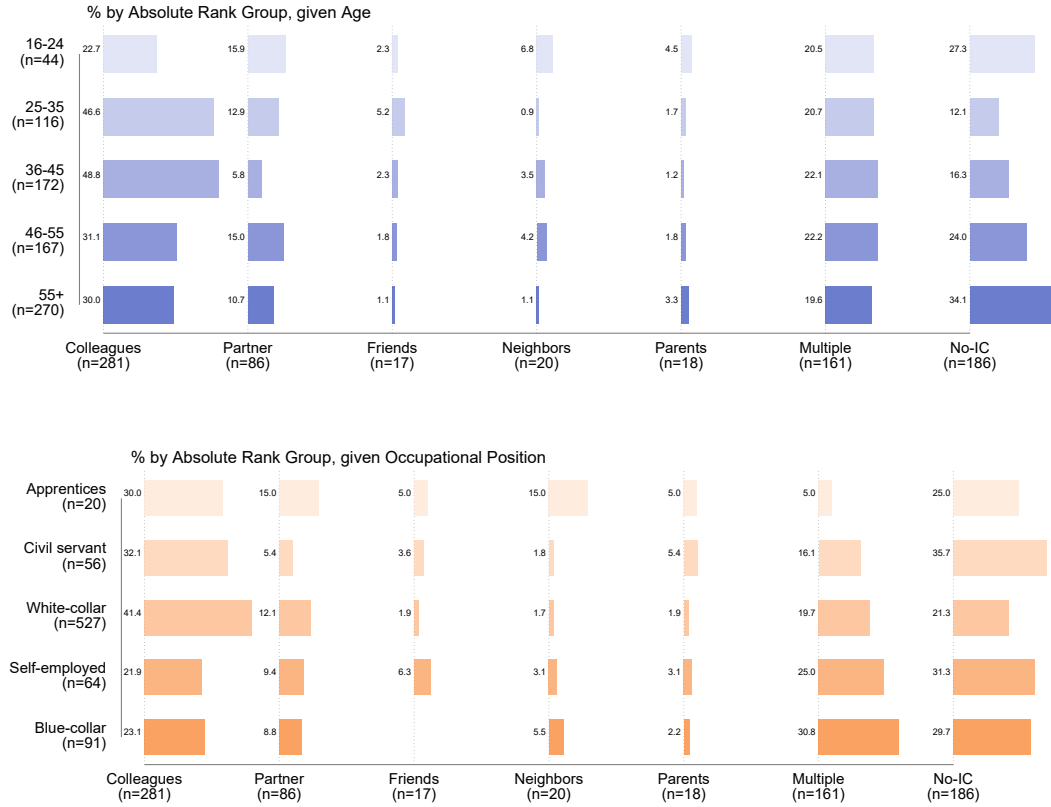


Figure 4: Distributions of *Absolute Rank Group* - by Age and Occupational Position

agriculture like blue-collar) compare more to their colleagues. They also found self-employed were less likely to compare in general, with significantly less likely to compare to colleagues, but more likely to compare to others like family members and friends.

3.2 Choice Patterns of Closest Workplace Colleagues

Colleagues are the main choice of reference groups in the context of income comparison. However, definitions of colleagues can be personal and widely varied, with scarce empirical evidence to characterize personally chosen workplace colleagues as reference groups. In this part, we employ survey data that focus on respondents' workplace colleagues whom they have the closest contact with, i.e. who are the potential reference groups for income comparison in the firm¹. As introduced in Section 2.2, our sample size in this part is 732 respondents² with more than one workplace colleague, after applying a filter question to restrict the definition of "workplace". By analyzing respondents' subjective choice of their closest colleagues, we explore the endogenous formation patterns of reference groups focusing on the workplace.

¹See questionnaire items (QIS.222) in Appendix.

²The excluded invalid 37 respondents do not impact the analyses, since they responded either "no answer" or "least important" to *importance rank* to colleagues, and 19 of them have "no-IC" as the absolute rank group, indicating they do not engage in income comparison for any of the five typical reference groups.

First, we utilize a series of information about these colleagues' demographics and occupational characteristics provided by respondents, to investigate the association between the two closest colleagues and respondents' demographics. Table 4 displays the results of Pearson's χ^2 test on these nominal data by respondents' gender, and occupational position separately. The bold numerical values highlight domains where the demographic characteristics of respondents have a strong association with that of both their two closest colleagues. Following, detailed illustrations are presented to explain these convergence choice patterns.

Table 4: Test on Associations Between Demographics and Workplace Colleagues

<i>Workplace Colleagues'</i>	<i>Respondents'</i>			N
	Gender	Age	Occupational Position	
Gender - A	0.00***	0.00**	0.02*	703
- B	0.00***	0.23	0.01**	681
Professional Relationship - A	0.00***	0.03*	0.00***	697
- B	0.00***	0.00**	0.00***	677
Age - A	0.77	0.00***	0.00***	701
- B	0.06	0.00***	0.00***	679
Professional Seniority - A	0.14	0.00***	0.00***	696
- B	0.29	0.00***	0.03*	674
Educational Background - A	0.08	0.03*	0.00***	632
- B	0.00**	0.10	0.00***	608
Same Occupational Position - A	0.72	0.16	0.17	702
- B	0.04*	0.00**	0.00**	679

Note: Values in table are p-values of Pearson's χ^2 test. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. With $p < 0.05$ reject the hypothesis that row variable has the same distribution among the population groups of column variable. The bold front highlights both two colleagues have significantly different distributions by the demographic of respondents. Source: SOEP-IS 2022.

Gender

Specifically, female and male respondents exhibit significantly different distributions concerning the gender and professional relationship of their two closest contact workplace colleagues. As shown in Figure 5, both genders mostly choose their two closest colleagues of the same gender. The majority also convergently contact with colleagues who work at the same professional level. However, the remaining male respondents have a relatively higher proportion being supervisors of their colleagues, while the remaining females are more at a lower professional level than their two closest contact workplace colleagues.

Age

Regarding the convergence patterns that appear by respondents' age, numerical value labels

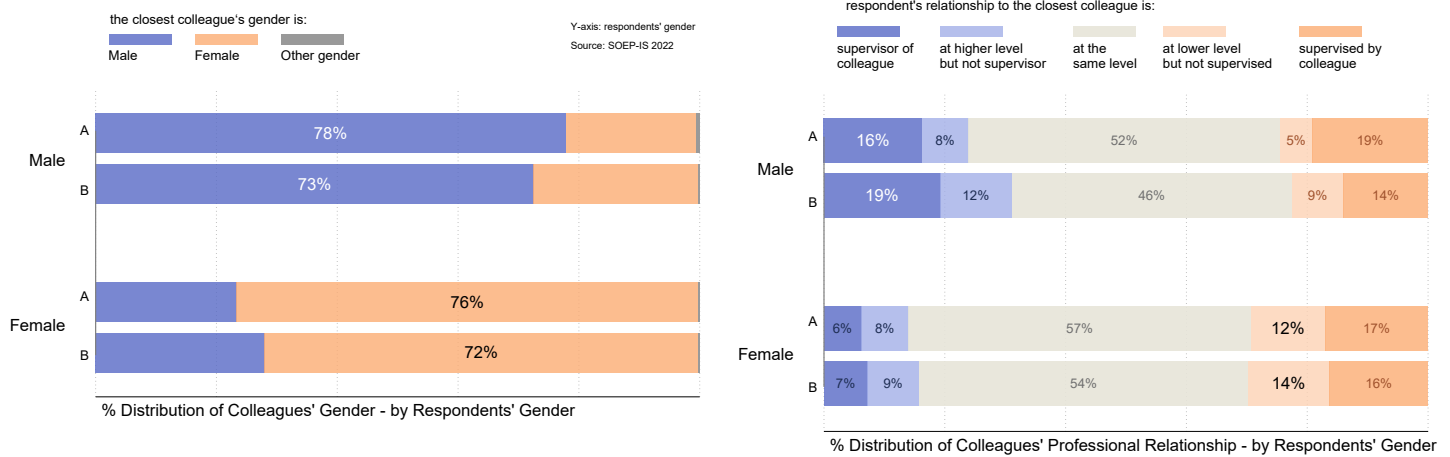


Figure 5: Distributions of Colleagues' Characteristics - by Gender

in Figure 6 highlight the bar position where the highest response frequency is located for each age group. We find respondents with different ages tend to have their closest colleagues who are in the same age group. The majority also have close contact with colleagues who have similar or little more years of employment seniority. In terms of significant associations in professional relationships, respondents aged 16-24 have the lowest percentage of being supervisors and the highest proportion of being supervised by their colleagues.

