Determinants and Consequences of Non-Standard Preferences

by

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Abstract

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This dissertation studies the determinants and consequences of standard, and in particular, non-standard economic preferences. Preferences are the primitives of choice theories in economics. An active body of research investigates the heterogeneity and determinants of economic preferences and their consequences for decision-making. In three chapters, this dissertation studies different aspects of this topic both theoretically and empirically. Chapter 1 *Preferences over Relative Income within the Household* investigates the existence of non-standard, immaterial preferences over relative income within the household. In intuitive terms, preferences over relative income capture the notion that individual partners have a preference over their share of total household income independently of the level of total household income. For instance, such preferences include inequality aversion or a preference for being the primary earner. The chapter documents the existence of preferences over relative income, quantifies their extent and documents heterogeneity by gender. The chapter also investigates the consequences of these preferences for household decision making and socio-economic gender inequality. Chapter 2 *Relationship of Gender Differences in Preferences to Economic Development and Gender Equality* empirically investigates cross-cultural variation of gender differences in several standard and non-standard economic preferences. The chapter investigates the role of economic development and gender equality in shaping gender differences in preferences across countries. Chapter 3 *Longevity and Patience* investigates the role of longevity in driving patience across countries and individuals. The chapter documents empirical evidence for the long-standing hypothesis that higher longevity fosters patience. In addition, the chapter explores theoretically the consequences of a positive link between longevity and patience for the emergence of development traps.

The first chapter *Preferences over Relative Income within the Household* tests for the existence and quantitative extent of non-standard, immaterial preferences over relative income within the household and analyzes their consequences for the matching of couples and family outcomes. This chapter presents a theoretical model and empirical evidence from administrative German tax data and furthermore documents results from an online experiment.[1] First, to guide the empirical

[1] The model and evidence from tax data have been developed in joint work with Nikolaus Hildebrand (Hermle and Hildebrand, 2020).

analysis, the chapter outlines a marriage market matching model in which prospective partners can hold non-standard preferences over relative income, such as inequality aversion or a preference or aversion for being the primary earner. The model yields testable predictions for the presence and structural form of partners' preferences over relative income either as a kink or notch at the point of equality in the relative income distribution of households, i.e. the distribution of the female share in total household income. The predictions are tested for the case of Germany using administrative tax data. The data indicates a kink at the 50%-threshold in the relative income distribution which indicates the presence of kinked preferences over relative income. To disentangle the preferences of women and men, a survey experiment is conducted and analyzed. The results indicate that women exhibit inequality aversion while men show a preference for being the primary earner. Finally, the chapter explores the consequences of non-standard preferences over relative income on further family outcomes such as divorce and household public good provision.

The second chapter *Relationship of Gender Differences in Preferences to Economic Development and Gender Equality* investigates the role of economic development and gender equality in driving gender differences in standard and non-standard economic preferences.[2] The chapter first lays out two contrasting hypotheses that make opposing predictions about the relationship of gender differences in preferences to economic development and gender equality. According to the Social Role Hypothesis, higher economic development and gender equality promote a dissolution of traditional gender roles, leading to a narrowing of gender differences in preferences. In contrast, according to the Resource Hypothesis, higher economic development and gender equality yields greater availability of material and social resources to both women and men and facilitates the independent development and expression of gender-specific preferences, ultimately leading to an expansion of gender differences. These hypotheses are tested using 76 representative country samples of validated measures of six preferences, including willingness to take risks, patience, positive reciprocity, negative reciprocity, altruism, and trust. The analysis shows that gender differences in preferences are positively associated with both economic development and gender equality, confirming the predictions of the Resource Hypothesis. The findings point toward the critical role of availability of and equal access to material and social resources for both women and men in facilitating the independent formation and expression of gender-specific preferences across countries.

The third chapter *Longevity and Patience* provides an empirical test of the long-standing and influential hypothesis stating that greater longevity fosters higher patience.[3] The chapter tests this hypothesis using data on an experimentally validated survey measure of patience in 76 representative country samples in conjunction with life table measures of longevity that vary across country-age-gender cells. The empirical framework analyzes the longevity-patience link in an econometric design that is akin to a difference-in-difference specification isolating the effect of longevity from age-, country-, and gender-specific confounders. The empirical results document that higher longevity is associated with higher patience: a ten-year increase in life expectancy is associated with a 5-percentage point increase in the discount factor. This relationship remains ro-

[2]The chapter includes material from a study joint with Armin Falk and published in *Science* (Falk and Hermle, 2018).

[3]The chapter includes material that has been developed in joint work with Armin Falk and Uwe Sunde (Falk et al., 2020).

bust for different proxies of life expectancy, for various sub-samples, when applying instrumental variable estimations, and when conditioning on lifetime experiences related to economic development, institutional quality, or violence. Finally, the chapter analyzes the longevity-patience link in a theoretical framework that demonstrates the consequences for the emergence of development traps due to a vicious cycle of high mortality, low patience, and low human capital investments.

To my parents Claudia and Elmar

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Finally, I would like to thank my parents Claudia and Elmar for their support and advice throughout my life. This dissertation is dedicated to them, the two best and fun teachers I have had.

Chapter 1

Preferences over Relative Income within the Household

1.1 Introduction

Individuals care about their income relative to others (Clark et al., 2008). Whether a worker is satisfied with her wage will depend on the wages her peers receive (Dube et al., 2019; Card et al., 2012; Cullen and Perez-Truglia, 2018). Whether an individual enjoys living in a particular neighborhood will depend on how her income compares to her neighbors (Luttmer, 2005; Perez-Truglia, 2019).

This study takes the notion of relative income concerns to the household by investigating the existence and form of preferences over relative income between partners. The motives for relative income concerns within the household are ambigious. For instance, individuals may prefer to earn a similar amount to their partner, implying inequality aversion. Alternatively, they may seek to earn more than their partner, reflecting a preference for being the primary earner.

Understanding the existence and form of non-material preferences over partners' relative income has important theoretical and empirical implications. In standard economic models of marriage and the household, partner selection and household decision-making is driven by material considerations (Becker, 1973, 1974; Chiappori, 1992). By assumption, preferences over relative income do not exist. If in reality they do exist, however, they will affect the selection, decision-making, and separation of couples.

In a seminal study, Bertrand et al. (2015) provide a first evidence on the existence of preferences over relative income by means of the relative income distribution - the distribution of the share earned by wives in total household income. They document a pronounced drop at the 50% threshold, a finding that has been interpreted as an artifact of a male breadwinner norm, i.e. couples' or individual spouses' preference for a male primary earner. In a reanalysis of the same data, however, Binder and Lam (2018) find no evidence for such a discontinuity rendering the existence of such preferences unclear.

Identifying preferences over relative income involves two key challenges: first, a researcher is

in need of a model that yields clear and testable predictions regarding the impact of preferences over relative income on observable marriage market outcomes. Second, to test the model predictions one requires large data on marriage outcomes that allow high-powered identification. In this study, we overcome these challenges both theoretically and empirically.

To guide our empirical analysis, we provide a flexible framework of preferences over relative income. Following the notion of a male breadwinner norm implicit in the findings of Bertrand et al. (2015), we start by considering preferences over relative income that feature a discrete jump (notch) at the point of earnings equality. This model feature allows individual spouses to obtain discrete utility from their status as either the primary or secondary earner (Zuo and Tang, 2000). This utility formulation, however, rules out a wide class of alternative motives such as inequality aversion.

To generalize our framework, we build upon the canonical models of Tversky and Kahneman (1991) and Fehr and Schmidt (1999) and introduce piece-wise linear utility functions over relative income that feature a kink at the point of income equality. The kink captures that marginal utilities from relative income will differ when being the primary as opposed to the secondary earner. This flexible framework allows us to distinguish between different classes of relative income preferences that have been discussed in sociology and psychology. For instance, following the sociological concept of homophily (McPherson et al., 2001), individuals might exhibit inequality aversion in income. Alternatively, our framework allows for a preference for or aversion against being the primary earner potentially stemming from gender-specific social roles (Eagly and Wood, 1999; West and Zimmerman, 1987).

We introduce these non-standard preferences in a marriage market matching model with search frictions to obtain empirically testable predictions for the selection and separation of couples as well as household public good provision. The main result of our model shows that the presence and structural form of preferences over relative income are identifiable from aggregate marriage outcomes. While mating preferences are generally unidentified from the global distribution of marriage outcomes (Binder and Lam, 2018), our model makes locally testable predictions for the structural form of the relative income distribution. In the absence of preferences over relative income, the relative income distribution is globally smooth. Their presence, however, produces a non-smoothness at the 50% threshold, the point where wives earn more than their husbands. In the case of a kink in preferences, the relative income distribution features a (concave) kink at the 50% threshold, while in the case of a notch, there will be a negative discontinuity.

We demonstrate that the structural distinction between a kink or notch in utility has important welfare consequences. In our model, preferences over relative income act equivalent to a tax on the opposite gender's income in terms of marriage market prospects. The incidence of this tax crucially depends on the structural form of these preferences as either a kink or notch in utility. For illustration, consider the situation where men hold a preference for being the primary earner. In the case of a kink, the negative impact on marriage rates (and welfare from marriage) due to a one-unit increase in income is increasing in a women's income as each additional unit of income negatively affects *all* potential matches in which the male is the secondary earner. Hence, in the case of a kink in utility, the norm operates as a *progressive* tax affecting high earning women the most. In contrast, in the case of a notch in utility each additional unit of income only affects those

matches where the woman out-earns the potential husband due to exactly this marginal increase in income. Hence, men's preferences operate as a *proportional* tax on women's income.

Using our main model prediction, we test for the presence and structural form of preferences over relative income for the case of Germany using large administrative income tax data. There are two key benefits from using Germany as a testing ground for our model. First, the German income tax system features income tax splitting for married couples, hence providing no incentive to distort relative income shares. Second, relative to prior evidence by Bertrand et al. (2015), the number of observations in our sample is more than an order of magnitude larger. This allows us to depict the relative income distribution in granular detail to uncover a potential non-smoothness at the 50% threshold, and to test for the structural distinction between a kink and a discontinuity.

Our main result shows a substantial and statistically significant concave kink at the 50% threshold of the relative income distribution. Importantly, we do not find any discontinuity. This evidence indicates the presence of preferences over relative income in form of a kink in utility. We rule out alternative explanations such as assortative matching or tax manipulation. We furthermore test for cultural variation by using the division and reunification of Germany as a natural experiment (Alesina and Fuchs-Schündeln, 2007). We demonstrate that the kink in the relative income distribution is much more pronounced in the rather conservative West Germany relative to the formerly communist and more gender-equal East Germany.

As a further model test we investigate spouses' household public good provision as a function of their relative income share. In our model, the provision of housework can serve as a compensation for partners' utility loss stemming from relative income concerns. As a consequence, patterns of household public good provision are suggestive of which side of the marriage market bears the incidence of relative income concerns. In particular, in the presence of a preference for being the primary earner among men, our model predicts that women will provide more public goods to the household when out-earning their husbands. Empirically, we find for the more conservative West Germany that women provide higher amounts of household public goods if they out-earn their husbands suggesting the existence of a preference for being the primary earner among man. In the more progressive East Germany such a pattern is absent.[1]

The observational data, however, is not enough to cleanly separate and quantify women's and men's preferences. To address this challenge, we design and implement a survey experiment in the United States and Germany that allows us to separately identify and quantify women's and men's preferences. Using two distinct methodologies we elicit preferences over relative income either through qualitative survey questions or quantitative choice questions. While the qualitative items are intuitive and easy to understand, the quantitative choice items allow us to identify preferences over relative income from hypothetical revealed choice. Moreover, these choice items facilitate the

[1] In our model, we also study the theoretical impact of preferences over relative income on the separation of couples. Intuitively, in the presence of relative income concerns, the separation rates will be higher for compositions of relative income that are disliked by their partners. As an empirically testable prediction, preferences over relative income produce, depending on their structural form, a non-smoothness as either a kink or notch in the separation rate at the income equality between partners. Our model, hence, provides a rationalization of empirically observed kink points in separations rates found in the Netherlands (Kalmijn et al., 2007), Canada (Bertrand et al., 2013), and Finland Zinovyeva and Tverdostup (2018).

quantification of the strength of relative income preferences in monetary terms by investigating the marginal rates of substitution between own relative income and total household income.

Our findings from the experimental evidence are threefold. First, both men and women hold kinked preferences over relative income confirming the evidence from the observational data. Second, women exhibit symmetric inequality aversion. In quantitative terms, women are willing to forego 3% to 4% in total household income for a 10%-point increase in their relative income share when being the secondary earner. Vice versa, women are willing to forego 3% to 4% in total household income for a 10%-point decrease in their relative income share when being the primary earner. Third, men in contrast exhibit a preference for being the breadwinner. Men are on average willing to forego 4% -5% in total household income for a 10%-point increase in their relative income share when being the secondary earner. However, men are not willing to trade off total household income and relative income when being the primary earner. These patterns are qualitatively and quantitatively stable across Germany and the United States as well as independent of the experimental methodology.

We contribute to different strands of the literature. First and most broadly, we contribute to the literature studying relative income preferences (Easterlin, 1974; Clark et al., 2008; Clark and Senik, 2010). Several studies provide field evidence for the existence of such preferences at the workplace (Dube et al., 2019; Card et al., 2012; Cullen and Perez-Truglia, 2018) and within neighborhoods (Luttmer, 2005; Perez-Truglia, 2019).[2] We add to this literature by providing, to the best of our knowledge, the first comprehensive evidence on the existence and form of preferences over relative income within the household.[3] Moreover, we study how these preferences affect economic behavior by investigating the consequences of preferences over relative income for the selection, separation, and family outcomes of couples.

Second and more specifically, we add to the literature studying the connection between gender identity and marital outcomes. Following the landmark study by Bertrand et al. (2015), several studies have assessed the existence of a male breadwinner norm by testing for a discontinuity at the 50% threshold in the relative income distribution. We provide an overview of these studies in Table 1.1. While Bertrand et al. (2015) document a negative discontinuity in US data, Binder and Lam (2018) find no evidence for the existence of such discontinuity. In the more gender-egalitarian countries, Sweden and Finland, Hederos and Stenberg (2019) and Zinovyeva and Tverdostup (2018) find evidence for a discontinuity among co-working spouses but no such evidence for the remainder of the population. They also document patterns of earnings compression among spouses which might be a result of individual income taxation in these countries that incentivizes couples to distort their income to a 50%-50% split. Finally, using survey data Doumbia and Goussé (2019) and Sprengholz et al. (2019) document a negative discontinuity for Canada and Germany,

[2]Moreover, preferences over relative income have been found to affect individuals' economic decision making, such as for job separation (Rege and Solli, 2013) and residence choice (Bottan and Perez-Truglia, 2017).