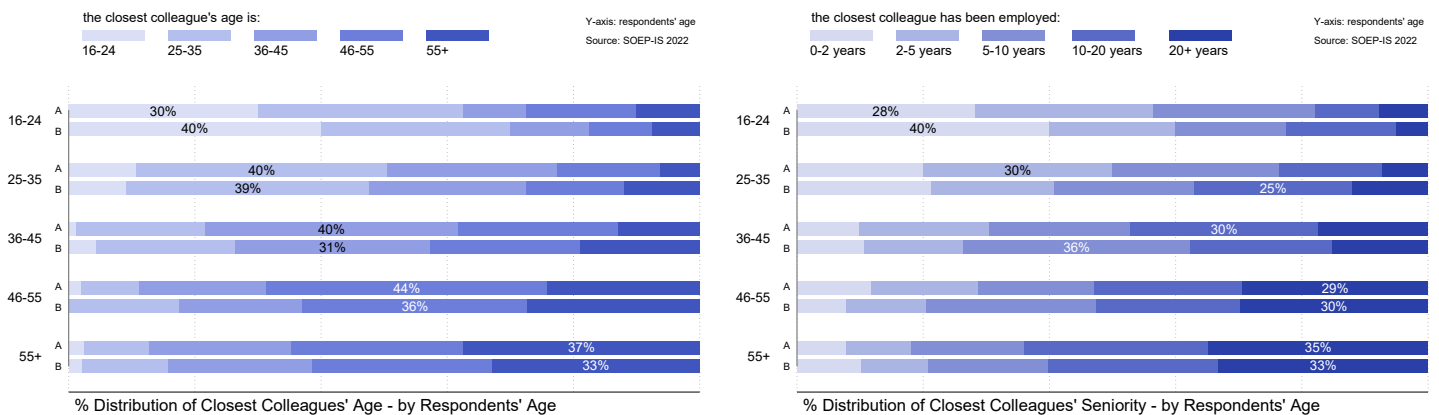


Figure 6: Distributions of Colleagues' Characteristics - by Age

Occupational Position

Among respondents with different occupational positions, the majority choose their closest colleagues who work in the same status. The significant results in that column are related to respondents' age-status association. For instance, apprentices, who are predominantly 16-24 years old, have a high percentage of recognizing their colleagues as non-binary gender. They also tend to contact colleagues who are aged 16-24 or have been employed in the company

for 0-2 years. Regarding associations in education, Figure 7 reveals diverse median values of colleagues' educational backgrounds, with a higher number generally indicating a higher education degree¹. Although we lack respondents' education data in this paper, an explanation could be related to the average income shown in Table 2, with the speculation that higher income is related to higher educational background². Respondents who work in different statuses might have different education, which is reflected by their income, and they have close contact with colleagues whose education corresponds to their own education degree.

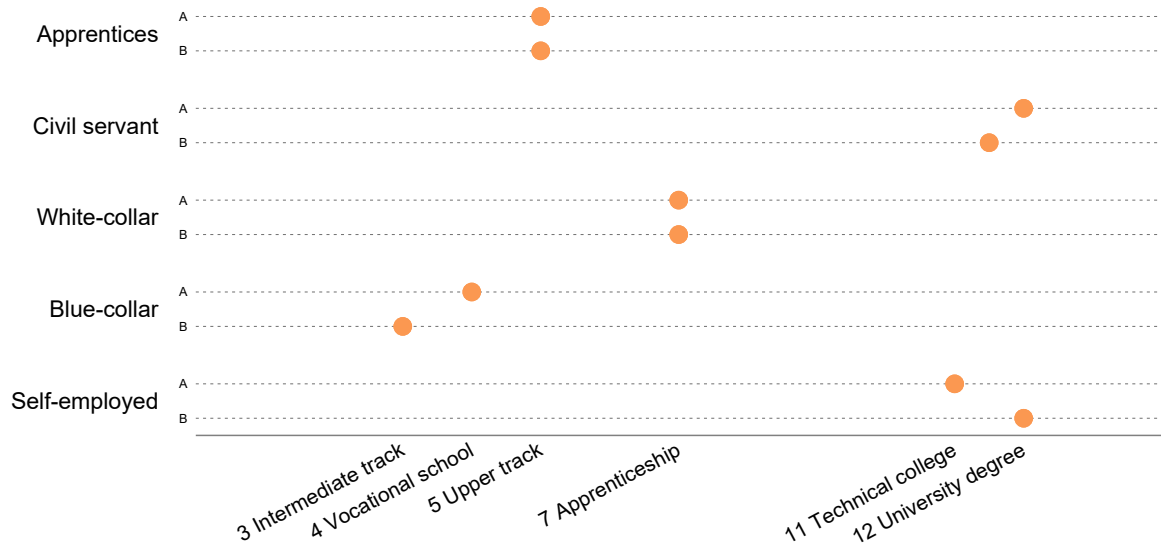


Figure 7: Median of Colleagues' Education - by Occupational Position

In this section, we take advantage of direct information on people's closest contact colleagues and find convergence in choice patterns of reference groups in the workplace. Respondents mostly have close interaction - including at work as well as outside the workplace - with colleagues who have the same gender, the same professional level, similar age and seniority, or similar education.

Overall, through the analysis of importance patterns and choice patterns, we advance empirical evidence that individuals are actively engaged in forming their reference groups in income comparison. Colleagues indeed are the prevailing reference groups, and people tend to compare to others in similar circumstances. Our results are supported by other scholars' findings. For instance, Goerke and Pannenberg (2015) proved that the occupational domain is one particularly important context in which income comparison can arise, as income comparisons are more

¹See complete descriptions of educational background in Questionnaire in Appendix A.1.

²This is also supported by the highest gross income mean value among 13 respondents who consider their parents as *absolute rank group*. The median values of their closest colleagues' education are 12 (University or university-level degree) and 11 (Technical or professionally oriented college) separately, which are much higher than 7 (Apprenticeship, Vocational degree as skilled worker) as the median for respondents who consider other domains as their *absolute rank group*.

intensive when people relate themselves to people from the work domain. Bygren (2004) found that Swedish workers primarily compare their pay with that of similar others, e.g., others with the same education and work experience.

3.3 Verify the Importance of Reference Groups

Accurately defining reference groups is important since previous research has found diverse contradictory influences on individuals' behavior and well-being from income comparison. The SOEP-IS *Income Comparison* module offers information on respondents' subjective feelings towards how adequacy their income is, both by itself and compared to the income of multiple reference groups. Hence, we utilize these subjective perception data to implement confirmatory analyses. Specifically, through regression, we examine to what extent respondents' adequacy perception of their own income is reflected by that perception relative to their reference groups. Those coefficients serve as indicators to show how important these reference groups are for respondents to evaluate their income, and therefore, to confirm their endogenous formation of reference groups.

3.3.1 Confirm Importance Roles of Multiple Reference Groups

To verify the importance of reference groups, we propose two hypotheses: First, individuals' adequacy perceptions of their own income are influenced by their view of its adequacy relative to others' income; And second, individuals are influenced more by the reference groups they attribute higher importance to in income comparison.

To test these hypotheses, our design designates responses to the *self-income-adequacy* question as the dependent variable, and chooses responses to subsequent *relative-income-adequacy* questions as independent variables¹. The percentage distributions of income adequacy perceptions are shown in Figure 8, with numerical values indicating the percentage of valid responses in each specific domain. It is notable that the majority of respondents consider their own income to be reasonably appropriate. However, the “reasonable” percentage of their own income from self-comparison (45.1%) is lower than that from comparing to all six reference groups (around 60%), and the highest “reasonable” proportion (66.5%) appears when respondents are asked to evaluate their own job earnings in comparison to those of their workplace colleagues.

¹See questionnaire items (QIS_220 and QIS_221) in Appendix.

In this part, we use Question QIS_221 instead of QIS_219 to represent *relative-income-adequacy* variables, because QIS_221 employs a seven-point Likert scale, which is better suited to reflect respondents' actual intention towards questions, compared to a five-point Likert scale (Awang et al., 2016).

Besides, a relatively larger proportion of respondents assign different degrees of “lower” to *self-income-adequacy* evaluation, but more “higher” adequacy perceptions when comparing their own income to that of their parents.

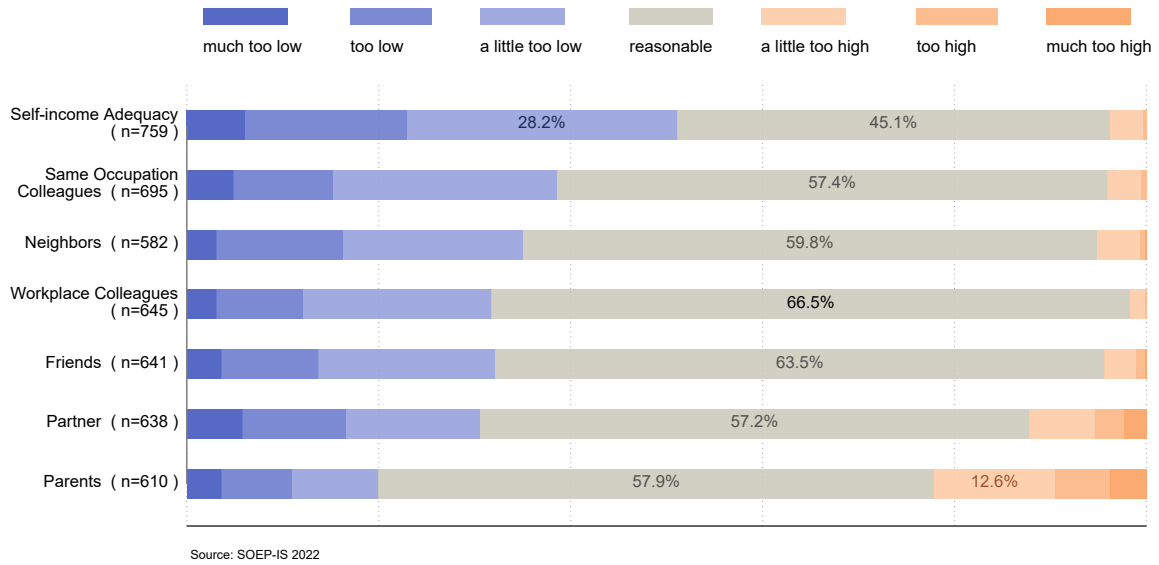


Figure 8: Distributions of Income Adequacy Perceptions

Before proceeding with ordered logistic regression, we conduct the Kruskal-Wallis test and depict detailed distributions¹, to assess whether the income adequacy perceptions differ across respondents’ three demographic characteristics. Our results show that respondents in different age groups have similar distributions of their income adequacy perceptions. However, more females evaluate their own income as lower adequacy and more civil servants have higher perceptions across all domains, which aligns with the objective diversity in average gross income.

Hypothesis 1: multiple reference groups jointly have influences

To investigate the first hypothesis that considering multiple reference group sources, we conduct ordered logistic regression on respondents’ *self-income-adequacy* variable and six *relative-income-adequacy* perception variables. This regression is performed on 479 respondents after excluding observations with invalid “no answer” responses, with the model χ^2 being 385.00 and the p-value being 0.00. This is highly significant to confirm that independent variables jointly influence respondents’ *self-income-adequacy* perceptions.

Specifically, coefficients in Table 5 reveal how important different reference group is in income comparison. For instance, if respondents’ *relative-income-adequacy* perceptions of their job earnings compared to that of “same occupation colleagues” increase in one category, their

¹Due to the length of this paper, see the result table and distribution figures in Appendix A.3.

self-income-adequacy perceptions increase with a high possibility (0.98 in ordered log odds), while holding other variables constant. The “odds ratios” column shows the proportional odds ratio parameters, which measure the change in categories in a cumulative sense and explain coefficients in an alternative way. Hence, with a one-category increase in the *relative-income-adequacy* compared to “same occupation colleagues”, the odds of higher *self-income-adequacy* perceptions versus combined lower response categories is approximately 2.02 ($\approx e^{0.70}$) times greater, assuming other variables are held constant. Similarly, coefficients for the “parents” row - although it is insignificant - imply that when respondents perceive their own income as higher compared to what their parents earned at their age, it is less likely for respondents to view their *self-income-adequacy* as better.

Overall, coefficients of ordered logistic regression measure to what extent a better feeling about respondents’ own income compared to a reference group will lead to a better feeling on their own income *per se*, which reflects the importance of that reference group for respondents to evaluate their income in social comparison. Therefore, these regressions confirm the results in Section 3.1, i.e. the significant role of “colleagues” and the fewest importance of “parents” for income comparison.

Table 5: Regressions on Income Adequacy Perceptions

	<i>Dependent variables: self-income-adequacy perception</i>				
	Log Odds	(SE)	Odds Ratios	(SE)	Brant-test p
Same Occupation Colleagues	0.98***	(0.16)	2.66***	(0.42)	0.39
Neighbors	0.91***	(0.18)	2.48***	(0.46)	0.77
Workplace Colleagues	0.70***	(0.17)	2.02***	(0.34)	0.00***
Partner	0.45***	(0.11)	1.57***	(0.18)	0.14
Friends	0.20	(0.17)	1.22	(0.21)	0.88
Parents	−0.01	(0.10)	0.99	(0.10)	0.94
Obs.				479	
Pseudo R^2				0.31	
χ^2				385.00	59.95
p-value				0.00	0.00

Note: Independent variables: *relative-income-adequacy* perceptions towards six different groups, jointly. Standard errors are in parentheses. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Brant-test $p < 0.05$ provides significant evidence that the parallel regression assumption has been violated, see detailed explanation in Appendix A.4. Source: SOEP-IS 2022.

Based on the divergence in income adequacy perceptions between female and male respon-

dents¹, in Figure 9, we visualize the diverse role of reference groups on the income adequacy perceptions, among all respondents (black dots) and by gender (orange and blue bars). We find that on average, comparison to “same occupation colleagues” has a higher chance of influencing respondents’ *self-income-adequacy* perceptions than “workplace colleagues”. However, male respondents consider the former to be more significant when accessing their own income, whereas comparison to the latter is more important to increase females’ *self-income-adequacy* perceptions. This significant gender disparity could be supported by previous studies such as Bygren (2004) found that women tend to use intra-occupational referents, whereas men instead appear to look more at the national labor market level.