[3]By eliciting preferences over relative income within the household we also relate to the literature measuring distributional preferences (Cooper and Kagel, 2016). Most studies investigating distributional preferences study a setting where subjects decide about a distribution of outcomes between themselves and an unknown other party (Charness and Rabin, 2002; Engelmann and Strobel, 2004; Fisman et al., 2015, 2007). We add to this literature by providing evidence on distributional preferences within the household, a setting where the other party, the partner, is well known.

respectively. The mixed evidence in this literature might be a result of the different countries studied and data used. Most importantly, however, none of the existing papers provided a model of preferences over relative income that yields testable predictions. In particular, as we show in our model under the plausible case of preferences over relative income being kinked, the relative income distribution will feature a kink and no discontiniuity at the 50% threshold. Through our model guided analysis we find no existence for a jump in the relative income distribution but document the existence of a kink point, a feature none of the prior studies tested for.[4]

Third, we contribute to the understanding of non-standard utility (Fehr and Schmidt, 1999; Tversky and Kahneman, 1991) in matching models. Relative to standard applications in which agents optimize on a domain over which they hold kinked or notched utility, we study the role of such non-standard utility in matching models with search frictions. Whereas kinked utility leads to bunching in models with behavioral responses, in matching models it yields kink points in the resulting distribution function. By theoretically studying the consequences of non-standard preferences over relative income for marriage outcomes, we specifically contribute to the theoretical literature on marriage markets (Becker, 1973, 1974; Choo and Siow, 2006; Shimer and Smith, 2000; Chiappori et al., 2009, 2012, 2017, 2018; Goussé et al., 2017; Bertrand et al., 2016). Our theoretical results might be applicable in other matching markets where kinked utility has been studied empirically, such as the housing (Genesove and Mayer, 2001) and labor market (Eliaz and Spiegler, 2014).

Finally, by documenting that preferences over relative income within the household differ substantially between women and men, we also add to the literature studying gender differences in preferences (Croson and Gneezy, 2009; Bertand, 2011). In contrast to existing literature that finds gender differences in social domains to either be small or insignificant (Niederle, 2016), we provide evidence that preferences over relative income differ between women and men not only in their quantitative magnitudes but also in their qualitative form: women show symmetric inequality aversion, while men exhibit a preference for being the breadwinner.[5]

This study proceeds as follows. In section 1.2, we present a framework of preferences over relative income within the household and introduce it in a marriage market matching model with search frictions. Section 1.3 tests the model predictions for the case of Germany providing observational evidence on existence and form of preferences over relative income. Section 1.4 provides evidence from a survey experiment to disentangle and quantify women's and men's preferences. We conclude in section 1.5.

[4]Furthermore, two related studies analyze gender norms in survey misreporting for the US (Murray-Close and Heggeness, 2018) and Switzerland (Roth and Slotwinski, 2018). Both studies find that households deflate women's earnings in survey responses if the male partner is the secondary earner. Our finding of a sharp kink in the distribution or relative income relies on administrative tax data and is also present for third-party reported labor income where no misreporting is feasible.

[5]By documenting that the qualitative and quantitative nature of these gender differences is stable between two distinct countries, the United States and Germany, we also add to the literature studying the variability of gender differences in preferences across countries and cultures (Gneezy et al., 2009; Falk and Hermle, 2018).

1.2 Model

To theoretically study how preferences over relative income affect marriage market outcomes of women and men, we provide a matching model of the marriage market. First, we outline a flexible framework of preferences over relative income that captures various motives. Thereafter, we provide the assumptions of our model. To gain intuition, we then study a one-period marriage market matching model similarly to Bertrand et al. (2016). Thereafter, we provide the full model in an infinite-horizon, continuous time setting with search frictions in the spirit of Shimer and Smith (2000); Goussé et al. (2017).

Preferences and Setup

What preferences do individuals hold over relative income within the household? Denote by y^{o} an individual's own income and by y^{p} their partner's income such that relative income is given by $y^{\text{o}} - y^{\text{p}}$. We denote by $\eta(y^{\text{o}}, y^{\text{p}})$ the non-material utility individuals obtain from relative income concerns. If individuals only hold purely material considerations $\eta(y^{\text{o}}, y^{\text{p}}) = 0$ as visualized in Figure 1.1, Panel A.

Notched Preferences over Relative Income: Following the notions implicit in the findings of Bertrand et al. (2015), we start by considering a framework in which individual spouses receive a discrete utility from their status as either the primary or secondary earner.[6] In this case, preferences over relative income can be captured by

$$\eta(y^{\text{o}}, y^{\text{p}}) = \beta_{\text{ahead}} \cdot I(y^{\text{o}} \geq y^{\text{p}}).$$

Here, β_{ahead} determines the discrete utility associated with being the primary earner. If $\beta_{\text{ahead}} > 0$, an individual exhibits a preference for being the primary earner, if $\beta_{\text{ahead}} < 0$ she holds a preference for being the secondary earner. Alternatively and equivalently to including $\beta_{\text{ahead}} \cdot I(y^{\text{o}} \geq y^{\text{p}})$ in the utility specification, we could incorporate a term $\beta_{\text{behind}} \cdot I(y^{\text{o}} \leq y^{\text{p}})$ which captures a preference for or aversion against being the secondary earner instead. For illustration, Figure 1.1, Panel B visualizes notched preferences for being the primary earner.

Kinked Preferences over Relative Income: A substantial shortcoming of the preference formulation featuring discontinuous notches is the inability to capture that marginal utilities from relative income might differ when being the primary as opposed to the secondary earner. As a consequence, this utility formulation rules out a wide class of potential motives.

We therefore consider a framework using a more flexible formulation building upon the canonical models by Charness and Rabin (2002) and Fehr and Schmidt (1999). In particular, we consider preferences over relative income as a piecewise linear function:

[6] Non-standard preferences in form of notches have been discussed in applications where individuals obtain utility from achieving a specific goal, see e.g. Allen et al. (2016) and Diecidue and Van De Ven (2008).

$$\eta(y^{\mathrm{o}}, y^{\mathrm{p}}) = \alpha_{behind} \cdot (y^{\mathrm{o}} - y^{\mathrm{p}}) \cdot I(y^{\mathrm{p}} > y^{\mathrm{o}}) + \alpha_{ahead} \cdot (y^{\mathrm{o}} - y^{\mathrm{p}}) \cdot I(y^{\mathrm{o}} \geq y^{\mathrm{p}}).$$

Here, α_{behind} and α_{ahead} represent the marginal utilities obtained from a one-unit increase in relative income when being ahead or behind in income relative to the partner. The difference in marginal utilities captures that concerns over relative income will depend on whether the individual is the primary or secondary earner. Holding total household income $y^{\mathrm{o}} + y^{\mathrm{p}}$ constant, the utility formulation captures several plausible cases of preferences over relative income.

First, individuals might have an aversion against inequality in incomes if $\alpha_{behind} > 0$ and $\alpha_{ahead} < 0$ (Figure 1.1, Panels C and D). A substantial body of literature in Economics argues that in various settings individuals dislike unequal economic outcomes (Fehr and Schmidt, 1999). Work in sociology and psychology emphasizes that such inequality aversion impacts mate selection: individuals will prefer a partner who is similar in economic status to themselves, a phenomenon labeled homophily (McPherson et al., 2001). Our utility formulation captures this preference by a sign reversal in marginal utility from relative income at the point where both partners earn the same. Intuitively, if an individual is the secondary earner, she will prefer a higher relative income. In contrast, if she is the primary earner, she will prefer a lower relative income. Inequality aversion may either be symmetric (Panel C) or asymmetric (Panel D). Symmetric inequality aversion arises if $|\alpha_{behind}| = |\alpha_{ahead}|$, implying that positive and negative deviations from income equality are disvalued at the same rate. Asymmetric inequality aversion arises if $|\alpha_{behind}| > |\alpha_{ahead}|$ implying that positive deviations from earnings inequality are disvalued less than negative ones.

Second, individuals might have a preference for being the primary earner which is the case if $\alpha_{behind} > \alpha_{ahead} \geq 0$. Under this condition, individuals receive higher marginal utility from increases in relative income when being the secondary earner as opposed to the primary earner, as visualized in Figure 1.1, Panel E. A preference for being the primary primary earner can stem from status utility. As highlighted by research in social psychology the prevalence of this preference might fundamentally differ by gender (Eagly and Wood, 1999). If the breadwinner status is perceived as a male characteristic, men will internalize a stronger preference to be the primary earner.[7]

Third, individuals might have a preference for being the secondary earner which is the case if $\alpha_{ahead} < \alpha_{behind} \leq 0$. Intuitively, increases in relative income are disvalued higher at the margin when being ahead relative to being behind in earnings (Figure 1.1, Panel F). This specification captures individuals' aversion against being the primary earner in the couple. Similarly to a preference for being the primary earner, a preference for being the secondary earner might be internalized as a result of the external social structure. Work in sociology highlights that individuals adapt their preferences according to their gender. As a result, a preference for being the secondary earner may thus be more prevalent among women, if the breadwinner role conflicts with the externally prescribed gender stereotype (West and Zimmerman, 1987).

[7] Fisman et al. (2006) provide empirical support for this hypothesis in a speed dating experiment. They find that men hold kinked preferences over women's personality traits that are relevant for their earnings ability. In particular, men prefer women who are more ambitious and intelligent. However, if men are outperformed in these traits by the potential female partner, they value these traits negatively at the margin.

Marriage Market Model Setup: How do preferences over relative income impact the selection of married couples? We study the impact of these preferences in a marriage market matching model. Each individual k has a job yielding income y^k and material consumption utility $c^k(y^k)$. Hence, the utility when being single is equal to $u_s^k = c^k(y^k)$. In the following, denote male types by m and female types by f. When a male individual m marries a female individual f, utility changes in three regards relative to being single.

First, the individual receives utility from an idiosyncratic, taste shock q_{mf} distributed according to a continuously differentiable distribution Φ_m. The taste shock captures the (subjective) quality of the match. Second, he receives utility from partner f's income. Here, we consider two motives. On one hand, individual m obtains a material benefit from spousal income y^f. We incorporate this feature in the consumption utility function $c_m^m(y^m, y^f)$. On the other hand, individual m receives utility from non-material preferences over relative income captured by $\eta^m(y^f, y^m)$. Third, m receives a non-monetary intra-household transfer $t \lesseqgtr 0$. The utility considerations for a female individual f marrying a male m are analogous.

Hence, the utility for a couple (m, f) when being married equals:

$$\begin{aligned} u_m^m(f) &= c^m(y^m, y^f) + \eta^m(y^f, y^m) + t + q_{mf} \\ u_m^f(m) &= c^f(y^f, y^m) + \eta^f(y^m, y^f) - t + q_{fm} \end{aligned}$$

where $q_{mf} \perp q_{fm}$ and t denotes the net-transfer from the wife to the husband.

Simple one-period model

To gain intuition on how preferences over relative income affect marriage outcomes, we first consider a simple one-period model with transferrable utility.[8] In this setting, individuals enter the marriage market being single and are matched with an individual of opposite gender. If they decide to marry, a marriage match is formed, otherwise both stay single.

Marriage Probabilities and Selection: To understand the impact of preferences over relative income on marriage selection, we construct the marriage probabilities for a given pair (m, f). Under transferrable utility, the couple (m, f) decides to marry iff $u_m^m(f) + u_m^f(m) \geq u_s^m + u_s^f$.

Hence, the marriage probability equals

[8] We study a model with non-transferrable utility in Appendix 1.6, showing that all predictions derived in the following remain unchanged.

$$
\begin{aligned}
P_{mf}(\Delta y) &= \Phi\Big(C + \bar{\alpha}_{m\ ahead} \cdot \Delta y \cdot I(\Delta y < 0) + \bar{\alpha}_{m\ behind} \cdot \Delta y \cdot I(\Delta y \geq 0) + \bar{\beta}_{m\ behind} \cdot I(\Delta y \geq 0)\Big), \\
&\text{where} \\
\Delta y &= y^f - y^m \text{ are the female's relative earnings} \\
C &= c^m(y^m, y^f) + c^f(y^f, y^m) - c^m(y^m) - c^f(y^f) \text{ is the material benefit from marriage} \\
\bar{\alpha}_{m\ ahead} &= \alpha^f_{behind} - \alpha^m_{ahead} \\
\bar{\alpha}_{m\ behind} &= \alpha^f_{ahead} - \alpha^m_{behind} \\
\bar{\beta}_{m\ behind} &= \beta^f_{ahead} + \beta^m_{behind} \\
\Phi &\text{ is the distribution function of } -q = -(q_{mf} + q_{f_m}).
\end{aligned}
$$

The parameters $\bar{\alpha}_{m\ ahead}$, $\bar{\alpha}_{m\ behind}$, and $\bar{\beta}_{m\ behind}$ govern the couple's aggregate preference over the female's relative earnings. For instance, $\bar{\alpha}_{m\ ahead}$ determines the couple's marginal utility from a one-unit increase in the wife's relative income for the case where the husband is the primary earner. This statistic is given as the average of the wife's marginal utility from an increase in her relative earnings (α^f_{behind}) plus the husband's marginal disutility from a one-unit decrease in his relative income ($-\alpha^m_{ahead}$). Similarly, $\bar{\alpha}_{m\ behind}$ governs the couples marginal utility from a one-unit increase in the wife's relative income in case the husband is the secondary earner. Finally, $\bar{\beta}_{m\ behind}$ determines the couple's average discrete utility from the wife being the primary earner.

Mating preferences are generally hard to recover from the global distribution of marriage outcomes (Binder and Lam, 2018). Therefore, we derive locally testable predictions for the impact of preferences over relative income on marriage selection by investigating the functional form of the marriage probability at the point of equal earnings $\Delta y = 0$. For simplicity, we assume that the consumption utility functions are equal for women and men and linear such that changes in relative income do not affect the aggregate material benefits from marriage.[9] In our exposition we distinguish between preferences over relative income as either a kink or a notch in utility.

Preferences over relative income as a notch in utility: First, we note that for $\bar{\beta}_{m\ behind} \neq 0$, that is preferences over relative income feature a discontinuity at income equality, it follows that $\lim_{\Delta y \to 0^+} P_{mf}(\Delta y) \neq \lim_{\Delta y \to 0^-} P_{mf}(\Delta y)$. Hence, the marriage probability features a discrete jump at the point of equality in incomes $y^f = y^m$. The direction and magnitude of the jump depends on the relative size of the partner's preferences. For instance, if men obtain discrete disutility from being the secondary earner while women do not have a preference over relative income, the marriage probability will feature a negative jump at $\Delta y = y^f - y^m = 0$.

Preferences over relative income as a kink in utility: If preferences over relative income feature a kink instead of a notch, $\lim_{\Delta y \to 0^+} P_{mf}(\Delta y) = \lim_{\Delta y \to 0^-} P_{mf}(\Delta y)$. Hence, there will be no jump in the *level* of the marriage probability at $\Delta y = 0$. However, in the presence of kinked preferences

[9] Our qualitative results hold if we assume any gender-specific continuously differentiable consumption utility function.

over relative income, the *slope* of the marriage probability will feature a discontinuity. To see this, we note that if $\bar{\beta}_{m\ behind} = 0$

$$\frac{dP_{mf}}{d\Delta y} = \begin{cases} \bar{\alpha}_{m\ ahead}\phi(C + \bar{\alpha}_{m\ ahead} \cdot \Delta y) & \text{if } \Delta y < 0 \\ \bar{\alpha}_{m\ behind}\phi(C + \bar{\alpha}_{m\ behind} \cdot \Delta y) & \text{if } \Delta y \geq 0, \end{cases} \tag{1.1}$$

where ϕ is the density function associated with Φ. Hence, we obtain a kink point in the marriage probability at $\Delta y = 0$ if $\bar{\alpha}_{m\ ahead} \neq \bar{\alpha}_{m\ behind}$. Whether this kink is convex or concave, depends on the relative size of $\bar{\alpha}_{m\ ahead}$ and $\bar{\alpha}_{m\ behind}$. We note, however, that the kink has to be concave if the partners possess any combination of inequality aversion, a preference for being the primary earner or a preference for being the primary earner.

Figure 1.2 visualizes the marriage probabilities as a function of women's relative income for different combinations of the individual preferences. Panel A shows the case where both women and men exhibit inequality aversion. Panel B and C visualize the cases where men have a kinked preference for being the primary earner or women have a kinked preference for being the secondary earner respectively. Finally, Panel D visualizes the case where men have a notched preference for being the primary earner.

Relative Income Distribution: Knowledge of the marriage probability conditional on relative income would facilitate a local test for the existence and structural form of preferences over relative income. However, marriage probabilities for a given combination of female and male types are unobservable objects. Hence, to obtain predictions that are empirically testable, we use the previous results to study the impact of preferences over relative income on the distribution of relative income. Intuitively, applying Bayes' Rule, the kink (notch) in the marriage probability conditional on relative income implies a kink (notch) in the distribution of relative income conditional on being married. This leads our first main result:

Result 1: *(a) If preferences over relative income feature a notch at equality of incomes, the relative income distribution will feature a jump at the point where wives out-earn their husbands.*
(b) If preferences over relative income feature a kink at equality of incomes, the relative income distribution features a kink at the point where wives out-earn their husbands.

In Appendix 1.6 we provide a formal proof. Figure 1.3 visualizes the relative income distribution for log-normally distributed incomes and an example set of model parameters under different assumptions on preferences over relative income. The blue distributions depict simulated relative income distributions, the gray distributions counterfactual distributions obtained from random matching of couples.

Panel A assumes that both women and men exhibit symmetric inequality aversion. Intuitively, we obtain a concave kink point at the 50% threshold of the relative income distribution. Furthermore, there is an excess mass of couples around the 50% threshold relative to the counterfactual distribution assuming random matching of couples. Panel B shows the relative income distribution for the case in which men hold a kinked preference for being the primary earner while women

have no concerns over relative income. We obtain a kink point in the relative income distribution at the 50% threshold and a missing mass of couples with a female primary earner. Panel C depicts the relative income distribution for the opposite case in which women hold a kinked aversion against being the primary earner while men have no concerns over relative income. Again, we obtain a kink point in the relative income distribution at the 50% threshold and a missing mass of couples with a female primary earner. The comparison of Panels A, B and C reveal that different combinations of partners' preferences over relative income can produce similar functional forms of the relative income distribution at the 50% threshold. In particular, Panels B and C provide identical relative income distributions even though they are determined by distinct preferences of the partners. Hence, observing a kink point in the relative income distribution at the 50% threshold is indicative of the presence of partners' preferences, but does not identify the gender-specific parameterization of the underlying preferences. However, the functional form of the relative income distribution at the 50% threshold is indicative of the structural form of preferences over relative income as either a kink or notch. This is underscored by Panel D which shows the relative income distribution for a notched preference of husbands for being the primary earner. Instead of a kink at the 50% threshold we observe a discrete jump.

In sum, the structural form of the relative income distribution at the 50% is indicative of the structural form of preferences over relative income. If the relative income distribution is smooth, there is no direct evidence of the existence of preferences over relative income. If it instead exhibits a kink (notch), this feature is indicative of kinked (notched) preferences over relative income. However, observing an unsmoothness does not allow for a direct parametrization of gender-specific preference parameters.

Transfers and Household Public Good Provision: Next, we study how preferences over relative income affect non-monetary intra-household transfers. In our empirical application we consider the provision of housework as an intra-household transfer as it imposes costs to the provider and yields benefits to the receiver.

Following Goussé et al. (2017), we posit that intra-household transfers for a married couple (m, f) are given as the solution to the Nash bargaining problem:

$$\max_t (u_m^m(f) - u_s^m)^\gamma (u_m^f(m) - u_s^f)^{1-\gamma},$$

where γ is the husband's bargaining weight. This yields the solution:

$$\begin{aligned} t &= \Big[\tilde{C} + (\gamma\alpha^f_{behind} + (1-\gamma)\alpha^m_{ahead})\Delta y I(\Delta y \leq 0) \\ &\quad + (\gamma\alpha^f_{ahead} + (1-\gamma)\alpha^m_{behind})\Delta y I(\Delta y \geq 0) + (\gamma\beta^f_{ahead} - (1-\gamma)\beta^m_{behind})I(\Delta y \geq 0)\Big], \end{aligned}$$

where

$$\begin{aligned} \tilde{C} &= \gamma(c^f(y^f, y^m) - c^f(y^f)) - (1-\gamma)(c^m(y^m, y^f) - c^m(y^m)), \\ &\quad \text{the bargaining weight-adjusted difference in material benefits from marriage.} \end{aligned}$$

Several observations about this equation are noteworthy. Consider the case where the bargaining weights of women and men are equal. In this case, if women's and men' preferences over (women's) relative income are aligned, i.e. $\alpha^f_{behind} = -\alpha^m_{ahead}$, $\alpha^f_{ahead} = -\alpha^m_{behind}$, $\beta^f_{ahead} = \beta^m_{behind}$ relative income concerns do not impact intra-household transfers. This is visualized in Panel A of Figure 1.4, where both spouses exhibit inequality aversion of the same magnitude.

If preferences over relative income are kinked and unaligned, this will lead to a kink point in intra-household transfers at the point of equality in income. We visualize one example in Panel B where we assume that the husband has a preference for being the primary earner while the wife has no preference over relative income. In this case, we obtain that intra-household transfers feature a convex kink at the point where the wife out-earns her husband. Intuitively, the husband requires a compensation for the disutility associated with being the secondary earner. Panel C visualizes the opposite case in which the husband has no preferences over relative income but the wife has an aversion against being the primary earner. In this case, intra-household transfers feature a concave kink at the point where the wife out-earns her husband. Here, the opposite logic applies: the wife requires a compensation for the disutility associated with being the primary earner. In sum, while in both cases the observed relative income distributions are identical (see Figure 1.3, Panels B and C), patterns of intra-household transfers differ. In particular, the direction of the flow of transfers indicates whether women or men bear the incidence of preferences over relative income. Finally, Panel D visualizes intra-household transfers for the case in which the husband has a notched preference for being the primary earner. Intuitively, we observe that the net transfer from wives to husbands features a positive jump at the point of equality. Hence, patterns of intra-household transfers are indicative of the structural form of preferences.

In sum, the observation of intra-household transfers facilitates the separation of preferences over relative income along two margins. First, the functional form of intra-household transfers at the point of equality in incomes distinguishes between kinked and notched preferences. Second, patterns of intra-household transfers can be suggestive of which side of the marriage market bears the incidence of relative income preferences. We summarize these predictions in our next result:

Result 2: *(a) If spouses' preferences over relative income are aligned and bargaining weights equal, preferences over relative income will not affect intra-household transfers.*
(b) Unaligned kinked preferences over relative income introduce a kink point in intra-household transfers at the point of equal incomes.
(c) Unaligned notched preferences over relative income introduce a discontinuity in intra-household transfers at the point of equal incomes.
In both cases, the direction of transfers is indicative of which side of the marriage market bears the incidence of preferences over relative income.

Divorce: Finally, we investigate the impact of preferences over relative income on divorce which arises when the taste shock gets updated. For illustration, suppose that after marriage each individual lives for an additional period but a spouse's taste shocks gets updated with probability π. Individuals then decide whether to stay in the match or file for divorce which occurs if

$u_m^m(f) + u_m^f(m) < u_s^m + u_s^f$. Note that given an updated taste shock, a divorce occurs in period t+1 with probability $1 - P_{mf}$

Hence, for a given combination of male income y and the female relative income share $k \in [0,1]$, the divorce probability equals:

$$Div(y,k) = \frac{\pi(1-P_{mf})P_{mf}m_m(y^m = y)m_f(y^f = \frac{1-k}{k}y)}{P_{mf}m_m(y^m = y)m_f(y^f = \frac{1-k}{k}y)} = \pi(1-P_{mf}),$$

where $m_m(\cdot)$ and $m_f(\cdot)$ denote the type distributions of male and female types. Therefore,

$$\frac{dDiv(y,k)}{dk} = -\pi\frac{dP_{mf}}{dk}.$$

Using the previous results on marriage rates, we formulate our third result.

Result 3: *(a) If preferences over relative income feature a kink at equality of incomes, the divorce probability features a kink at the point where wives out-earn their husbands.*
(b) If preferences over relative income feature a notch at equality of incomes, the divorce probability will feature a jump at the point where wives out-earn their husbands.

Figure 1.5 visualizes divorce probabilities for different combinations of partners' preferences. Panel A shows divorce probabilities for the case where both partners feature symmetric inequality aversion. The divorce probability features a kinked V-shaped pattern reaching its minimum at the point of equal earnings. A similar structural form of the divorce probability is reported for the gender-egalitarian Finland by Zinovyeva and Tverdostup (2018) who find that divorce probabilities are lowest for couples with similar levels of incomes. Panels B and C show the divorce probabilities for couples in which the husband has a kinked preference to be the primary earner (Panel B) or similarly the wife has a kinked preference for being the secondary earner (Panel C). In both cases, divorce probabilities are stable until the point of equal earnings but increase in a kinked fashion for higher relative income of wives. Empirically, such a pattern has been observed for Canada (Bertrand et al., 2013) as well as the Netherlands (Kalmijn et al., 2007). A standard explanation for this empirical pattern involves women's economic independence and higher outside options on the marriage market when being the primary earner. Our model instead is able to predict these patterns as a result of couples' preferences over relative income. For instance, if husbands are averse against a female primary earner, this will increase the instability of the match. In line with this channel, Bertrand et al. (2015) find that couples with a female breadwinner report lower marriage satisfaction. Finally, Panel D shows the divorce probability for the case in which men exhibit a preference for being the primary earner in form of a notch. In this case, we intuitively observe a positive jump in the divorce probability at the point of equality in incomes. Hence, in addition to the structural form of the relative income distribution as well as intra-household transfers, the structural form of divorce probabilities can be indicative of the presence and structural form of preferences over relative income.

Marriage Rates and Welfare: The structural form of preferences over relative income as either a kink or a notch in utility has important consequences for marriage rates and welfare. We study the welfare consequences under simplifying assumptions in a non-transferrable utility framework in Appendix 1.6. Intuitively, preferences over relative income - independently of their structural form - act equivalently to a tax on the opposite gender's earnings in form of negative impacts on marriage prospects and resulting welfare losses. In the Appendix, we demonstrate that the structural distinction between modeling these preferences as either a kink or a notch in utility has important consequences for the incidence of this tax.

For illustration, we discuss the situation in which women hold no concerns over relative income while men exhibit a preference for being the breadwinner. In Figure 1.6, we visualize the welfare consequences of this preference for women as a function of their income decile and different assumption on the model parameters. In the case of a kink (Panel A), the negative impact on marriage rates (and welfare from marriage) due to a one-unit increase in income is increasing in a woman's income. This results from the fact that each additional unit of income negatively affects *all* potential matches where the male would be the secondary earner. Hence, in the case of a kink in utility, the norm operates as a *progressive* tax affecting high earning women the most. In contrast, in the case of a notch (Panel B) each additional unit of income only affects those matches where the woman out-earns the potential husband due to exactly this marginal increase in income. As a consequence, the marginal impact of an increase in a woman's income is proportional to the density of potential husbands at the same level of income. In this case, the norm operates as a *proportional* tax on women's income.

Full model in continuous time and infinite-horizon

Next, we provide the full model with search frictions in a continuous time and infinite horizon setting in the spirit of Shimer and Smith (2000) and Goussé et al. (2017). We retain the basic assumptions of the simple one-period model. We further assume that only singles search for a partner, thus ruling out search for an alternative spouse during marriage. Let λ be the poisson rate at which individuals meet, s be the exogenous dissolution rate of marriages (divorce), and r be the discount rate. In terms of notation, let $m_m(\cdot)$ and $m_f(\cdot)$ be the distribution functions of male and female types with associated income distribution functions $f_m(y) = \int_{m:\ y_m=y} m_m(m)dm$ and $f_f(y) = \int_{f:\ y_f=y} m_f(f)df$. Furthermore, $m^s_m(\cdot)$ and $m^s_f(\cdot)$ denote the distribution of single male and female types with associated income distribution functions $f^s_m(y)$ and $f^s_f(y)$. Furthermore, $m(\cdot,\cdot)$ denotes the distribution of married couples with joint income distribution $f(y_m, y_f)$. The total number of married couples is denoted by $M = \iint m(m,f)dmdf = \iint f(y_m,y_f)dy_m dy_f$.

Bellman equations, search equilibrium, and stationary distribution: We first determine the Bellman equations. Consider a male individual m. The present value of being single has to equal the flow utility plus the option value of engaging in a marriage,

$$rV_s(m) = u_s(m) + \lambda \iiint I_{mfq}[V_m(mfq) - V_s(m)]m^s_f(f)dj\phi(q_{mf})\phi(q_{fm})dq_{mf}dq_{fm},$$

where $V_s(m)$ denotes the value of being single, $V_m(mfq)$ the value of being married to an individual f conditional on taste shocks $q = (q_{mf}, q_{fm})$, and I_{mfq} an indicator for a match being formed between m and f conditional on q. Suppose now individual f meets individual m. From m's perspective, the present value of accepting the match has to equal the flow utility from marriage net of divorce,

$$rV_m(mfq) = u_m(mfq) + s(V_s(m) - V_m(mfq)).$$

Subject to intra-household transfers, both individuals will accept the match iff the total utility from being married exceeds the total utility from being single or iff $V_m(mfq) + V_m(fmq) \geq V_s(m) + V_s(f)$, implying $c^m(y^m, y^f) + c^m(y^f, y^m) + \eta^m(y^f, y^m) + \eta^f(y^m, y^f) + q \geq r(V_s(m) + V_s(f))$. As a consequence, the marriage probability is given by:

$$P_{mf} = 1 - \Phi\left(r(V_s(m) + V_s(f)) - c^m(y^m, y^f) - c^m(y^f, y^m) - \eta^m(y^f, y^m) - \eta^f(y^m, y^f)\right).$$

The resulting flow into marriage $m^{flow}(m, f)$ equals

$$m^{flow}(m, f) = \lambda P_{mf} m_m^s(m) m_f^s(f).$$

In the steady state, outflows and inflows into marriage must balance out. Thus the stationary distribution is pinned down by

$$\lambda m_m^s(m) m_f^s(f) \cdot P_{mf} = sm(m, f).$$

Relative income distribution: Similarly to the one-period case, if preferences over relative income feature a kink at equality of incomes, the relative income distribution features a kink at the 50% threshold. Analogously, if preferences over relative income feature a notch, the relative income distribution will feature a discontinuous jump at the 50% threshold. To see this, we translate the stationary income distribution into the relative income distribution $f_{rel}(\frac{y_f}{y_m + y_f} = k)$,

$$\begin{aligned} f_{rel}(k) &= \frac{1}{M} \iint_{\{f: \frac{y_f}{y_m + y_f} = k\}} m(m, f) df dm = \frac{\lambda}{sM} \iint_{\{j: \frac{y_f}{y_m + y_f} = k\}} P_{mf} m_m^s(m) m_f^s(f) df dm \\ &= \frac{\lambda}{sM} \int P_{mf} m_m^s(y^m = y) m_f^s(y^f = \tilde{k} y) dy, \end{aligned}$$

where we denote $\tilde{k} = \frac{k}{1-k}$. By the Leibniz Rule

$$\frac{d}{dk} f_{rel}(k) = \frac{\lambda}{sM} \int m_m^s(y^m = y) \cdot \left\{ m_f^s(y^f = \tilde{k} y) \frac{d}{dk} P_{mf} + P_{mf} \frac{d}{dk} m_f^s(y^f = \tilde{k} y) \right\} dy.$$

Note that $m_f^s(y^f)$ is smooth for all y^f and $\frac{k}{1-k}$ is smooth $\forall k \in [0, 1)$. Similarly to the one-period case, note that in the case of notched preferences $\lim_{\Delta y \to 0^+} P_{mf} \neq \lim_{\Delta y \to 0^+} P_{mf}$. Hence, the relative income distribution features a jump at the 50% threshold. Furthermore, in the case of kinked preferences $\lim_{\Delta y \to 0^+} \frac{dP_{mf}}{d\Delta y} \neq \lim_{\Delta y \to 0^+} \frac{dP_{mf}}{d\Delta y}$, implying a kink point in the relative income distribution. This establishes Result 1.