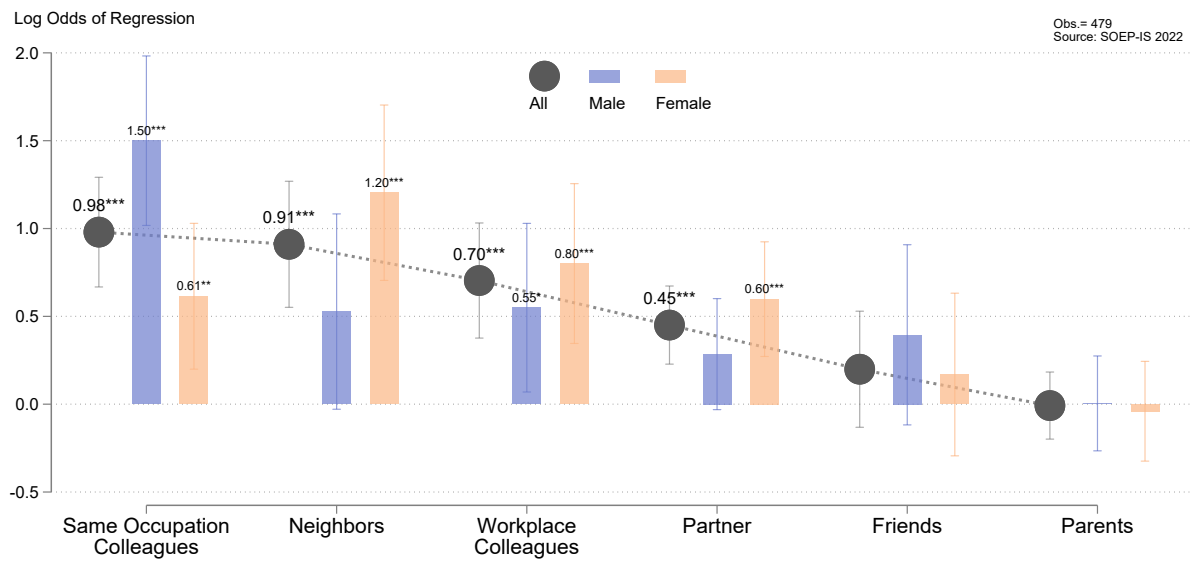


Figure 9: Coefficients of Regressions on Income Adequacy Perceptions

Hypothesis 2: the important reference group has more influence

Subsequently, we test the second hypothesis that suggests respondents are influenced more by reference groups they attribute higher importance to in income comparison. In this part, we perform ordered logistic regression on each reference group separately, taking into account whether respondents assigned high importance to that particular reference group. To be specific, the *self-income-adequacy* variable is regressed on a single *relative-income-adequacy* variable, for all respondents with valid answers, also for respondents who assign this corresponding reference group “most important”, and those who assign it a lower *importance rank*. The explanation is that, since coefficients represent the importance of reference groups, then for each reference group, the endogenous importance (i.e. rank assigned by respondents) should align with the inferred importance (i.e. effect coefficients by regressions), which will be confirmed by a higher

¹ See detailed Figure in Appendix A.3.

coefficient for regression constricting on respondents who indeed think that reference group is important for income comparison.

Our results verify the importance of the most personally chosen reference groups, as displayed in Table 6 and Figure 10. For instance, when considering each reference group separately, a greater estimation coefficient appears in the “most important” column for the majority domains such as “same occupation colleagues”, “neighbors”, “friends”, and “partners”. However, coefficients decrease in the “most important” column for “parents”¹ and “workplace colleagues” domains, and we will delve into this deviation in the next part. Gender difference is similar to that in the last part, shown by dots that represent regressions on the reference group with high importance and departing by gender. Hence, we have significant evidence to confirm that respondents’ *self-income-adequacy* perceptions are particularly influenced by those reference groups they consider to be important.

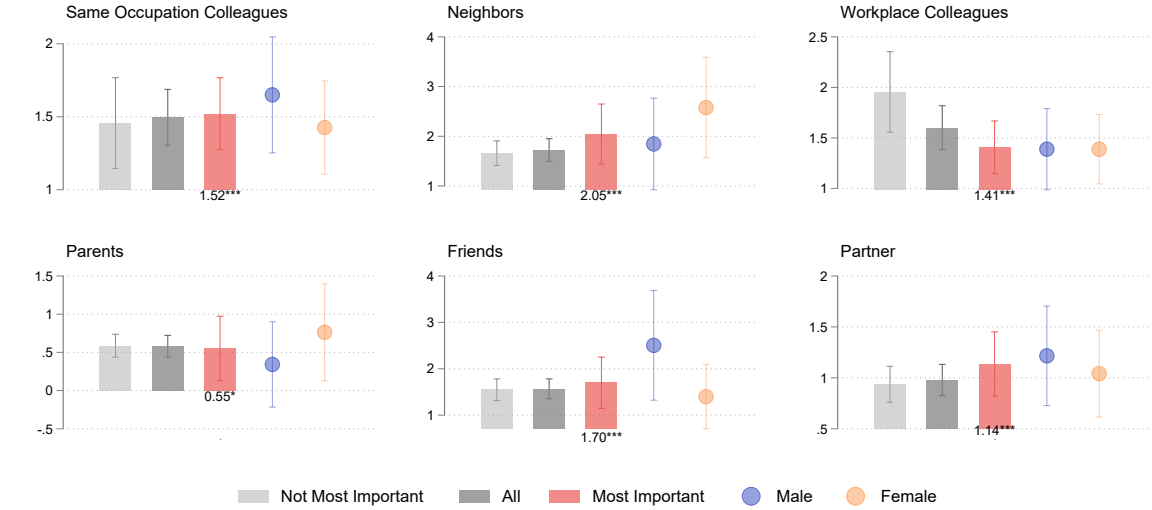
Table 6: Regressions on Income Adequacy Perceptions with Importance Condition

	<i>Dependent variables: self-income-adequacy perception</i>					
	Logistic on: All		Most Important		Not Most Important	
	Log Odds	N (SE)	Log Odds	N (SE)	Log Odds	N (SE)
Same Occupation Colleagues	1.50***	694 (0.10)	1.52***	392 (0.13)	1.46***	302 (0.16)
Neighbors	1.72***	582 (0.12)	2.05***	89 (0.31)	1.66***	493 (0.13)
Workplace Colleagues	1.60***	645 (0.11)	1.41***	387 (0.13)	1.95***	258 (0.20)
Partner	0.98***	636 (0.08)	1.14***	166 (0.16)	0.94***	470 (0.09)
Friends	1.57***	641 (0.11)	1.70***	100 (0.28)	1.55***	541 (0.12)
Parents	0.58***	610 (0.07)	0.55*	72 (0.22)	0.59***	538 (0.08)

Note: Independent variable: *relative-income-adequacy* perceptions towards six different groups, separately. Standard errors are in parentheses. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: SOEP-IS 2022.

Overall, through regressions to test these two hypotheses, we confirm the importance roles of the majority of typical reference groups. Specifically, respondents’ adequacy perceptions

¹The potential reason for “parents” could be the highest average income (4584 Euro/month) for 16 respondents who chose their parents to be their *absolute rank group*, as shown in Table 2. Hence, 16 out of 72 respondents who assign high importance to “parents” have higher *relative-income-adequacy* perceptions while maintaining “reasonable” or lower estimations for *self-income-adequacy*. This leads these two distributions to be less similar, which in turn results in a relatively smaller coefficient.



Source: SOEP-IS 2022

Figure 10: Coefficients of Regressions with Importance Condition

of their own wages are indeed affected by income comparison, especially by the reference groups they personally choose as most important. Besides, the deviation between “workplace colleagues” and “same occupation colleagues” motivates us to further investigate the concrete picture of colleagues as a reference group.

3.3.2 Distinguish Different Roles Between Two Types of Colleagues

Notably, two deviations regarding the colleagues as reference groups appear in regression results: First, when considering all typical reference groups jointly, “same occupation colleagues” has an averagely greater influence on respondents’ income adequacy perceptions; And second, when considering respondents who assign high importance to “colleagues”, the importance role is verified for “same occupation colleagues” but not for “workplace colleagues”, with the coefficient increases for the former domain while decreases for the latter domain. To understand these deviations, in this part, we investigate the influence of colleagues at the workplace, which reveals they have different importance from colleagues with the same occupation in general.

Confirm the importance: failed for workplace colleagues

The SOEP-IS *Income Comparison* module asks respondents to estimate their work earnings relative to those of their two closest contact workplace colleagues¹. First, we utilize these *relative-income-adequacy* perceptions to check the robustness of deviations between these two types of colleagues. We find respondents’ income adequacy perceptions compared to their clos-

¹See questionnaire items (QIS.222) in Appendix.

est contact colleagues exhibit a similar influence pattern as that compared to their workplace colleagues. Specifically, the proportion of respondents who evaluate their income to be “reasonable” adequate compared to that of their closest contact colleagues is the highest (about 67.8%). Furthermore, the decreased coefficients appear as well when we conduct the regressions on respondents who consider “colleagues” important, implying the failure to verify the importance of closest workplace colleagues¹. As shown in Figure 11, we could include respondents’ closest contact colleagues into the “workplace colleagues” domain, with different importance roles from “same occupation colleagues” in income comparison.

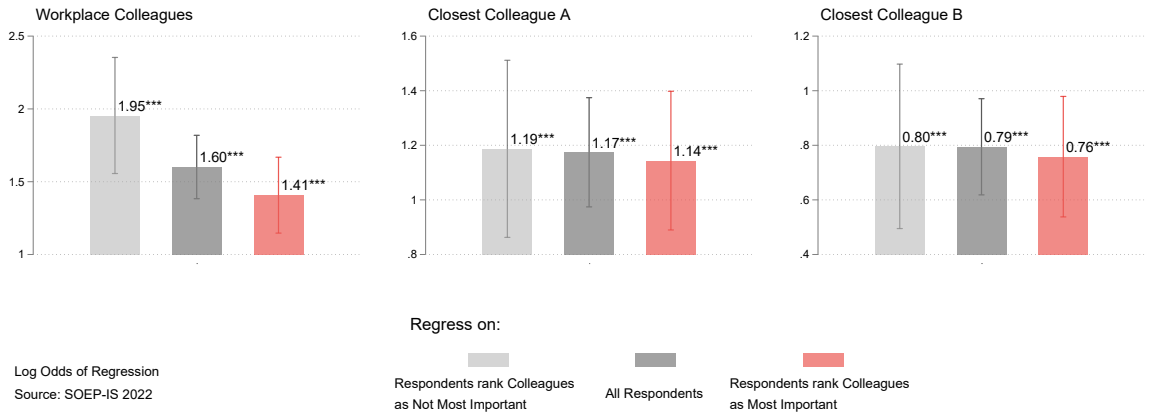


Figure 11: Coefficients of Regressions with Importance Condition on Colleagues

Hence, “workplace colleagues” and “same occupation colleagues” should be treated as different reference groups. Our results reveal that when respondents consider their colleagues to be important in income comparison, the workplace colleagues failed to robust this importance. When respondents evaluate their income compared to colleagues in the workplace to a higher level of adequacy, this will be less likely to reflect on their *self-income adequacy* perceptions and, has a smaller possibility of leading respondents to feel better about their own income.

Evaluate relative income adequacy: overly moderate for workplace colleagues

Delving into the distributions of income adequacy perceptions, we think failed importance confirmation (i.e. the smaller coefficient) is caused by the polarization of the proportions of “reasonable” responses: that ratio is the lowest (around 45%) when respondents access their *self-income-adequacy*, whereas it becomes the highest (around 67%) for *relative-income-adequacy* perceptions when compared to colleagues in the workplace¹. Therefore, we propose two features that will appear in income comparisons with workplace colleagues: people mostly

¹Due to the length of this paper, see the distribution figure and the regression results table for two closest contact workplace colleagues in Appendix A.5.

tend to compare to similar colleagues, then engage in “upwards comparison”; And people have more moderate *relative-income-adequacy* perceptions. These features might explain the proportions of “reasonable” responses.

The data confirmed our congestion. Our analyses of choice patterns of closest contact colleagues have shown that the majority (around 52%) interact with others who work at the same hierarchical level. Besides, more respondents chose their closest colleagues to be those who are at higher professional levels or are their supervisors (around 27%), and the least chose colleagues from lower professional levels (around 21%), e.g., supervised by respondents. Figure 12 displays respondents’ *relative-income-adequacy* perceptions according to their occupational relations with their closest colleagues. Surprisingly, respondents’ “reasonable” perceptions hold a leading position no matter their professional relations with that colleague.

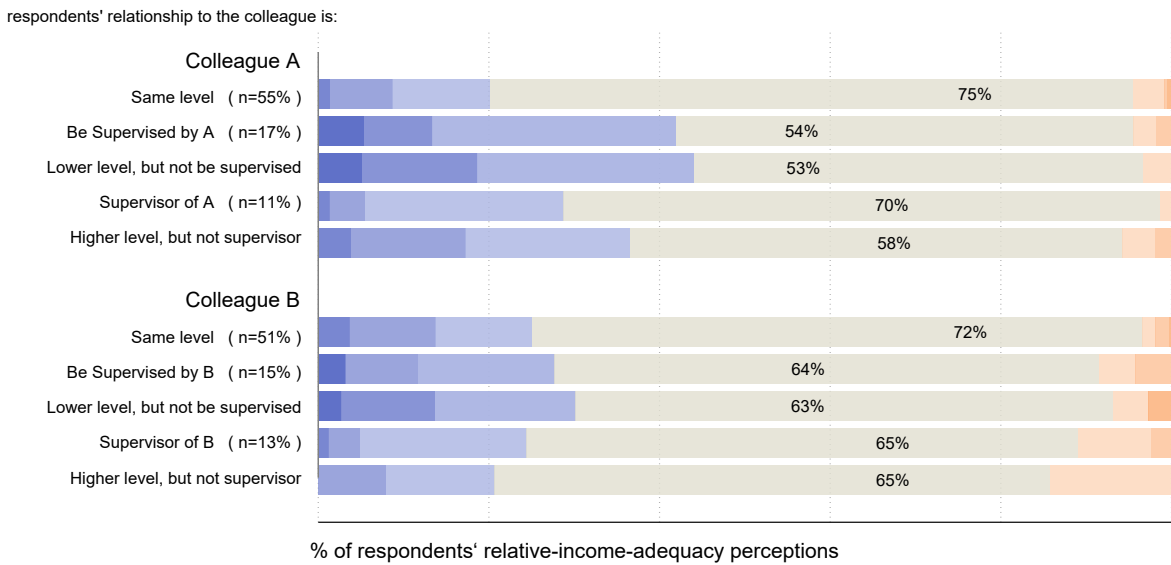


Figure 12: Distributions of *Relative-Income-Adequacy* Perceptions - by Professional Relationship

According to the narrow geographic definition of “workplace”¹ and detailed information of workplace colleagues, we subsequently discuss three potential reasons for the prevailing “reasonable” responses. First, due to the closer geographic proximity and frequent daily interactions with these workplace colleagues, respondents might be more inclined to consider their own income are reasonably adequate compared to those colleagues. This might generally happen in “downwards comparison”, although the logic behind their behavior may be a spontaneous aversion to inequality due to fairness, or a forced pro-sociality due to self-image. Second, motivated

¹As defined in the questionnaire, the context “workplace” specifically refers to the place respondents are working at located at one address. For example, in the context of a retailer with several stores and a main office, all stores and the main office are considered to be different workplaces. The definition of “workplace” confines respondents into the situation of comparing to colleagues whom they closely work with.

by the signal effect that higher wages of coworkers may be a promising prospect for their own future, respondents may justify their income as “reasonable”. This may especially happen in “upwards comparison” when respondents want self-protection. Third, instead of being in a position to select a strategy, respondents may also be forced to respond “reasonable” subjected to misinformation. Respondents may have misconceptions about their colleagues’ wages, especially underestimating the incomes of their high-level colleagues and overestimating that of lower-level colleagues.