Household public good provision: As in the one-period case, intra-household transfers are pinned down by maximization of the Nash bargaining criterion

$$\max_t (V_m(mfq) - V_s(m))^{\gamma} (V_m(fmq) - V_s(f))^{1-\gamma}.$$

This yields the solution

$$\begin{aligned} t \;=\; & \Big[\gamma(c^f(y^f, y^m) - rV_s(f)) - (1-\gamma)(c^m(y^m, y^f) - rV_s(m)) + (\gamma\alpha^f_{behind} \\ & + (1-\gamma)\alpha^m_{ahead})\Delta y I(\Delta y \leq 0) + (\gamma\alpha^f_{ahead} + (1-\gamma)\alpha^m_{behind})\Delta y I(\Delta y \geq 0) \\ & + (\gamma\beta^f_{ahead} - (1-\gamma)\beta^m_{behind}) I(\Delta y \geq 0)\Big]. \end{aligned}$$

The equilibrium t in the continuous time, infinite horizon setting exhibits the same properties as in the one-period model, establishing Result 2.

Divorce: Lastly, we extend the model to allow for endogenous divorce. To model divorce, assume that every period the match-specific taste shock gets updated with probability δ according to the updating rule $q^{new}_{mf} = min\{q^t_{mf}, q^{t+1}_{mf}\}$. Varying δ, we can make the stochastic process of q_{mf}'s more or less persistent. The resulting flow of divorces equals

$$m^{div}(m, f) = \delta(1 - P_{mf})m(m, f).$$

We obtain that the divorce rate for a given pair (m, f) equals

$$Div(m, f) = \delta(1 - P_{mf}),$$

which yields Result 3 following algebra analogous to the one-period case.

1.3 Observational Results

Data and Setting

Data: To test for the existence and form of preferences over relative income, we investigate the model predictions for the case of Germany, Europe's largest economy in terms of income and population. The German tax system administers income tax splitting for married couples, hence providing no incentive for spouses to distort their relative income shares. This feature is crucial for the identification of preferences over relative income by means of the relative income distribution. Other countries with available high-quality tax data typically feature individual-income taxation, which provides an incentive for couples to equalize their income in order to minimize tax liability. This feature may for instance explain patterns of income compression among co-working spouses-detected in Sweden (Hederos and Stenberg, 2019) and Finland (Zinovyeva and Tverdostup, 2018). This concern does not apply in our context.

We use a representative 10% cross-sectional sample of the universe of German administrative tax returns for the years 2001, 2004, and 2007. To maximize precision, we pool all years for our analysis assigning a weight of $1/3$ to each year. We focus on dual-earner married couples for which we impose the following sample restrictions: we exclude from our analysis couples who engage in a joint business activity and split income perfectly as the relative income share is not meaningful in this case. Technically, we drop couples reporting the same amount in one of the income categories for business activities or self-employment.[10] We also exclude couples if one of the spouses is older than 70 years or receives retirement income. Further, we exclude couples if one of the spouses reports negative income from self-employment or business activities. Finally, we only keep couples who report some income from either labor, self-employment, or business activity.[11] The remaining sample contains a total number of 1,702,676 dual-earner couples with a mean annual income of 58,420 Euro. The average female share in a couple's income amounts to 35.8%. We complement the administrative tax data using survey data on housework from the German Socio-Economic Panel (GSOEP) (Wagner et al., 2007).

Cultural Setting: We further exploit the division and later reunification of Germany in 1949 and 1990 as a natural experiment following Alesina and Fuchs-Schündeln (2007). This historical feature provides exogenous variation in gender-specific social roles between the more conservative West and the more progressive East Germany under contemporarily equal formal institutions. The variation in these roles might provoke that relative income concerns within the household vary between the two parts of the country.

Shortly after establishment of the German Democratic Republic (East Germany) in 1949, the East German government took steps towards the goal of gender equality in economic and social life. In particular, the East German government aimed at abolishing the traditional single-earner model. The communist government introduced a new family law in 1950 that regulated: "The equality of men and women in social life requires their equality in family law. Laws and regulations establishing a restriction or reduction of women's rights in family law have been repealed with the entry into force of the Constitution of the German Democratic Republic. [...] The marriage does not restrict or diminish the rights of the wife. [...] The marriage must not prevent a woman from pursuing a job or pursuing vocational training and her social and political education" (§13, 14 and 15, Gesetz über den Mutter- und Kinderschutz und die Rechte der Frau). In contrast, the government of the Federal Republic of Germany (West Germany) retained the traditional family model with the husband as the main breadwinner. Until 1976 West German civil law regulated: "The wife is in charge of the household. She is entitled to work, as far as this is compatible with her duties in marriage and family." (§1356 (1), Bürgerliches Gesetzbuch). Scholars have argued that after reunification and equalization of formal institutions in 1990, the status of women in the economy as well as gender-specific roles towards work still feature substantial differences between East and West Germany (Rosenfeld et al., 2004; Matysiak and Steinmetz, 2008). These differing

[10] We also exclude couples for which there is a deviation of ± 1 Euro.

[11] All remaining income is either due to capital, rent, or special income categories like alimonies.

gender-specific social roles might imply that relative income concerns within the household and their incidence dramatically differ between the two parts of the country.

Relative Income Distribution

We begin testing our model predictions by analyzing the structural form of the relative income distribution – the distribution of the share of couples' income earned by wives – for the entire country. In the absence of any relative income concerns we would expect the distribution to be globally smooth. However, in the presence of spousal preferences over relative income, we would expect a non-smoothness at the 50% threshold, the point where both spouses earn the same. Specifically, if preferences feature a kink at income equality, we would expect a kink point. In the case of a notch in preferences, we would expect a discontinuity.

Main Results: Figure 1.7, Panel A presents the relative income distribution for Germany, performing the specification of Bertrand et al. (2015) using 5%-points bins. The visual evidence suggests a negative discontinuity at the 50% threshold. To statistically test for the presence of a level jump, we conduct a McCrary-test (McCrary, 2008) dropping observations for which the wife's relative income share is exactly 50% as suggested by Binder and Lam (2018). Using a binwidth of 0.05 we find a log difference in the level of the density of -0.094 (s.e.$= 0.0064$) which is quantitatively close to the estimate provided by Bertrand et al. (2015) for the United States. This feature appears to be consistent with notched preferences over relative income in the form of either husbands' preference for or wives' aversion against being the primary earner. A shortcoming of Figure 1.7, Panel A, however, is its resolution: the large binwidth renders it impossible to distinguish between a notch and a kink at the 50% threshold. As a key advantage of our data, the number of observations is more than a magnitude larger relative to Bertrand et al. (2015). This data feature allows us to conduct a more granular inspection by reducing the binwidth and depicting the distribution in finer detail.

We do so in Figure 1.7, Panel B which shows the distribution for 0.5%-points bins. In contrast to the specification using 5%-point bins the more granular resolution reveals no visible jump at the 50% threshold. We test for a discontinuity using a McCrary (2008) test using optimal bin- and bandwidth selection yielding an insignificant log difference of -0.22 (s.e.$= 0.014$). Alternatively, we use the manipulation test based on density discontinuity proposed by Cattaneo et al. (2018) which avoids prebinning the data. This test yields an insignificant test-statistic of $T = -1.1073$ ($p = 0.2682$) using a quadratic polynomial to construct the density point estimators.[12] We conclude that in our case the sharp discontinuity at the 50% is a result from aggregation: using a more granular resolution the discontinuity becomes close to zero.

While we do not observe a discontinuity, Figure 1.7, Panel B shows a visually pronounced concave kink. Left of the 50% threshold, the distribution is moderately decreasing; towards the right of the 50% threshold, there is a much steeper decline in the density, producing a concave kink.

[12] Using a 3rd- or 4th-order polynomial instead similarly yields insignificant test statistics of $T = -0.8498$ ($p = 0.3954$) and $T = -0.9975$ ($p = 0.3185$).

In the light of our model, this pattern is consistent with kinked preferences over relative income at the point of income equality.

To statistically test for this kink we follow a methodology proposed by Card et al. (2015) and Landais (2015). We fit different *n*-order polynomials within the $+/-10\%$ percentage-point range of the 50% threshold. We allow for a slope change of the linear term by an interaction with an indicator for being to the right of the 50% threshold. To reduce the sensitivity to noise, we follow a "donut hole" approach by excluding the data points just to the right and the left of the 50% threshold.[13] The estimated coefficient on this interaction serves as the test-statistic for the kink in the distribution. As placebo, we repeat this procedure for each 10%-threshold along the relative income distribution. Figure 1.8, Panel A presents the results for 3rd- and 5th-order polynomials. We obtain a statistically significant slope change at the 50% of the relative income distribution independently of the order of the estimated polynomial. For other Placebo thresholds, we detect no robust slope change. For completeness, we repeat this procedure allowing for a level change by including an indicator for levels above the 50% threshold. Figure 1.8, Panel B plots the estimated coefficients on the indicator. Confirming our prior results, there are no robust discontinuities at the 50% threshold or other points along the relative income distribution.

Alternative Explanations: *Random Matching:* Would a kink point arise in the absence of preferences over relative income? While we do not observe the relative income distribution in the absence of preferences over relative income, we can benchmark the actual distribution relative to a distribution arising from random matching. To do so, we perform a random match of female and male individuals within age groups and geographical regions and plot the resulting distribution using gray dots in Figure 1.7, Panel B. We observe that the resulting distribution (gray dots) features no kink. As a secondary observation, relative to the counterfactual of random matching the empirical relative income distribution features a missing mass of couples with a female primary earner of 27.4%.

Assortative Matching: While random matching is unable to explain the observed distribution, in reality individuals might not match randomly but instead form a match with a partner who exhibits similar attributes and characteristics. Such positive assortative matching is a standard prediction of canonical models of the marriage market (Becker, 1973; Shimer and Smith, 2000). Does assortative matching on income explain the observed distribution and in particular the kink?

To investigate assortative matching as a candidate explanation for the observed relative income distribution, we rank-order individuals according to their income and match each individual to the individual of opposite gender with the same income rank. The resulting relative income distribution is shown in Figure 1.9 which indicates that perfect assortative matching does poorly in replicating the observed income distribution. In particular, under the perfect assortative matching assumption almost all couples exhibit a male breadwinner as the income distribution of men exhibits close to first-order stochastic dominance over the one of women.

[13] For theory and applications of the "donut hole" regression method, see Barreca et al. (2016), Card and Giuliano (2014) and Bajari et al. (2011). In particular, this approach reduces the vulnerability to local confounders in our setting such as earnings compression as discussed by Hederos and Stenberg (2019) and Zinovyeva and Tverdostup (2018).

To give assortative matching a fighting chance in replicating the observed distribution, we introduce noise to the matching process. For this purpose, female and male individuals are ranked according to their income level to which a noise term is added. The noise term is distributed according to a normal distribution with a mean of zero and different scenarios for the standard deviation expressed in terms of the standard deviation of the gender-specific income distribution. The resulting relative income distributions are shown in Figure 1.10 for different degrees of noise. For small degrees of noise, we observe, relative to the empirical distribution, a substantial excess mass in the middle of distribution. When increasing the noise, the relative income distribution under assortative matching converges to the randomly matched distribution. Again, the kink cannot be reproduced. We conclude that assortative matching is unable to explain the observed distribution.

Tax incentives: An alternative explanation might be that the observed kink in the relative income distribution does not reflect preferences over relative income, but instead is an artifact of tax manipulation. Unlike individual income tax systems, the German tax system administers income splitting for married couples, implying that the tax burden does not depend on the relative income shares. As a consequence, there is no incentive for couples to distort their relative income, rendering an explanation based on tax manipulation unlikely. As an additional robustness test, we calculate the relative income distribution for wage earners who only earn third-party reported income. If the observed kink is a product of tax manipulation, we would not expect this pattern for third-party reported income as it cannot be easily manipulated (Kleven et al., 2011). Figure 1.11 shows a similar (if anything stronger) kink at the 50% for third-party reported income thus providing no support for a tax manipulation confound.

Cultural Variation: Finally, we study cultural heterogeneity of the presence of relative income concerns within the household by separately investigating East and West Germany. Formal institutions between the two parts of the countries are equal in the contemporary Germany. However, due to the historical division and later reunification of Germany, scholars have emphasized the differing attitudes to gender-specific earnings between the formerly communist and more gender-equal East Germany and the rather conservative West Germany (Rosenfeld et al., 2004; Matysiak and Steinmetz, 2008).

These attitudes might provoke that relative income concerns within the household are less pronounced in East Germany. Figure 1.12 plots the relative income distribution, including the randomly matched counterfactual distribution, for West and East Germany. Testing for a discontinuity in the slope as suggested by Card et al. (2015) and Landais (2015), we find the presence of a statistically significant kink point in West Germany but not in East Germany (see Figure 1.13).[14]

Furthermore, we observe that the distribution for East Germany looks much more symmetric around the 50% threshold. In addition, relative to the randomly matched counterfactual the observed distribution in West Germany features a missing mass of couples with a female primary

[14]We also do not find evidence for the presence of a significant jump in the level of the density for neither West nor East Germany. A McCrary-test (McCrary, 2008) with optimal bin- and bandwidth selection yields insignificant log differences of -0.014 (s.e.= 0.014) for West and 0.008 (s.e.= 0.028) for East Germany. Alternatively, using the manipulation test based on density discontinuity proposed by Cattaneo et al. (2018) confirms these results.

earner of 33.5%. In contrast, the corresponding missing mass amounts to only 13.6% in East Germany. In sum, the evidence for West Germany indicates the existence of kinked preferences over relative income. For the more gender-equal and formerly communist East Germany relative income concerns within the household seem to be absent or much weaker.

Household Public Good Provision

As a further model-guided test for the presence of preferences over relative income, we investigate household public good provision by wives and husbands as a function of their relative income share similarly to Lippmann et al. (2019). In our model, the provision of housework can serve as a compensation for disutility stemming from relative income concerns of the partner. In the presence of preferences over relative income, our model predicts an unsmoothness in the observed household public good provision at the point of equality in income. Importantly, the structural form of this unsmoothness as either a kink or a notch is again indicative of the structural form of preferences.

Furthermore, patterns of household public good provision can be suggestive of which side of the marriage market bears the incidence of relative income preferences. Consider the situation in which men hold a kinked preference for being the primary earner. Primary earner wives will bear a part of the incidence by providing intra-household transfers to compensate men for the utility loss associated with being the secondary earner. Observationally, this behavior would manifest by wives' household public good provision exhibiting a convex kink at the 50% threshold in their relative income.

Drawing from data from the GSOEP, Figure 1.14 plots housework (in hours per day) provided by wives (Panel A) and husbands (Panel B) as a function of the female relative share in household income. Intuitively, for both husbands and wives provided housework is decreasing in their contribution to household income. There is no salient kink or notch in husbands' household public good provision at the 50% threshold. However, we observe a pronounced convex kink in housework conducted by women: women provide a comparatively higher amount of household public goods when being the primary earner.

We test for the statistical significance of this pattern in Table 1.2, Panel A: in all columns we regress wives' household public good provision on their relative income share. In columns 1 to 3, we include an indicator for a female primary earner. We obtain a statistically significant positive effect of being the primary earner on wives' work in the household unconditionally (column 1), or conditionally on wave fixed effects, a cubic in household income, age fixed effects for husband and wife and number of children (column 2), as well as when additionally controlling for job hours of both spouses (column 3). In columns 4 to 6, we additionally allow for an interaction of the relative income share with the dummy for being a female primary earner. The coefficient on this interaction captures a change in the slope at the 50% threshold. We observe that the coefficient on the indicator becomes insignificant, while the coefficient on the interaction becomes significant. In all specifications, the coefficient on the interaction is roughly of the absolute magnitude of the baseline coefficient on the relative income share, indicating that the negative trend of household public

good provision is fully offset for values above the 50% threshold.[15] We provide parallel regression evidence for husbands in Panel B confirming the visual evidence that there is no significant reversal in housework at the 50% threshold.

These patterns are suggestive of (husbands') kinked preferences over relative income. Moreover, in the light of our model these findings suggest that women bear the incidence of preferences over relative income. For instance, in our model the patterns of household public good provision can be rationalized by a combination of inequality aversion among women and a kinked preference for being the breadwinner among men.

We provide geographic heterogeneity by comparing the more gender-equal East Germany to the more traditional West Germany in Figure 1.15 and Tables 1.5 and 1.6. The patterns of household public good provision in West Germany mirror the aggregate patterns for the entire country. For the more gender-equal East Germany, we observe neither a kink nor a notch at the 50% threshold for both wives' and husbands' household public good provision.

1.4 Experimental Results

Motivation and Design

The observational evidence on marriage outcomes provides evidence on the existence and structural form of preferences over relative income. Without further assumptions, however, it does not facilitate the quantification and separate identification of women's and men's preferences. To address these challenges and disentangle as well as quantify women's and men's preferences, we conducted a survey experiment in the United States and Germany. We designed the experiment to empirically distinguish between different motives and quantify their strength in monetary terms. We follow a twofold methodological approach eliciting preferences either through qualitative satisfaction questions or quantitative choice questions. The combination of both approaches mitigates concerns that our results are driven by methodology-specific confounds.

Socio-economic background questions: In the first part of the survey, we elicit a battery of standard socio-economic questions, including age, gender, and marital status. Importantly, we also inquire about respondents' personal income and the income of their partner which we use in the subsequent parts of the survey. Individuals who do not know or provide their income are excluded from the remainder of the experiment.

Qualitative elicitation of preferences: Among a subset of respondents, we elicit preferences over relative income through simple qualitative satisfaction questions. Each respondent is presented with 11 different situations regarding their relative income within their household holding

[15] We also show that the same patterns hold if we restrict women's relative income to range between 30% and 70% in total household income (Table 1.3). Furthermore, the same patterns persist when solely exploiting changes in relative income over time within the household. We provide this evidence in Table 1.4 which additionally includes couples fixed effects.

total household income constant. In particular, total household income is set equal to the amount the respondent indicated in the pre-experimental part of the survey. We then ask the respondent to indicate on a 7-point Likert scale how satisfied they would be with a given situation. The precise survey question reads:

> *You indicated your own annual income is X and your partner's annual income income is Y. Hence, your combined annual income as a couple is $X+Y$.*
>
> *Suppose now, you earned $p\dot{(}X+Y)$ and your partner earned $(1-p)\dot{(}X+Y)$. How satisfied would you be with this situation? Please answer on a scale from 1 (Not at all satisfied) to 7 (Very satisfied).*

The fraction p was varied in the set $p \in \{0.3,\ 0.4,\ 0.45,\ 0.47,\ 0.49,\ 0.5,\ 0.51,\ 0.53,\ 0.55,\ 0.6,\ 0.7\}$. In particular, we oversampled fractions around $p = 0.5$ in order to obtain a granular picture of the structural form of preferences over relative income at the point of income equality. In sum, the qualitative survey items allow us to non-parametrically assess partners' satisfaction with a given composition of relative incomes within the household holding total material considerations constant.

Quantitative elicitation of preferences: While the qualitative items are easy to understand for the participants, there are two drawbacks to solely relying on qualitative items. First, the concept of satisfaction is ambiguous and subjective, which renders the comparison of answers across individuals complicated.[16] Second, observing satisfaction measures does not allow us to quantify the strength of preferences over relative income in monetary terms or on other quantifiable scales.

To address these challenges, we implement a complementary survey battery that elicitis preferences over relative income using quantitative choice questions among the remainder of participants. Each item presents two situations that involve different relative incomes of the partners as well as total household income. We ask for each item which of the two situations the respondent would prefer. We then vary across items both partners' relative income as well as their total household income in the two situations. Intuitively, by comparing the choice behavior across different items this strategy allows us to infer individuals' preferences over relative income using a revealed preference approach. Furthermore, this strategy allows us to quantify the strength of preferences in monetary terms by calculating the marginal rates of substitution between relative income and total household income. The precise survey questions read:

[16] For a detailed discussion of identification problems arising with the use of subjective response scales, see Bond and Lang (2019).

Please indicate which situation you prefer:

Situation A: Your own annual income is $p \cdot H_A$ *and your partner's annual income is* $(1-p) \cdot H_A$.

Situation B: Your own annual income is $0.5 \cdot H_B$ *and your partner's annual income is* $0.5 \cdot H_B$.,

where $p \in \mathscr{P} = \{0.2,\ 0.3,\ 0.45,\ 0.55,\ 0.6,\ 0.7\}$ and $H_B \in \mathscr{H}_2 = \{0.85 \cdot H_A,\ 0.9 \cdot H_A,\ 0.95 \cdot H_A,\ H_A,\ 1.05 \cdot H_A,\ 1.1 \cdot H_A,\ 1.15 \cdot H_A\}$. To keep the scenarios as realistic as possible, for a specific respondent household income H_A is set equal to the actual household income the respondent indicated in the first part of the survey.[17] While in situation A, relative incomes are always unequal, situation B always involves a situation where own relative income is precisely 50%. By varying H_B, respondents' switching behavior between Situation A and B across different scenarios, hence, allows us to infer individuals' willingness to pay to change the relative income shares from a $p\% - (1-p)\%$ to a 50% - 50% composition.

In order to limit the number of questions to a reasonable limit, we randomly select only two elements $p \in \mathscr{P}$ for each respondent. We then vary H_B across all elements in $\mathscr{H}_2$ such that each subject responds to a total of 14 items. The presentation order of items is randomized to prevent potential strategic response behavior of the respondents.

Identification of preference parameters: To identify the gender-specific preference parameters, we adapt the utility framework of kinked preferences over relative income from section 1.2. Suppose individuals' utility from total household income H and own relative income share $p \in [0,1]$ equals:

$$U = \delta H + \alpha_{\text{behind}} p \cdot I(p <= 0.5) + \alpha_{\text{ahead}} (p - 0.5) \cdot I(p > 0.5).$$

Here, δ represents individuals' marginal utility from total household income H. The terms α_{behind} and α_{ahead} again represent the marginal utilities from relative relative income depending on whether the individual is the secondary (α_{behind}) or primary earner (α_{ahead}).

To illustrate our identification strategy, consider a choice scenario, consisting of situations A and B (where $p_B = 0.5$). An individual will choose situation B if $U_B \geq U_A$, or iff

$$\delta(H_B - H_A) + \alpha_{\text{ahead}}(0.5 - p_A) \cdot I(p_A > 0.5) + \alpha_{\text{behind}}(0.5 - p_A) \cdot I(p_A <= 0.5) \geq 0.$$

The preference parameters are then identified from respondents' switching behavior between choices A and B when varying either differences in total household income $(H_B - H_A)$, relative income shares $(0.5 - p_A)$, or whether the respondent is the primary or secondary earner $I(p_A >$

[17] For respondents who do not know their partner's income we assume that total household income is twice the personal income of the respondent.

0.5). In more detail, each preference parameters is identified by varying the corresponding input to the utility function holding the other inputs constant. For instance, marginal utility from household income δ is identified from variation between differences in household income in situation A and B ($H_B - H_A$), holding the relative income shares fixed.

To econometrically estimate the utility function, we perform the following logit regression:

$$\text{Choose B} = \delta(H_B - H_A) + \alpha_{\text{ahead}}(0.5 - p_A) \cdot I(p_A > 0.5) + \alpha_{\text{behind}}(0.5 - p_A) \cdot I(p_A <= 0.5) + q, \tag{1.2}$$

where Choose B is an indicator for choosing option B and q represents an idiosyncratic error term. We cluster standard errors at the individual level.

In addition, the quantitative choice approach allows us to quantify the strength of preferences over relative income in monetary terms by calculating the marginal rates of substitution between changes in total household income and relative income $\alpha_{\text{ahead}}/\delta$ and $\alpha_{\text{ahead}}/\delta$. Intuitively, these statistics measure the percentage amount of total household income an individual is willing to give up in order to change relative income by 1%-point.

Recruitment and Sample Characteristics: In the United States, we recruited 420 respondents to participate in the qualitative elicitation and another 736 participants to participate in the quantitative elicitation of preferences both through Amazon Mechanical Turk. In Germany, we recruited an additional 262 participants through clickworker.com to participate in the quantitative elicitation of preferences. The samples was restricted to individuals who are in a dual-earner relationship.[18] Table 1.7, Panel A presents the summary statistics for the qualitative US sample. Men represent 50% of our sample with an average age of 38 years. In total, 50% of the respondents are married. 85% of our sample are employed full-time and earn an average income of 50,142 USD. Summary statistics for the other samples are very similar (Table 1.7, Panels B and C).

Results

Qualitative Evidence:

Figure 1.16 presents the qualitative evidence on preferences over relative income for women (Panel A) and men (Panel B) in the United States. The figure plots gender-specific standardized satisfaction as a function of the own relative income. For men, we observe satisfaction to be strongly increasing in their own relative income share until the point where both partners earn equal amounts. At the point of equality we observe a kink: satisfaction stays roughly constant for an even higher amount of own relative income. In sum, in the aggregate men display a preference for being the primary earner. Furthermore, we do not observe any noticeable jump in stated satisfaction at equality of incomes. This pattern indicates that the structural form of men's preference for being the primary earner is in form of kink and not a notch in utility.

For women, we again observe that satisfaction is increasing in their own relative income share for levels below 50%. However, for levels higher than 50%, satisfaction is decreasing in a quan-

[18] In addition, we required participants to know and provide their annual income before taxes.

titatively similar magnitude. Said differently, satisfaction is a decreasing function in the absolute distance to an equal 50%-50% composition. This pattern suggest that women exhibit symmetric inequality aversion.[19]

In sum, the qualitative evidence indicates that the structural form of preferences over relative income for both women and men can be captured by a kinked utility function. However, the underlying psychological motives of men and women differ sharply: while men exhibit a preference for being the primary earner, women show inequality aversion.

Quantitative Evidence:

Baseline Estimates: Now, we show the results from the quantitative choice questions. Columns (1) to (3) in Table 1.8 show the estimates of δ (preference weight on total household income), α_{behind} (preference weight on relative income when being secondary earner), and α_{ahead} (preference weight on relative income when being primary earner) when estimating equation (1.2) for all respondents, as well as separately for women and men.

For the pooled sample of women and men, we find a large and positive coefficient $\delta = 10.85$ (s.e.=0.45), indicating that respondents strongly value total household income. Turning to our coefficients of interest, we find a positive weight on own relative income when being the secondary earner $\alpha_{\text{behind}} = 4.92$ (s.e.=0.38). In contrast, when being the primary earner, the weight on own relative income is estimated to be negative in a magnitude of $\alpha_{\text{ahead}} = -2.55$ (s.e.=0.33). These patterns are consistent with preferences over relative income exhibiting inequality aversion. Furthermore, the higher weight on relative income when being the secondary as opposed to the primary earner indicates that inequality aversion is asymmetric: for a given deviation from a 50%-50% composition of relative income, individuals dislike this deviation less if their relative income increases as opposed to their partners'.

Do these estimates mask substantial heterogeneity by gender? The qualitative evidence in Figure 1.16 suggests that men show a preference for being the primary earner while women exhibit symmetric inequality aversion. Columns (2) and (3) in 1.8 investigate preference heterogeneity by gender for the quantitative choice questions. Both, women and men strongly care about total household income with an estimated δ of roughly 10 independent of gender. However, the genders strongly differ in terms of their concerns regarding relative income. Consistent with the qualitative evidence from Figure 1.16, women exhibit symmetric inequity aversion with estimated $\alpha_{\text{behind}} = 4.29$ (s.e.=0.55) and $\alpha_{\text{ahead}} = -4.17$ (s.e.= 0.48). A Wald-test of the Null-hypothesis of symmetry ($\alpha_{\text{behind}} = -\alpha_{\text{behind}}$) fails to reject at p=.87.

For men, on the other hand, we estimate the weight on relative income when being the secondary earner as $\alpha_{\text{behind}} = 5.68$ (s.e.=0.50). When being the primary earner the weight on own relative income shrinks to $\alpha_{\text{ahead}} = -0.91$ (s.e.=0.45). Hence, men's preferences over relative

[19] One notes that there is a mild jump in satisfaction at the 50% threshold. This feature might arise due two to reasons. First, a 50%-50% composition might be more focal (due to the quality of being perceive as a "round" number). Second, women might have a discrete preference for a 50%-50% composition over any composition in the local neighborhood. Note however, that the jump to the left and the right of the 50% threshold is symmetric such there is no discrete preference for either being the primary or secondary earner.

income appear to exhibit heavily asymmetric inequality aversion: men strongly dislike negative deviations from a 50%-50% composition of relative income when becoming the secondary earner. However, they only exhibit a weak distaste for inequality when being primary earner.

How strong are these preferences? To quantify the strength of preferences over relative income, we calculate the marginal rates of substitution between total household income and own relative income $\alpha_{\text{behind}}/\delta$ and $\alpha_{\text{ahead}}/\delta$. These statistics indicate the amount of total household income an individual is willing to pay (or accept) for a given change in relative income.

For women, we find marginal rates of substitution of $\alpha_{\text{behind}}/\delta = 0.41$ and $\alpha_{\text{ahead}}/\delta = -0.40$. Said intuitively, women are willing to give 4.1% of total household income for a 10% increase in relative income when being the secondary earner. Vice versa, women are willing to give up 4.0% of of total household income for a 10% decrease in relative income when being the primary earner. We visualize the willingness to pay for a 50%-50% composition of relative income as a function of the own relative income share by the solid lines in Figure 1.17, Panel A. For men, we find implied marginal rates of substitution of $\alpha_{\text{behind}}/\delta = 0.50$ and $\alpha_{\text{ahead}}/\delta = -0.08$, visualized by the solid lines in Figure 1.18, Panel A.

Discrete Preference for Equal Incomes: Note that without a constant, specification (1.2) enforces the limits $\lim_{p\to 0.5^+} U(p,H)$ and $\lim_{p\to 0.5^-} U(p,H)$ to equal $U(0.5,H)$. In intuitive terms, individuals' preferences over relative income are assumed to be continuous at the point of equality in income. This specification, however, will lead to biased estimates if preferences feature a discontinuity at income equality. This might arise if individuals have a discrete preference for equality of incomes over any composition in the local neighborhood. Similarly, bias would arise if individuals are more likely to opt for a 50%-50% composition as it is more focal. In fact, note that a symmetric discontinuity is already suggested by the evidence from the qualitative satisfaction questions for women.