Some studies support our above discussions. For instance, Clark and Senik (2010) and Gøerke and Pannenberg (2015) found income comparisons are mostly upward. Regarding information friction, Fehr et al. (2022) and Hvidberg et al. (2020) found misperceptions is universal and center-biased: whereby people with higher income overestimate others’ incomes and the reverse is true for people with lower income. Cullen and Perez-Truglia (2022) and Kiatpongsan and Norton (2014) calculated that in firms, employees have significant misperceptions about their managers’ wages and underestimate actual wage gaps.

4 Conclusion

By analyzing the German representative data from SOEP-IS *Income Comparison* module, this paper delves into the formation patterns of multiple reference groups from an endogenous perspective, with a focus on the importance of colleagues in the context of income comparison.

One of our main contributions is exploring personally assigned importance patterns on multiple reference groups. The results reveal that colleagues consistently emerge as a significant reference group, while parents contribute the least importance. Variations in these importance patterns exist, with colleagues especially taking precedence in income comparison among the 25-45 age group or white-collar workers. Another contribution of this paper is the accurate depiction of personal convergence choice patterns on closest contact colleagues. The results demonstrate that people are inclined to interact with coworkers who have similar characteristics (e.g., gender, age, seniority, or education).

Moreover, through the investigation into the income adequacy perception, we clarify differences between the two types of colleagues as a reference group. Colleagues in the same occupation have more average influence than colleagues in the same workplace. Gender disparity exists, with males being more influenced by “same occupation colleagues”, while “workplace colleagues” hold greater significance for females. We discuss the potential reasons such as aversion to inequality, self-protection, or misperceptions of the wage gap.

Based on the confirmatory analysis of the different importance between two types of colleagues, as well as the discussion on the misconceptions of workplace colleagues’ wages, further research can develop in two directions. First, to examine the high ratio of “reasonable” responses to *relative-income-adequacy* perceptions, link the SOEP-IS *Income Comparison* module with administrative data, and document how well individuals are informed about their position in the establishment. Second, to examine the low ratio of “reasonable” responses to *self-income-adequacy* perceptions, link the SOEP-IS *Income Comparison* module with previous SOEP panel modules. Since individuals’ income perception might be subject to the individual’s own situation in the past (McBride, 2001), the reference standards in income comparison may be others at the same time, or it may be yourself at a different time.

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A Appendices

A.1 English Questionnaire

Reference Groups segment

Income Comparison module

SOEP-IS-2022

If you are currently not employed, and the last year you were employed is 2022, 2021, or 2020:

QIS.216 What did you earn from your last work within the last two years?

If you are currently employed:

QIS.217 What did you earn from your work last month?

Please state the gross income, which means income before the deduction of taxes and social security. If you received extra income such as vacation pay or back pay, please do not include this. Please do include overtime pay. If you are self-employed: Please estimate your monthly income before taxes.

QIS.218 Thinking about how well one is paid, it can also be relevant to compare to other individual's job earnings. If you think about your own gross job earnings compared to other groups: **How important is it for you to compare your own gross job earnings to ...**

Note that in this context "workplace" specifically refers to the place you are working at located at one specific address. For example, in the context of a retailer with several stores and a main office, all stores and the main office are considered to be different workplaces. If you are currently unemployed, please think back to your last employment. Please answer using the following scale. The value 1 means: completely unimportant. The value 7 means: extremely important. You can use the values between 1 and 7 to grade your opinion.

	1 (completely unimportant)	2	3	4	5	6	7 (extremely important)	-1 Can not/Prefer not to answer
your neighbors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your colleagues at your workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your parents when they were of your age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your partner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

QIS.219 How do your gross job earnings compare to individuals of the following groups? In comparison to ...

If you are uncertain about the job earnings of any of those groups, please give your best estimate.

	1 much lower	2 a little lower	3 about the same	4 a little higher	5 much higher	-1 Can not/Prefer not to answer
your neighbors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your colleagues at your workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your parents when they were of your age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your partner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

QIS.220 In general: How appropriate do you think your income from employment is? For this comparison, please think of your gross income from employment last month.

	1 much too low	2 too low	3 a little too low	4 rea- sonable	5 a little too high	6 too high	7 much too high	-1 Can not/Prefer not to answer
my income from em- ployment is	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

QIS.221 And how appropriate do you think are your own job earnings compared to the job earnings of the following groups? In comparison to ...

	1 much too low	2 too low	3 a little too low	4 rea- sonable	5 a little too high	6 too high	7 much too high	-1 Can not/Prefer not to answer
your neighbors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your colleagues at your workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
individuals with the same occupation in general	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your parents when they were of your age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
your partner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

QIS.215 How many employees work in the company where you work/worked last? Do not count yourself.

If you don't know the exact answer, please give your best guess. Note that in this context "workplace" specifically refers to the place you are working at located at one specific address. For example, in the context of a retailer with several stores and a main office, all stores and the main office are considered to be different workplaces. If you are currently unemployed, please think back to your last employment.

If you have more than one employee working in the company where you work/worked, please answer questions to Person A:

If you have more than two employees working in the company where you work/worked, please answer questions to Person A and Person B:

QIS.222 Now we have some questions about the colleagues at your workplace: **Please think about [x], with whom you have the most contact at your workplace.** This can include contact at work as well as contact outside the workplace. If you are currently unemployed, please think back to your last employment. We ask you to provide some information for each of your two closest colleagues. To make it easier for you, please first note down the first name of each of them.

What gender do you identify [x]?	Male	Female	Other gender not listed here	Can not/Prefer not to answer
Person A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What age [x] is?	16-24	25-35	36-45	46-55	55+	Can not/Prefer not to answer
Person A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How long has [x] been employed in the company?	0-2 years	2-5 years	5-10 years	10-20 years	20+ years	Can not/Prefer not to answer
Person A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Does [x] perform the same professional activity as you?	Yes	No	Can not/Prefer not to answer
Person A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What is the highest educational level of [x]?	Person A	Person B
1 Left school without graduating	<input type="checkbox"/>	<input type="checkbox"/>
2 Lower track (Volksschule / Hauptschule / 8th grade GDR)	<input type="checkbox"/>	<input type="checkbox"/>
3 Intermediate track (Realschule / Mittlere Reife / 10th grade GDR)	<input type="checkbox"/>	<input type="checkbox"/>
4 Vocational school (Fachoberschule)	<input type="checkbox"/>	<input type="checkbox"/>
5 Upper track (Abitur / Hochschulreife)	<input type="checkbox"/>	<input type="checkbox"/>
6 Other school-leaving certificate	<input type="checkbox"/>	<input type="checkbox"/>
7 Apprenticeship (Lehre), Vocational degree as skilled worker (Facharbeiter- abschluss)	<input type="checkbox"/>	<input type="checkbox"/>
8 Full-time vocational school (Berufsfachschule), commercial college (Han- delsschule), Health sector school (Schule des Gesundheitswesens)	<input type="checkbox"/>	<input type="checkbox"/>
9 Higher level trade or technical school (e.g. Meisterschule, Technikerschule)	<input type="checkbox"/>	<input type="checkbox"/>
10 Training for civil servants (Beamtenausbildung)	<input type="checkbox"/>	<input type="checkbox"/>
11 Technical or professionally oriented college (Fachhochschule, Beruf- sakademie; formerly also engineer or teacher training)	<input type="checkbox"/>	<input type="checkbox"/>
12 University or university-level degree	<input type="checkbox"/>	<input type="checkbox"/>
13 Doctoral studies (Promotion)	<input type="checkbox"/>	<input type="checkbox"/>
14 Other degree	<input type="checkbox"/>	<input type="checkbox"/>
-1 Can not / Prefer not to answer	<input type="checkbox"/>	<input type="checkbox"/>

What is your professional relationship with [x]?	Person A	Person B
I am the supervisor of [x]	<input type="checkbox"/>	<input type="checkbox"/>
[x] works at a lower hierarchical level, but I am not their supervisor	<input type="checkbox"/>	<input type="checkbox"/>
[x] and I work at the same hierarchical level	<input type="checkbox"/>	<input type="checkbox"/>
[x] is not my supervisor, but works at a higher hierarchical level	<input type="checkbox"/>	<input type="checkbox"/>
[x] is my supervisor	<input type="checkbox"/>	<input type="checkbox"/>
Can not / Prefer not to answer	<input type="checkbox"/>	<input type="checkbox"/>

What do you estimate is the gross monthly earnings of [x]?