To allow for this possibility, we enrich specification (1.2) by including a constant term which captures a discretely higher propensity to opt for a 50%-50% composition.[20] Columns (4) to (6) in Table 1.8 present the estimates. For women, we observe that the estimates in column (5) are qualitatively similar to the estimates obtained when excluding a constant in columns (2). However, the quantitative magnitude differs. While δ remains stable at 10.51 (s.e =0.61), α_{ahead} and α_{behind} are estimated lower in magnitude of 3.40 (s.e.= 0.72) and -3.31 (s.e.= 0.64) respectively, indicating again symmetric inequality aversion.[21] The estimates imply marginal rates of substitution between relative income and total household income of 0.32 when being the secondary earner and -0.31 when being the primary earner.

For men, the coefficient α_{behind} remains large and statistically insignificant at 4.58 (s.e.=0.66), implying a marginal rate of substitution of 0.40. In contrast α_{ahead} is estimated as 0.16 (se=0.63) and not statistically significant different from zero. These patterns indicate that men's concerns over relative income in fact reflect a preference for being the breadwinner. In intuitive terms, men

[20] Technically, the specification assumes that preferences fulfill the following condition $\lim_{p\to 0.5^+} U(p,H) = \lim_{p\to 0.5^-} U(p,H) \neq U(0.5,H)$.

[21] Again, a Wald-test of the Null-hypothesis of symmetry ($\alpha_{\text{behind}} = -\alpha_{\text{behind}}$) fails to reject at p=0.89.

strongly prefer higher relative income if they are the secondary earner; they show no concerns over relative income, however, if they are in the position of the primary earner.

We visualize women's and men's willingness to pay for a 50%-50% composition of relative income as a function of the own relative income share by the solid lines in Panel B of Figures 1.17 and 1.18.[22]

Robustness to Inconsistent Answering Behavior: We observe that roughly 22% of answers in our sample exhibit behavior that is inconsistent with a non-negative preference weight on total household income. In particular, consider a respondent who faces two choice scenarios between (p_A, H_A) and $(0.5, H_B^{low})$ as well as between (p_A, H_A) and $(0.5, H_B^{high})$, where $H_B^{high} > H_B^{low}$. We classify a response sequence as exhibiting answering behavior that is inconsistent with a non-negative preference weight on total household income if $(0.5, H_B^{low}) \succ (p_A, H_A)$ but $(p_A, H_A) \succ (0.5, H_B^{high})$. The inclusion of these respondents in our estimation sample might bias the estimates and increase noise.

In Table 1.10 we repeat the analysis of Table 1.8 for a restricted sample excluding response sequences that feature inconsistent answering behavior. We distinguish between the model in equation (1.2) without a constant (Columns (1) to (3)) and with a constant (Columns (4) to (6)). Qualitatively, we observe similar patterns to Table 1.8: women exhibit symmetric inequity aversion. Men show asymmetric inequality aversion in the model without a constant, and a preference for being the breadwinner in the model with a constant. Intuitively, the estimated coefficients are larger in magnitude, however, the implied marginal rates of substitution between relative income and total household income remain similar to Table 1.8. We visualize preferences for the restricted sample by dashed lines in Figures 1.17 and 1.18.

Quantitative Evidence for Germany Are gender-specific preferences over relative income universal or do they differ by country? Falk and Hermle (2018) and Gneezy et al. (2009) provide evidence that gender-specific preferences can vary across countries and cultures. To explore this possibility in our setting and relate to our observational evidence, we next investigate the case of Germany.

Table 1.11 shows the model estimates from specification (1.2) for Germany. We find qualitatively and quantitatively similar estimates as for the United States. In particular, for women, we estimate $\delta = 12.95$ (s.e.=1.19) in the specification without a constant (column (2)). The preference weights on relative income are statistically indistinguishable with magnitudes of $\alpha_{\text{behind}} = 5.88$ (se=1.10) and $\alpha_{\text{ahead}} = -5.62$ (se=1.05). These parameters imply marginal rates of substitution between relative income and total household income of 0.45 and -0.43, indicating symmetric inequality aversion. We find qualitatively similar but quantitatively smaller marginal rates of substitutions of 0.26 and -0.25 when allowing for a constant in column (5). We visualize this evidence in Figure 1.21.

[22] We discuss and provide evidence for alternative functional forms of preferences and non-parametric evidence in Appendix 1.6, as well as Table 1.9 and Figures 1.19 and 1.20.

For men, we estimate δ to be similar in magnitude (14.02, s.e.=1.19 in column (5)). The nature of preferences over relative income, however, strongly differs from women. In particular, we find in the model without a constant term preference weights of $\alpha_{\text{behind}} = 5.38$ (se=0.67) and $\alpha_{\text{ahead}} = -2.56$ (se=0.82). These patterns appear to suggest asymmetric inequity aversion. When including a constant, however, we obtain weights of $\alpha_{\text{behind}} = 3.36$ (se=0.85) and $\alpha_{\text{ahead}} = -0.36$ (se=0.99). These values indicate that men's preferences over relative income reflect a preference for being the breadwinner. The implied marginal rates of substitution are 0.24 when being the secondary earner and -0.03 when being the primary earner. We visualize men's preferences over relative income in Figure 1.22. We again find analogous pattern when restricting the sample to respondents who exhibit answering behavior that is consistent with non-negative utility from household income (Table 1.12).

In sum, the evidence for Germany resembles the patterns detected for the United States qualitatively and quantitatively: women show symmetric inequality aversion, while men exhibit a preference for being the primary earner with similar marginal rates of substitution as in the United States.[23]

1.5 Discussion

This study provides evidence on the existence and form of preferences over relative income within the household. We provide a flexible framework of relative income preferences that either exhibit a kink or notch at income equality between partners. In a marriage market matching model with search frictions, we study theoretically how these preferences affect couple selection and separation as well as intra-household transfers.

Consistent with the existence of kinked relative income preferences we find a kink point in the distribution of wives' relative income at the point of income equality for the case of Germany. This result cannot be explained by tax incentives or assortative mating. Furthermore, the kink point is only present for the rather conservative West Germany and not the more gender-equal and formerly communist East Germany.

We also provide evidence on a convex kink point in wives' household public good provision suggesting that women carry the incidence of relative income preferences. This kink point is only found in the conservative West Germany and not the more gender-equal East Germany. Through the lens of our model, these patterns can be suggestive of differing gender-specific relative income concerns. For West Germany the kink point in the relative income distribution in conjunction with the convex kink point in wives' household public good provision suggests that men exhibit a preference for being the primary earner. For East Germany, the absence of a kink point in the relative income distribution as well as spouses' household public good provision suggests that relative income concerns within the household play less of a role.[24]

[23] We again discuss and provide evidence for alternative functional forms of preferences and non-parametric evidence in Appendix 1.6, as well as Table 1.13 and Figures 1.23 and 1.24.

[24] This interpretation can also be supported by the fact that relative to the counterfactual of random matching of couples, the observed relative income distribution in West Germany features a missing mass of female-breadwinner

Finally, as gender-specific preferences over relative income are unidentified from solely observing the relative income distribution, we provide complementary experimental evidence. Using both a qualitative approach and quantitative methodology involving choice questions, we demonstrate that women feature symmetric inequality aversion over relative income while men exhibit a kinked preference for being the breadwinner. Quantitatively, women are willing to trade 3% to 4% of household income to narrow by 10%-points the gap between a given relative income composition and income equality. In contrast, men are willing to trade off 4% to 5% of household income to increase their relative income share by 10%-points when being the secondary earner but not when being the primary earner. Overall, these findings are consistent with the observational patterns found for the distribution of relative income as well as household public good provision.

In our theoretical and empirical analysis, we emphasize the distinction of preferences over relative income as either exhibiting a kink or notch at the point of income equality. While we believe this distinction to be intrinsically important for the conceptual understanding of these non-standard preferences (Fehr and Schmidt, 1999; Tversky and Kahneman, 1991), we also highlight that the welfare implications of the two distinct structural forms differ substantially.

Conceptually, preferences over relative income of one gender can be understood as taxes on the opposite gender's income in terms of marriage returns. In Appendix 1.6, we illustrate this logic from women's perspective for the case in which men exhibit a preference for being the breadwinner. While men's preferences over relative income in form of a notch in preferences act equivalent to a proportional tax, in the case of a kink they act as a progressive tax (see Figure 1.6). As a consequence, the gender-specific preferences we uncover – women exhibiting inequality aversion while men showing a preference for being the primary earner – imply a marriage-crowd out and welfare costs that are particularly pronounced for high-income women.

From a life-cycle perspective, these findings imply that the returns to choosing a higher-income career may differ between women and men due to the additional marriage tax imposed on women's income. In fact, recent research uncovered that gender gaps in choosing high-paying STEM career paths are *larger* in countries that feature higher levels of female income and in which women consequently are more likely to be the family breadwinner (Stoet and Geary, 2018; Borrowman and Klasen, 2019). Future research in this regard may further investigate how differential preferences over relative income between women and men affect gender-specific marriage returns and career outcomes from a life-cycle perspective.

couples of 33.5% while it is only 13.6% in East Germany.

1.6 Appendix I

Mathematical Proofs

Proof of Result 1 in the one-period model:

Note that we can express the relative income distribution f_{rel} at a given share of female income $k = \frac{y^f}{y^f+y^m} \in [0,1]$ for the sample of married couples as

$$f_{rel}(\frac{y^f}{y^m+y^f} = k|married) = Pr(married|\frac{y^f}{y^m+y^f} = k) \cdot \frac{f_{rel}(\frac{y^f}{y^m+y^f} = k)}{Pr(married)},$$

where $f_{rel}(\frac{y^f}{y^m+y^f} = k)$ is the distribution of relative income in the sample of matched women and men. Denote by $f_m(y^m)$ and $f_f(y^f)$ the continuously differentiable income distribution of male and female types. Then, $f_{rel}(\frac{y^f}{y^m+y^f} = k)$ can be written as $\int_{y^m} f_m(y^m) f_f(\tilde{k}y^m)\mu(y^m,\tilde{k}y^m)dy^m$, where $\tilde{k} = \frac{k}{1-k}$ and $\mu(y^m,y^f)$ is the matching function of women and men. If $\mu(y^m,y^f)$ is continuously differentiable, it follows that $f_{rel}(\frac{y^f}{y^m+y^f} = k)$ is continuously differentiable.

We can write $f_{rel}(\frac{y^f}{y^m+y^f} = k|married)$ as

$$\int_{y^m} \Big(\Phi(C + \bar{\alpha}_{m\ ahead} \cdot (\tilde{k}y^m - y^m) \cdot I(\tilde{k}y^m - y^m < 0) + \bar{\alpha}_{m\ behind} \cdot (\tilde{k}y^m - y^m) \cdot I(\tilde{k}y^m - y^m \geq 0)$$
$$+\bar{\beta}_{m\ behind} \cdot I(\tilde{k}y^m - y^m \geq 0)\Big) \cdot$$
$$f_m(y^m) f_f(\tilde{k}y^m)dy^m \cdot \frac{f_{rel}(\tilde{k})}{Pr(match)},$$

where $\tilde{k} = \frac{k}{1-k}$.

Preferences over relative income as a notch in utility: Assume that $\bar{\alpha}_{m\ ahead} = \bar{\alpha}_{m\ behind} = 0$ and $\bar{\beta}_{m\ behind} \neq 0$. Hence,

In this case, it follows that

$$\lim_{k\to 0.5^+} f_{rel}(k|married) < \lim_{k\to 0.5^-} f_{rel}(k|married) \quad \text{iff} \quad \bar{\beta}_{m\ behind} < 0$$
$$\lim_{k\to 0.5^+} f_{rel}(k|married) > \lim_{k\to 0.5^-} f_{rel}(k|married) \quad \text{iff} \quad \bar{\beta}_{m\ behind} > 0.$$

Preferences over relative income as a kink in utility: Assume that $\bar{\alpha}_{m\ ahead} \neq 0 \vee \bar{\alpha}_{m\ behind} \neq 0$ and $\bar{\beta}_{m\ behind} = 0$. In this case,

$$f_{rel}(\frac{y^f}{y^m+y^f}=k|married)=\begin{cases}\int_{y^m}\Big(\Phi(C+\bar{\alpha}_{m\ ahead}\cdot(\tilde{k}y^m-y^m)\cdot I(\tilde{k}y^m-y^m<0)\Big) & \\ \cdot f_m(y^m)f_f(\tilde{k}y^m)dy^m\cdot\frac{f_{rel}(\tilde{k})}{Pr(match)}, & \text{if } \tilde{k}<1\\ \int_{y^m}\Big(\Phi(C+\bar{\alpha}_{m\ behind}\cdot(\tilde{k}y^m-y^m)\cdot I(\tilde{k}y^m-y^m\geq 0)\Big) & \\ \cdot f_m(y^m)f_f(\tilde{k}y^m)dy^m\cdot\frac{f_{rel}(\tilde{k})}{Pr(match)}, & \text{if } \tilde{k}\geq 1\end{cases}$$

where $\tilde{k}=\frac{k}{1-k}$.

First, note that $f_{rel}(\tilde{k})$ and $\frac{k}{1-k}$ are smooth $\forall k\in[0,1)$. Furthermore, $\lim_{k\to 0.5^+} f_{rel}(k|married)=\lim_{k\to 0.5^-} f_{rel}(k|married)$. However, taking the derivate and using equation (1.1), yields that the relative income distribution features a kink at the 50% threshold.

Model with Non-Transferrable Utility

This section provides a brief investigation of preferences over relative income in a matching model of the marriage market with non-transferrable utility. We retain the assumptions of section 1.2 but no longer assume that housework is provided through intra-household transfers t. Instead, we model that each individual k provides housework h^k at cost $\hat{e}_k(h)$, such that $h^k=\arg\max_h c(y^k)+\zeta\log(h^k)-\hat{e}_k(h)$. Hence, an individual's utility from being single is equal to

$$u_s^k=c(y^k)+\zeta\log(h^k)-\hat{e}_k(h^k).$$

Analogously, to the case with transferrable utility, we specify the utilities from being married for a couple (m,f) to be equal to

$$\begin{aligned}u_m^m(f) &= c^m(y^m,y^f)+\eta^m(y^f,y^m)+\zeta\log(h^mh^f)-\hat{e}_m(h^m)+q_{mf}\\ u_m^f(b) &= c^m(y^f,y^m)+\eta^f(y^m,y^f)+\zeta\log(h^fh^n)-\hat{e}_f(h^f)+q_{fm},\end{aligned}$$

where we specify the production function of household public goods to be multiplicative and $q_{fm}\perp q_{mf}\perp\{y^m,y^f,h^m,h^f\}$. For simplicity, we assume that idiosyncratic taste shocks q_{fm} and q_{mf} are distributed according to Φ for both women and men. Furthermore, for simplicity we also assume that the material benefits from marriage are zero for both partners which is the case if the partner's income does not enter into the material sub-utility function. The results remain unchanged if this assumption is not made.

Simple one-period model

We again first consider a simple one-period model. In this setting, individuals enter the marriage market being single and are randomly matched with an individual of opposite gender. If both decide to marry, a marriage match is formed, otherwise both stay single.

Marriage Probabilities and Relative Income Distribution: An individual m decides to marry individual f iff $u_m^m(f) \geq u_s^m$, and analogous for f marrying m.
Hence, the marriage probability for a pair (m, f) equals:

$$P_{mf} = \begin{cases} \Big(1-\Phi[\alpha^m_{\text{ahead}}\Delta y - \beta^m_{\text{ahead}} - \zeta\log(h^f)]\Big) & \\ \cdot\Big(1-\Phi[-\alpha^f_{\text{behind}}\Delta y - \zeta\log(h^m)]\Big) & \text{if} \quad y^m \geq y^f \\ \Big(1-\Phi[\alpha^m_{\text{behind}}\Delta y - \zeta\log(h^f)]\Big) & \\ \cdot\Big(1-\Phi[-\alpha^f_{\text{ahead}}\Delta y - \beta^f_{\text{ahead}} - \zeta\log(h^m)]\Big) & \text{if} \quad y^m < y^f. \end{cases} \tag{1.3}$$

Preferences over relative income as a notch in utility: If $\beta^f_{\text{ahead}} \neq 0$ or $\beta^m_{\text{ahead}} \neq 0 \lim_{\Delta y\to 0^+} P_{mf}(\Delta y) \neq \lim_{\Delta y\to 0^-} P_{mf}(\Delta y)$, hence it follows that P_{mf} features a discontinuity at $\Delta y = 0$.

Preferences over relative income as a kink in utility: If preferences over relative income feature a kink instead of a notch, $\lim_{\Delta y\to 0^+} P_{mf}(\Delta y) = \lim_{\Delta y\to 0^-} P_{mf}(\Delta y)$, i.e. the *level* of the marriage probability will be unaffected at $\Delta y = 0$. However, the marriage probability has a concave kink at $\Delta y = 0$. To see this, observe that

$$\frac{dP_{mf}}{dy^f} = \begin{cases} -\alpha^m_{\text{ahead}}\phi\Big(\alpha^m_{\text{ahead}}\Delta y - \zeta\log(h^f)\Big)\Big(1-\Phi[-\alpha^f_{\text{behind}}\Delta y - \zeta\log(h^m)]\Big) & \\ +\alpha^f_{\text{behind}}(1-\Phi[\alpha^m_{\text{ahead}}\Delta y - \zeta\log(h^f)]\Big)\phi\Big(-\alpha^f_{\text{behind}}\Delta y - \zeta\log(h^m)\Big) & \text{if} \quad y^m \geq y^f \\ -\alpha^m_{\text{behind}}\phi\Big(\alpha^m_{\text{behind}}\Delta y - \zeta\log(h^f)\Big)\cdot\Big(1-\Phi[-\alpha^f_{\text{ahead}}\Delta y - \zeta\log(h^m)]\Big) & \\ +\alpha^f_{\text{ahead}}\Big(1-\Phi[\alpha^m_{\text{behind}}\Delta y - \zeta\log(h^f)]\Big)\cdot\phi\Big(-\alpha^f_{\text{ahead}}\Delta y - \zeta\log(h^m)\Big) & \text{if} \quad y^m < y^f. \end{cases} \tag{1.4}$$

This directly yields result 1 following the same logic as in section 1.2.

Household Public Good Provision: Next, we study how preferences over relative income affect household public good provision. Similarly to the model with transferrable utility, housework can serve as a compensation for utility losses associated with preferences over relative income. We focus on the formulization of preferences over relative income in form of a kink. To understand how preferences over relative income affect observed household public good provision, note that a male agent m accepts the match with female f iff

$$q_{mf} \geq -\eta^m(y^f, y^m) - \zeta\log(h^f).$$

Hence, conditional on the taste shock and income levels, the cutoff level of female housework $\underline{h}^f$ accepted by the male equals

$$\begin{aligned} h^f \geq \underline{h}^f &= \exp\Big[\frac{1}{\zeta}\Big(-\eta^m(y^f, y^m) - q_{mf}\Big)\Big] \\ &= \begin{cases} \exp\Big[\frac{1}{\zeta}\Big(-\alpha^m_{\text{behind}}\Delta y - q_{mf}\Big)\Big] & if\, \Delta y \leq 0 \\ \exp\Big[\frac{1}{\zeta}\Big(-\alpha^m_{\text{ahead}}\Delta y - q_{mf}\Big)\Big] & if\, \Delta y > 0. \end{cases} \end{aligned}$$

Therefore, the minimum level of female housework accepted by a given male type i features a convex kink at $\Delta y = y^m - y^f = 0$ as

$$\frac{\partial \underline{h}^f}{\partial \Delta y} = \begin{cases} -\alpha^m_{\text{behind}} \frac{h^f}{\zeta} & if\, \Delta y \leq 0 \\ -\alpha^m_{\text{ahead}} \frac{h^f}{\zeta} & if\, \Delta y > 0. \end{cases} \tag{1.5}$$

Hence, if $\alpha^m_{\text{behind}} \neq \alpha^m_{\text{ahead}}$, this yields a kink point at $\Delta y = 0$. Calculating $\frac{\partial \underline{h}^m}{\partial \Delta y}$ is analogous. Moreover, if preferences over relative income feature a notch, this will produce a notch in the provision of household public goods following a similar logic. This establishes result 2.

Divorce: Not that as in the model with transferrable utility, for a given combination of male income y, female and male housework $h^m,\ h^f$, and the female relative income share k, the divorce probability equals:

$$Div(y, h^m, h^f, k) = \frac{\pi(1-P_{mf})P_{mf} m_m(y^m = y, h^m) m_f(y^f = \frac{1-k}{k} y, h^f)}{P_{mf} m_m(y^m = y, h^m) m_f(y^f = \frac{1-k}{k} y, h^f)} = \pi(1-P_{mf}),$$

where $m_m(,)$ and $m_f(,)$ denote the type distributions of male and female types. Following the same argument as in section 1.2 yields result 3.

Full model in continuous time and infinite-horizon

Marriage Probabilities and Relative Income Distribution: We note that Bellman equations as well as steady state conditions are analogous to the model with transferrable utility. However, a couple only enters marriage if both agree to the match, which is the case if $V_m(mfq) \geq V_s(m)$ and $V_m(fmq) \geq V_s(f)$, or $c^m(y^m, y^f) + \eta^m(y^f, y^m) + \zeta \log(h^m h^f) + q_{mf} \geq rV_s(m)$ and $c^m(y^f, y^f) + \eta^f(y^m, y^f) + \zeta \log(h^f h^n) + q_{fm} \geq rV_s(f)$. As a consequence, the probability of a marriage match to be formed equals:

$$\begin{aligned} P_{mf} \quad = \quad & \Big(1 - \Phi(rV_s(m) - c^m(y^m, y^f) - \eta^m(y^f, y^m) - \zeta \log(h^m h^f))\Big) \cdot \\ & \Big(1 - \Phi(rV_s(f) - c^m(y^f, y^f) - \eta^f(y^m, y^f) - \zeta \log(h^f h^n))\Big). \end{aligned}$$

Following similar algebra as for the one-period model, and noting that the steady state condition equals the one in the model with transferrable utility establishes result 1.

Household public good provision: Following the logic of the one-period model, note that the cutoff level of female housework $\underline{h}^f$ accepted by the male equals

$$\underline{h}^f = \Big[\frac{1}{\zeta}(rV_s(m) - q_{mf} - \zeta \log(h^m) - c^m(y^m, y^f) - \eta^m(y^f, y^m))\Big].$$

Conducting analogous algebra as in the one-period model establishes result 2.

Divorce: Lastly, we extend the model to allow for endogenous divorce. To model divorce, assume that every period the match-specific taste shock gets updated with probability δ according to the updating rule $q_{mf}^{new} = min\{q_{mf}^{t}, q_{mf}^{t+1}\}$. Varying δ, we can make the stochastic process of q_{mf}'s more or less persistent. The resulting flow of divorces equals

$$m^{div}(m,f) = \delta(1 - P_{mf})m(m,f).$$

We obtain that the divorce rate for a given pair (m,f) equals

$$Div(m,f) = \delta(1 - P_{mf}).$$

Holding household public good supplies fixed, as in the one-period case, this expression exhibits a convex kink at the point where $y^m = y^f$.

Marriage Rates and Welfare Considerations

This section provides a discussion of the impact of preferences over relative income on marriage rates and welfare. For simplicity, we consider the model with non-transferrable utility outlined before. For illustration, we consider the case in which women have no concerns over relative income, while men exhibit preferences for being the primary earner. We then study how men's preferences affect marriage rates and welfare for women. Note that in the following the same intuitions carry overto alternative classes of preferences over relative income. Intuitively, in the model men's preferences over relative income act as a tax on women's earnings in terms of marriage prospects and welfare. In the exposition, we distinguish between the scenarios in which men's preferences over relative income are in form of either a notch or kink in utility. In our model notched preferences act as *proportional* taxes whereas kinked preferences act as *progressive* taxes.

Impact of Preferences over Relative Income on Marriage Rates

We first analyze the impact of men's preference for being the primary earner on marriage rates among matches in which the potential wife is the primary earner. To do so, we study how increases in women's income affect their marriage prospects. Furthermore, we investigate how these comparative statics are affected by changes in the strength of men's preferences. We first focus on the formulation of this preference in form of a kink in utility. For simplicity, we further assume that $\alpha_{\text{behind}} > \alpha_{\text{ahead}} = 0$. In addition, we assume that individuals value material consumption linearly with marginal utility $\delta > 0$ no matter whether they are married or single. This assumption does not affect the results but considerably shortens the math. For simplicity, we also assume that idiosyncratic taste shocks are distributed according to Φ for both women and men.

Preferences as a kink in utility: Consider a woman f earning y^f and providing housework h^f. Denote by $f_m(y)$ and $f_f(y)$ the income distributions of men and women. For f, the differential probability of marrying a secondary earner husband in the presence of men's preferences over relative income compared to the non-existence of these preferences is equal to

$$\begin{aligned}\Delta(y^f) &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\\ &\cdot(1-\Phi(-\delta y^f+\alpha_{\text{behind}}(y^f-y^m)-\zeta\log(h^f)))f_m(y^m)k_m(h^m|y^m)dh^m dy^m\\ &-\int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\\ &\cdot(1-\Phi(-\delta y^f-\zeta\log(h^f)))f_m(y^m)k_m(h^m|y^m)dh^m dy^m<0,\end{aligned}$$

where $\bar{h}$ is the maximum level of an individual's household public good provision and $k_m(h^m|y^m)$ denotes the male distribution of household public good provision conditional on income.
Taking the derivative with respect to y^f yields

$$\begin{aligned}d\Delta(y^f)/dy^f &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))(\delta-\alpha_{\text{behind}})\\ &\phi(-\delta y^f+\alpha_{\text{behind}}(y^f-y^m)-\zeta\log(h^f))f_m(y^m)k_m(h^m|y^m)dh^m dy^m\\ &-\int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\delta\\ &\cdot\phi(-\delta y^f-\zeta\log(h^f))f_m(y^m)k_m(h^m|y^m)dh^m dy^m\end{aligned}$$

A complication constitutes that the density of the taste shock is variable. If we assume that y^m and y^f are bounded and taste shocks are distributed uniformly on the interval $[b,k]$ (with b and k such that all matches have positive probability of marriage), we obtain

$$d\Delta(y^f)/dy^f = -\int_0^{y^f}\int_0^{\bar{h}}\Big(1-\frac{-\delta y^m-\zeta\log(h^m)-k}{b-k}\Big)\frac{\alpha_{\text{behind}}}{b-k}f_m(y^m)k_m(h^m|y^m)dh^m dy^m<0.$$

Hence, for women with a higher income y^f there is a strictly stronger impact of men's preferences for being the primary earner on women's probability of marrying a secondary earner man. Said differently, there is a negative impact on the differential probability of marrying a secondary earner man for each additional unit of income earned by a women. Furthermore,

$$d^2\Delta(y^f)/dy^{f2} = -\int_0^{\bar{h}}\Big(1-\frac{-\delta y^f-\zeta\log(h^m)-k}{b-k}\Big)\frac{\alpha_{\text{behind}}}{b-k}f_m(y^f)k_m(h^m|y^f)dh^m\leq 0.$$

Intuitively, the negative impact on the differential probability of marrying a secondary earner man is increasing in a woman's income y^f. Hence, men's preference for being the primary earner in form of a kink acts equivalently to a progressive tax on women's income in terms of marriage prospects. Next, we study the comparative statics if we change the strength of the preference parameter. Note,

$$\begin{aligned} d\Delta(y^f)/d\alpha_{\text{behind}} &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))(y^m-y^f) \\ &\cdot\phi(-\delta y^f+\alpha_{\text{behind}}(y^f-y^m)-\zeta\log(h^f)) \\ &\cdot f_m(y^m)k_m(h^m|y^m)dh^m dy^m<0, \end{aligned}$$

meaning that increases in the preference parameter decrease the probability of a women entering into a marriage with a secondary earner man. Again, assume that y^m and y^f are bounded and taste shocks are distributed uniformly on the interval $[b,k]$ (such that each potential match has a positive probability of marriage). Suppose there are two women f' and f'' with incomes $y^{f'}<y^{f''}$. In this case,

$$\begin{aligned} d\Delta(y^f)/d\alpha_{\text{behind}}|_{y^{f'}} &= \int_0^{y^{f'}}\int_0^{\bar{h}}\Big(1-\frac{-\delta y^m-\zeta\log(h^m)-k}{b-k}\Big)(y^m-y^{f'}) \\ &\cdot\frac{1}{b-k}f_m(y^m)k_m(h^m|y^m)dh^m dy^m<0 \end{aligned}$$

and

$$\begin{aligned} d\Delta(y^f)/d\alpha_{\text{behind}}|_{y^{f''}} &= \int_0^{y^{f'}}\int_0^{\bar{h}}\Big(1-\frac{-\delta y^m-\zeta\log(h^m)-k}{b-k}\Big) \\ &\cdot(y^m-y^{f'})\frac{1}{b-k}f_m(y^m)k_m(h^m|y^m)dh^m dy^m \\ &+\int_0^{y^{f'}}\int_0^{\bar{h}}\Big(1-\frac{-\delta y^m-\zeta\log(h^m)-k}{b-k}\Big) \\ &\cdot(y^{f'}-y^{f''})\frac{1}{b-k}f_m(y^m)k_m(h^m|y^m)dh^m dy^m \\ &+\int_{y^{f'}}^{y^{f''}}\int_0^{\bar{h}}\Big(1-\frac{-\delta y^m-\zeta\log(h^m)-k}{b-k}\Big) \\ &\cdot(y^m-y^{f''})\frac{1}{b-k}f_m(y^m)k_m(h^m|y^m)dh^m dy^m \\ &< d\Delta(y^f)/d\alpha_{\text{behind}}|_{y^{f'}}<0 \end{aligned}$$

Hence, the negative impact on the marriage probability of an increase in the preference parameter is larger among higher earner women. There are two effects. First, if $y^f=y^{f'}$, couples with male income in the range $[y^{f'},y^{f''}]$ are unaffected by an increase in the preference parameter. Second, there is a stronger crowding out-effect on matches with male income below $y^{f'}$ if $y^f=y^{f''}$ as compared to $y^f=y^{f'}$.