Please indicate the gross earnings, that is, wages or salary before deduction of taxes and social security.

Person A : _____

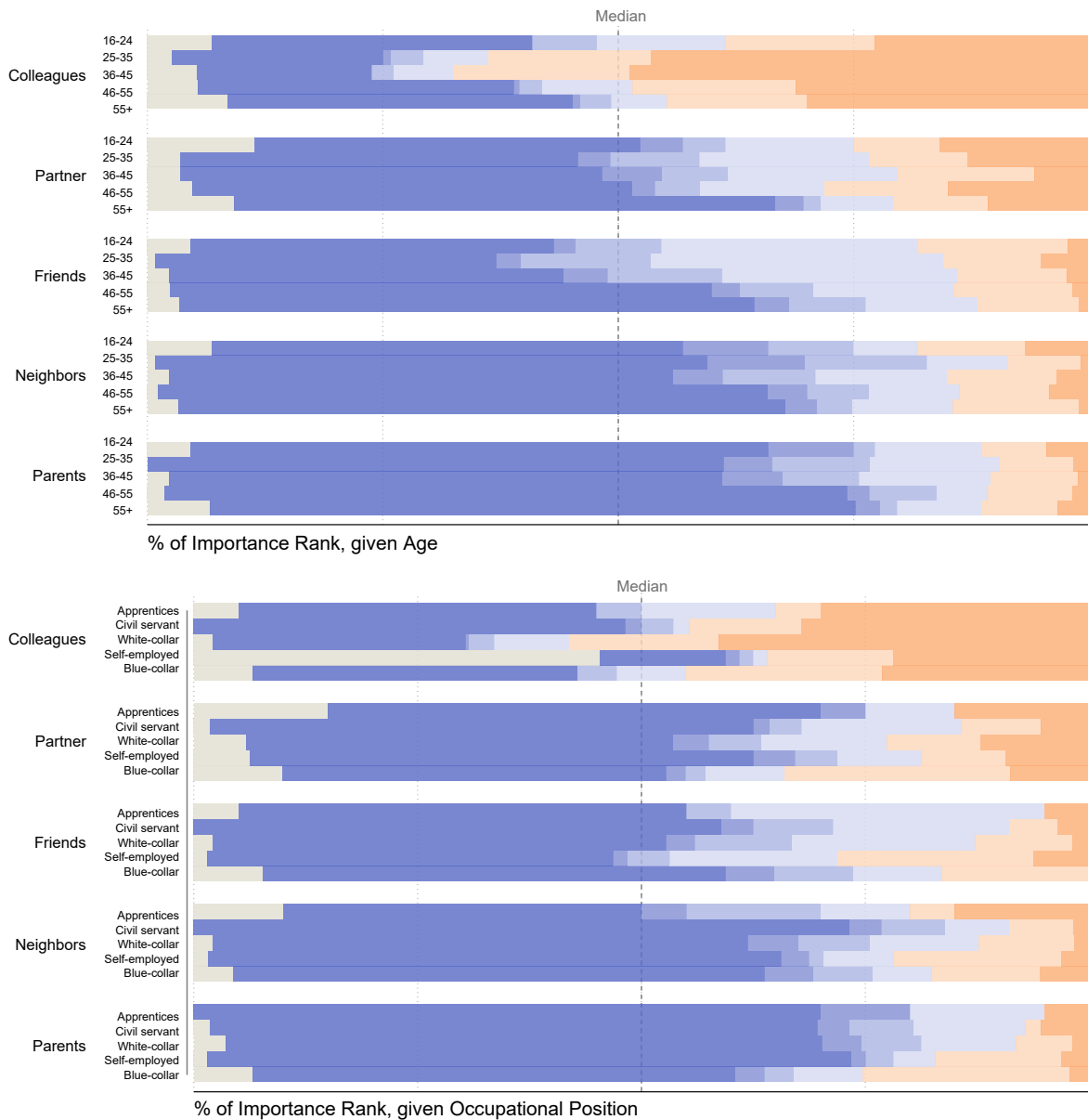
Person B : _____

How do you estimate your own work earnings relative to those of [x]?

	1 much too low	2 too low	3 a little too low	4 rea- sonable	5 a little too high	6 too high	7 much too high	-1 Can not/Prefer not to answer
Person A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Person B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

A.2 Distributions of *importance rank*

Here we display distributions of *importance rank* by respondents' age and professional position, as discussed in Section 3.1.



A.3 Distributions of income adequacy perceptions

Here we display distributions of income adequacy perceptions by respondents' demographics, as discussed in Section 3.3.

First, we statistically test whether distributions differ among respondents with different demographics. As the p-values of χ^2 for the Kruskal-Wallis test in Table 19 indicate, there is no significant evidence to reject the null hypothesis, suggesting that respondents' income adequacy

perceptions are similarly distributed among the five age groups for all listed domains. However, significant results for gender and occupational positions indicate that at least one sample group in these characteristics stochastically dominates others.

Table 19: Test on Income Adequacy Perceptions over Demographics

	Gender	Age	Occupational Position	N
<i>Kruskal–Wallis test</i>				
Self-income Adequacy	0.00**	0.07	0.01*	759
Same Occupation Colleagues	0.05*	0.39	0.00***	695
Neighbors	0.00**	0.72	0.00**	582
Workplace Colleagues	0.01**	0.64	0.01**	645
Friends	0.00***	0.19	0.00**	641
Partner	0.00***	0.38	0.00***	638
Parents	0.01**	0.29	0.03*	610

Note: Values in table are p-values of χ^2 with ties. $p < 0.05$ to reject that there is no stochastic dominance between the sample groups from the column variable. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Source: SOEP-IS 2022.

Then, we visualize the distributions across two genders and five status groups. Notably, females are more likely to evaluate their own income as lower adequacy when compared to different groups, especially in comparison to the “partner”. In terms of professional positions, civil servants or public administration employees tend to have higher income adequacy perceptions across all domains. These results align with the objective diversity in average gross income.

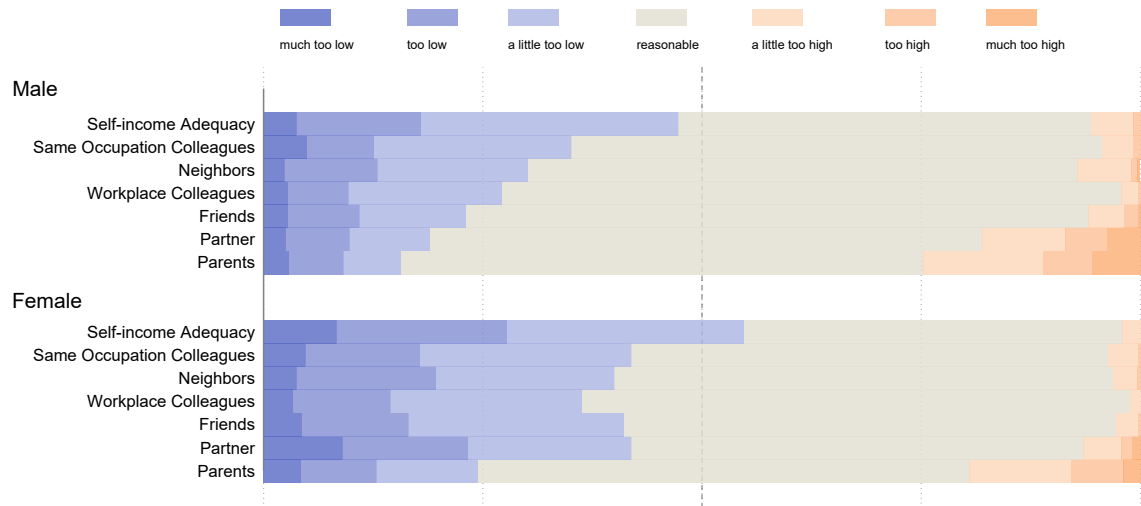
A.4 Brant test of ordered logistic regressions

Here we explain the Brant test for regressions, as shown in Table 5.

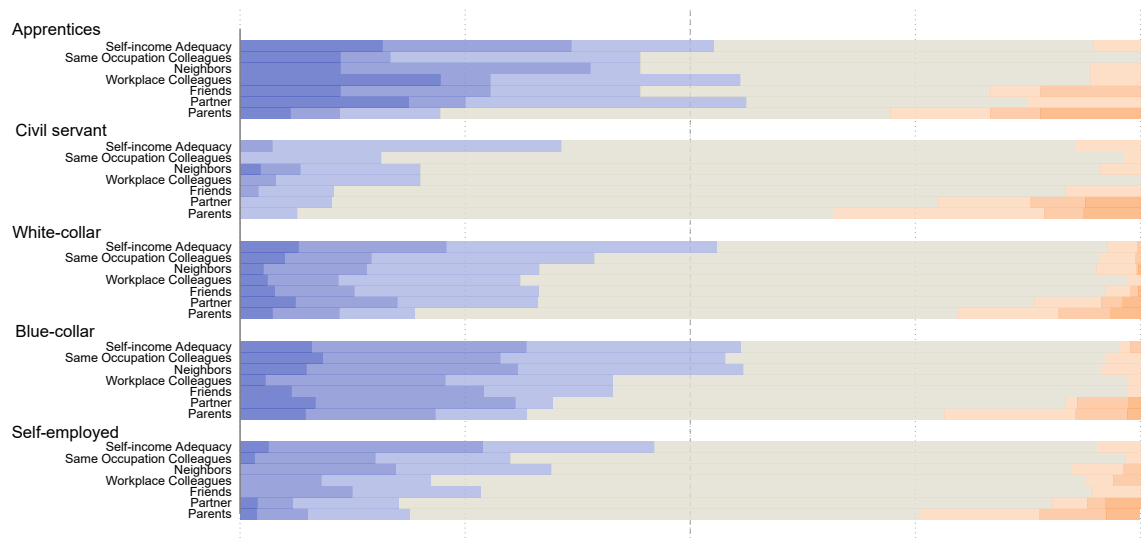
It’s critical to be aware of the parallel regression assumption underlying the ordered logistic model when interpreting the estimate parameters. This assumption posits that the relationships between each pair of alternative groups in the dependent variable are the same. For instance, the coefficients that describe the relationship between “much too low” versus all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories, etc. Hence, there is only one set of coefficients.

We conduct the Brant test and display the results in the “Brant-test p” column to assess this assumption. The significant overall χ^2 value rejects the null hypothesis that there is no difference in the coefficients between alternative groups of the self-income fairness perception. Examining the details of the Brant tests for each independent variable, we find that all parallel regression assumptions hold, with p-values greater than 0.05, except for the workplace

Source: SOEP-IS 2022



% distributions of income adequacy perceptions - by Gender



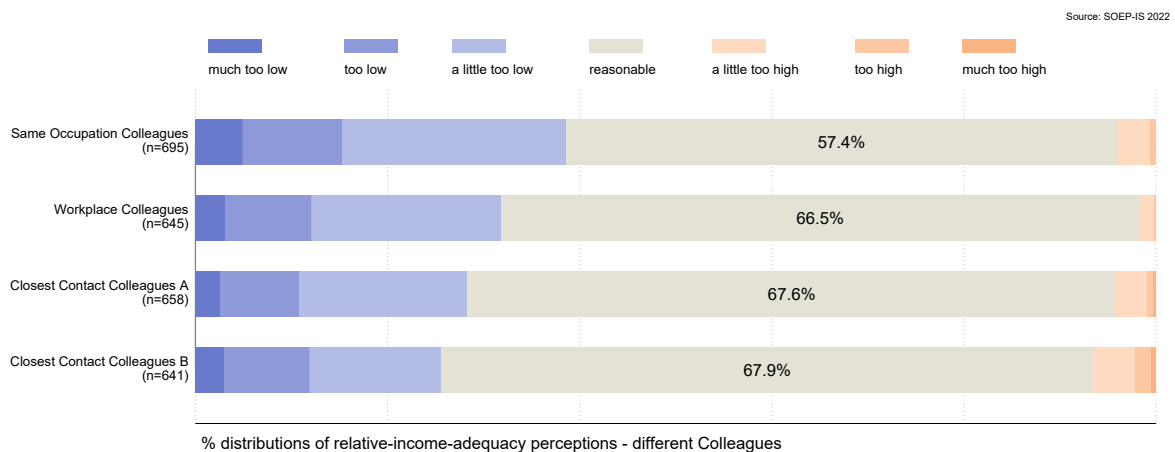
% distributions of income adequacy perceptions - by Occupational Position

colleagues domain. While this single significant result leads to the overall significance in rejecting the parallel regression assumption for this module, it is not uncommon to find at least one variable that violates the assumption, especially with a relatively large dataset in this study (Williams, 2018). Hence, it's evident for the confirmation of the first hypothesis that the existence of reference groups indeed influences how respondents feel about their income adequacy.

A.5 *relative-income-adequacy* perceptions towards closest workplace colleagues

Here we display the analysis of income adequacy perceptions focusing on respondents' two closest contact workplace colleagues, as discussed in Section 3.3.

First, we display percentage distributions of *relative-income-adequacy* perceptions for four types of “colleagues”. We find the majority of respondents regard their own job earnings as “reasonable” compared to colleagues, and even more “reasonable” proportions concerning closest contact workplace colleagues workplace.



Then, we utilize perceptions data that directly compared to two closest workplace colleagues, to process with the ordered logistic regressions. Results in the table reveal that closest colleagues exhibit a similar influence pattern as the workplace colleagues. We visualize regression results shown in Figure 11.

To be specific, when respondent attributes high importance rank to their colleagues as the reference group, their *relative-income-adequacy* perceptions compared to workplace colleagues will be less similar distributed to their *self-income-adequacy* perceptions, which is mostly due to more “reasonable” responses. This pattern is reflected by the lower log odds in the “most important” column for three workplace colleagues lines. Hence we can include these two per-

Table 20: Regressions on Income Adequacy Perceptions with Importance Condition on Colleagues

	<i>Dependent variables: Self-income adequacy perception</i>					
	Logistic on: All		Most Important		Not Most Important	
	Log Odds	N (SE)	Log Odds	N (SE)	Log Odds	N (SE)
Workplace Colleagues	1.60***	645 (0.11)	1.41***	387 (0.13)	1.95***	258 (0.20)
Closest Colleague A	1.17***	656 (0.10)	1.14***	383 (0.13)	1.19***	273 (0.17)
Closest Colleague B	0.79***	639 (0.09)	0.76***	371 (0.11)	0.80***	268 (0.15)

Note: Standard errors are in parentheses. Significant level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Independent variable: *relative-income-adequacy* perceptions compared to different workplace colleagues separately. Source: SOEP-IS 2022.

sonally chosen colleagues into the domain as workplace colleagues, and analyze the different roles between colleagues in the same occupation and colleagues in the workplace.