Preferences as a notch in utility: How do these comparative statics change if men's preference for being the primary earner is in form of a notch instead of a kink in utility? In this case, we obtain that the differential probability of marrying a secondary earner husband in the presence of men's preference for being the primary earner as compared to the case where these preferences do not exist equals

$$\begin{aligned}\Delta(y^f) &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\\ &\quad\cdot(1-\Phi(-\delta y^f+\alpha_{\text{behind}}-\zeta\log(h^f)))f_m(y^m)k_m(h^m|y^m)dh^m dy^m\\ &\quad-\int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\\ &\quad\cdot(1-\Phi(-\delta y^f-\zeta\log(h^f)))f_m(y^m)k_m(h^m|y^m)dh^m dy^m.\end{aligned}$$

Taking the derivative with respect to y^f yields

$$\begin{aligned}\frac{\Delta(y^f)}{dy^f} &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\delta\phi(-\delta y^f+\alpha_{\text{behind}}-\zeta\log(h^f)))\\ &\quad\cdot f_m(y^m)k_m(h^m|y^m)dh^m dy^m\\ &\quad+\int_0^{\bar{h}}(1-\Phi(-\delta y^f-\zeta\log(h^m)))(1-\Phi(-\delta y^f+\alpha_{\text{behind}}-\zeta\log(h^f)))\\ &\quad\cdot f_m(y^f)k_m(h^m|y^f)dh^m\\ &\quad-\int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^m-\zeta\log(h^m)))\delta\phi(-\delta y^f-\zeta\log(h^f)))\\ &\quad\cdot f_m(y^m)k_m(h^m|y^m)dh^m dy^m\\ &\quad-\int_0^{\bar{h}}(1-\Phi(-\delta y^f-\zeta\log(h^m)))(1-\Phi(-\delta y^f-\zeta\log(h^f)))\\ &\quad\cdot f_m(y^f)k_m(h^m|y^f)dh^m.\end{aligned}$$

Again, assume that the income distributions are bounded and taste shocks are distributed uniformly on the interval $[b,k]$ (such that each potential match has a positive probability of marriage). Then,

$$d\Delta(y^f)/dy^f = -\int_0^{\bar{h}}\Big(1-\frac{-\delta y^f-\zeta\log(h^m)-k}{b-k}\Big)\frac{\alpha_{\text{behind}}}{b-k}f_m(y^f)k_m(h^m|y^f)dh^m\leq 0.$$

Hence, there is a negative impact on the differential probability of marrying a secondary earner man for each additional unit of income earned by a women. Now, consider again two women earning $y^{f''}>y^{f'}$. Does it still hold that the negative impact is increasing in a woman's income

y^f, i.e. $d\Delta(y^f)/dy^f|_{y^{f\prime}} > d\Delta(y^f)/dy^f|_{y^{f\prime\prime}}$? The effect is ambiguous as it depends on the mass of men at y^f, i.e., $f_m(y^f)$. If $f_m(y^f)$ is small, there will be a small impact of men's preferences on the marriage rate. As a consequence, the marginal impact of men's preferences will be small for women at the top of the income distribution where the density is low, and large for women around the mode of the income distribution. Hence, men's preference for being the primary earner in form of a notch acts equivalently to a proportional tax on women's income in terms of marriage prospects.

Remember that the negative marginal impact of each additional unit of income earned is increasing in a woman's income in the case of preferences in form of a kink. Where does this difference stem from? If the norm is in form of a kink, each additional unit of income earned by a women will reduce the marriage probability for *all* matches where a woman out-earns the potential husband. In case of a notch, each additional unit of income earned will reduce the marriage probability only for those matches where a woman out-earns the potential husband due to precisely this additional unit of income. In sum, if we conceptualize preferences over relative income as a tax on income in form of marriage returns, we can think of a preference for being the primary earner in form of a kink as a progressive tax, while in case of a notch as a proportional tax.

Next, we again study the comparative statics if we change the strength of the preference parameter. If we assume uniformity of the taste shock as before, we obtain

$$\begin{aligned} d\Delta(y^f)/d\alpha_{\text{behind}} &= -\int_0^{y^f}\int_0^{\bar{h}} \Big(1 - \frac{-\delta y^m - \zeta \log(h^m) - k}{b-k}\Big) \frac{1}{b-k} f_m(y^m) k_m(h^m|y^m) dh^m dy^m \\ &\leq 0. \end{aligned}$$

Is the impact of an increase in α_{behind} stronger if y^f is larger?

$$d^2\Delta(y^f)/d\alpha_{\text{behind}} dy^f = -\int_0^{\bar{h}} \Big(1 - \frac{-\delta y^f - \zeta \log(h^m) - k}{b-k}\Big) \frac{1}{b-k} f_m(y^f) k_m(h^m|y^f) dh^m \leq 0.$$

Again, if there is a small mass of man around y^f, an increase in the norm does not affect women with higher y^f in a stronger magnitude at the margin.

Impact of Preferences over Relative Income on Welfare

We conduct a parallel analysis on the impact on women's welfare from a match with a secondary earner man. The results and their intuition mirror those for the marriage rates.

Preferences as a kink in utility: Note that a woman's differential welfare from a match with a secondary earner man in the presence of the men's preferences over relative income compared to the situation in which such preferences are absent is equal to

$$
\begin{aligned}
W(y^f) &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^f+\alpha_{\text{behind}}(y^f-y^m)-\zeta\log(h^f))) \\
&\quad \int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\
&\quad -\int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^f-\zeta\log(h^f))) \\
&\quad \cdot\int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m.
\end{aligned}
$$

Taking the derivative with respect to y^f yields

$$
\begin{aligned}
\frac{dW(y^f)}{dy^f} &= \int_0^{y^f}\int_0^{\bar{h}}(\delta-\alpha_{\text{behind}})\phi(-\delta y^f+\alpha_{\text{behind}}(y^f-y^m)-\zeta\log(h^f)) \\
&\quad \int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\
&\quad -\int_0^{y^f}\int_0^{\bar{h}}\delta\phi(-\delta y^f-\zeta\log(h^f)) \\
&\quad \cdot\int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m.
\end{aligned}
$$

Again, assume that the income distributions are bounded and taste shocks are distributed uniformly on the interval $[b,k]$ (such that each potential match has a positive probability of marriage). Then,

$$
\begin{aligned}
dW(y^f)/dy^f &= -\int_0^{y^f}\int_0^{\bar{h}}\frac{\alpha_{\text{behind}}}{b-k} \\
&\quad \cdot\int_{-\delta y^m-\zeta\log(h^m)}^{b}(\delta y^m+\zeta\log(h^m)+q_{fm}) \\
&\quad \cdot\frac{1}{b-k}dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m<0.
\end{aligned}
$$

and

$$
\begin{aligned}
d^2W(y^f)/dy^{f2} &= -\int_0^{\bar{h}}\frac{\alpha_{\text{behind}}}{b-k}\int_{-\delta y^f-\zeta\log(h^m)}^{b}(\delta y^f+\zeta\log(h^m)+q_{fm}) \\
&\quad \cdot\frac{1}{b-k}dq_{fm}k_m(h^m|y^f)dh^m f_m(y^f)\leq 0.
\end{aligned}
$$

Hence, for women with a higher income y^f there is a stronger impact of men's preferences on welfare. Furthermore, the negative impact on welfare is increasing in a woman's income y^f.
We do a parallel analysis as above for changes in the preference parameter α_{behind}. Note,

$$\begin{aligned} dW(y^f)/d\alpha_{\text{behind}} &= -\int_0^{y^f}\int_0^{\bar{h}}(y^f-y^m)\phi(-\delta y^f+\alpha_{\text{behind}}(y^f-y^m)-\zeta\log(h^f)) \\ &\quad \int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm} \\ &\quad \cdot k_m(h^m|y^m)dh^m f_m(y^m)dy^m<0. \end{aligned}$$

Again, suppose there are two women f' and f'' with incomes $y^{f'}<y^{f''}$. and assume that y^m and y^f are bounded and taste shocks are distributed uniformly on the interval $[b,k]$ (such that each potential match has a positive probability of marriage). In this case,

$$\begin{aligned} dW(y^f)/d\alpha_{\text{behind}}\big|_{y^{f'}} &= -\int_0^{y^{f'}}\int_0^{\bar{h}}(y^{f'}-y^m) \\ &= \cdot\frac{1}{b-k}\int_{-\delta y^m-\zeta\log(h^m)}^{b}(\delta y^m+\zeta\log(h^m)+q_{fm})\frac{1}{b-k}dq_{fm} \\ &\quad \cdot k_m(h^m|y^m)dh^m f_m(y^m)dy^m<0. \end{aligned}$$

and

$$\begin{aligned} \frac{dW(y^f)}{d\alpha_{\text{behind}}\big|_{y^{f''}}} &= -\int_0^{y^{f'}}\int_0^{\bar{h}}(y^{f'}-y^m)\Big(\frac{1}{b-k}\Big)^2 \\ &\quad \cdot\int_{-\delta y^m-\zeta\log(h^m)}^{b}(\delta y^m+\zeta\log(h^m)+q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\ &\quad -\int_0^{y^{f'}}\int_0^{\bar{h}}(y^{f''}-y^{f'})\Big(\frac{1}{b-k}\Big)^2 \\ &\quad \cdot\int_{-\delta y^m-\zeta\log(h^m)}^{b}(\delta y^m+\zeta\log(h^m)+q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\ &\quad -\int_{y^{f'}}^{y^{f''}}\int_0^{\bar{h}}(y^{f''}-y^m)\Big(\frac{1}{b-k}\Big)^2 \\ &\quad \cdot\int_{-\delta y^m-\zeta\log(h^m)}^{b}(\delta y^m+\zeta\log(h^m)+q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\ &< dW(y^f)/d\alpha_{\text{behind}}\big|_{y^{f'}}<0. \end{aligned}$$

Hence, the impact of an increase in men's preference is bigger if $y^{f''} > y^{f'}$. The logic follows the intuition on the impact on marriage rates.

Preferences as a notch in utility: In the case in which men's preference for being the primary earner are in form of a notch in utility, a woman's differential welfare from a match with a secondary earner man in the presence of these preference compared to the situation where these preferences are absent is equal to

$$\begin{aligned} W(y^f) &= \int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^f+\alpha_{\text{behind}}-\zeta\log(h^f))) \\ &\quad\cdot\int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\ &\quad-\int_0^{y^f}\int_0^{\bar{h}}(1-\Phi(-\delta y^f-\zeta\log(h^f))) \\ &\quad\cdot\int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m. \end{aligned}$$

Taking the derivative with respect to y^f yields

$$\begin{aligned} dW(y^f)/dy^f &= \int_0^{y^f}\int_0^{\bar{h}}\delta\phi(-\delta y^f+\alpha_{\text{behind}}-\zeta\log(h^f)) \\ &\quad\cdot\int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\ &\quad+\int_0^{\bar{h}}(1-\Phi(-\delta y^f+\alpha_{\text{behind}}-\zeta\log(h^f))) \\ &\quad\cdot\int_{-\delta y^f-\zeta\log(h^m)}^{\infty}(\delta y^f+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^f)dh^m f_m(y^f) \\ &\quad-\int_0^{y^f}\int_0^{\bar{h}}\delta\phi(-\delta y^f-\zeta\log(h^f)) \\ &\quad\cdot\int_{-\delta y^m-\zeta\log(h^m)}^{\infty}(\delta y^m+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^m)dh^m f_m(y^m)dy^m \\ &\quad-\int_0^{\bar{h}}(1-\Phi(-\delta y^f-\zeta\log(h^f))) \\ &\quad\cdot\int_{-\delta y^f-\zeta\log(h^m)}^{\infty}(\delta y^f+\zeta\log(h^m)+q_{fm})\phi(q_{fm})dq_{fm}k_m(h^m|y^f)dh^m f_m(y^f). \end{aligned}$$

Again, assume that y^f and y^f are bounded and taste shocks are distributed uniformly on the interval $[b,k]$ and that $y^{f'} < y^{f''}$ (such that each potential match has a positive probability of marriage). In this case,

$$dW(y^f)/dy^f = -\int_0^{\bar{h}} \frac{\alpha_{\text{behind}}}{b-k} \int_{-\delta y^f - \zeta \log(h^m)}^{b} (\delta y^f + \zeta \log(h^m) + q_{fm}) \frac{1}{b-k} dq_{fm} \cdot k_m(h^m|y^f) dh^m f_m(y^f) \leq 0.$$

Consider again two women earning $y^{f\prime\prime} > y^{f\prime}$. Does it still hold that $dW(y^f)/dy^f|_{y^{f\prime}} > dW(y^f)/dy^f|_{y^{f\prime\prime}}$? The effect is ambiguous as it depends on the mass of men at y^f, i.e., $f_m(y^f)$. If $f_m(y^f)$ is small there will be a small impact on welfare. Hence, the marginal impact will be small for top earning women, and large for women around the mode of the income distribution.
We do a parallel analysis as above for changes in the preference parameter α_{behind}. Note,

$$dW(y^f)/d\alpha_{\text{behind}} = -\int_0^{y^f} \int_0^{\bar{h}} \frac{1}{b-k} \int_{-\delta y^m - \zeta \log(h^m)}^{b} (\delta y^m + \zeta \log(h^m) + q_{fm}) \frac{1}{b-k} dq_{fm} k_m(h^m|y^m) dh^m f_m(y^m) dy^m \leq 0.$$

Is the impact of an increase in α_{behind} stronger if y^f is larger?

$$d^2W(y^f)/d\alpha_{\text{behind}} dy^f = -\int_0^{\bar{h}} \frac{1}{b-k} \int_{-\delta y^f - \zeta \log(h^m)}^{b} (\delta y^f + \zeta \log(h^m) + q_{fm}) \frac{1}{b-k} dq_{fm} k_m(h^m|y^f) dh^m f_m(y^f) \leq 0.$$

Hence, if there is a small mass of man around y^f, an increase in the norm does not affect women with higher y^f in a stronger way at the margin.

Experimental Evidence: Alternative Functional Forms and Non-Parametric Evidence

United States:

The main experimental evidence assumed piecewise linear preferences. In this section, we discuss evidence under alternative functional form assumptions.

First, we enrich specification (1.2) by including dummies for being the secondary $I(p_A < 0.5)$ or primary earner $I(p_A > 0.5)$ in the situation with an unequal composition of relative income. Including these dummies allows for asymmetric discontinuities in preferences over relative income to the left or right of the 50%-threshold. In intuitive terms, the estimated coefficients on these dummies β_{behind} and β_{ahead} can be interpreted as the discrete utility obtained when changing the

composition of relative income from an unequal distribution to a 50%-50% split. In addition, we allow for a quadratic term in relative income.

Table 1.9 presents the results for the full sample and respondents who exhibit consistent answering behavior. In the linear specifications (odd columns), β_{ahead} is close to zero for both women and men. However, we obtain a large and statistically significant coefficient β_{behind}, suggesting a discrete disutility from being the secondary earner. However, given that we estimate a model with a linear functional form assumption, the large coefficient might represent a non-linearity rather than a discrete jump. Such non-linearities were already suggested by the qualitative evidence for men in Figure 1.16.

In order to investigate this possibility, columns (5) to (8) include quadratic terms for the own relative income share. In these specifications, the coefficient β_{behind} becomes statistically insignificant and close to zero for both women and men. In Figures 1.19 and 1.20, we visualize the quadratic fit including a non-parametric representation of preferences over relative income for both the full sample as well as respondents exhibiting consistent answering behavior. The regressions as well as graphical evidence suggest that the differential discontinuities at the 50% threshold in the linear specification rather represent non-linearities. We conclude, that there is no robust evidence for a differential jump in utility at the 50% threshold consistent with kinked preferences over relative income.

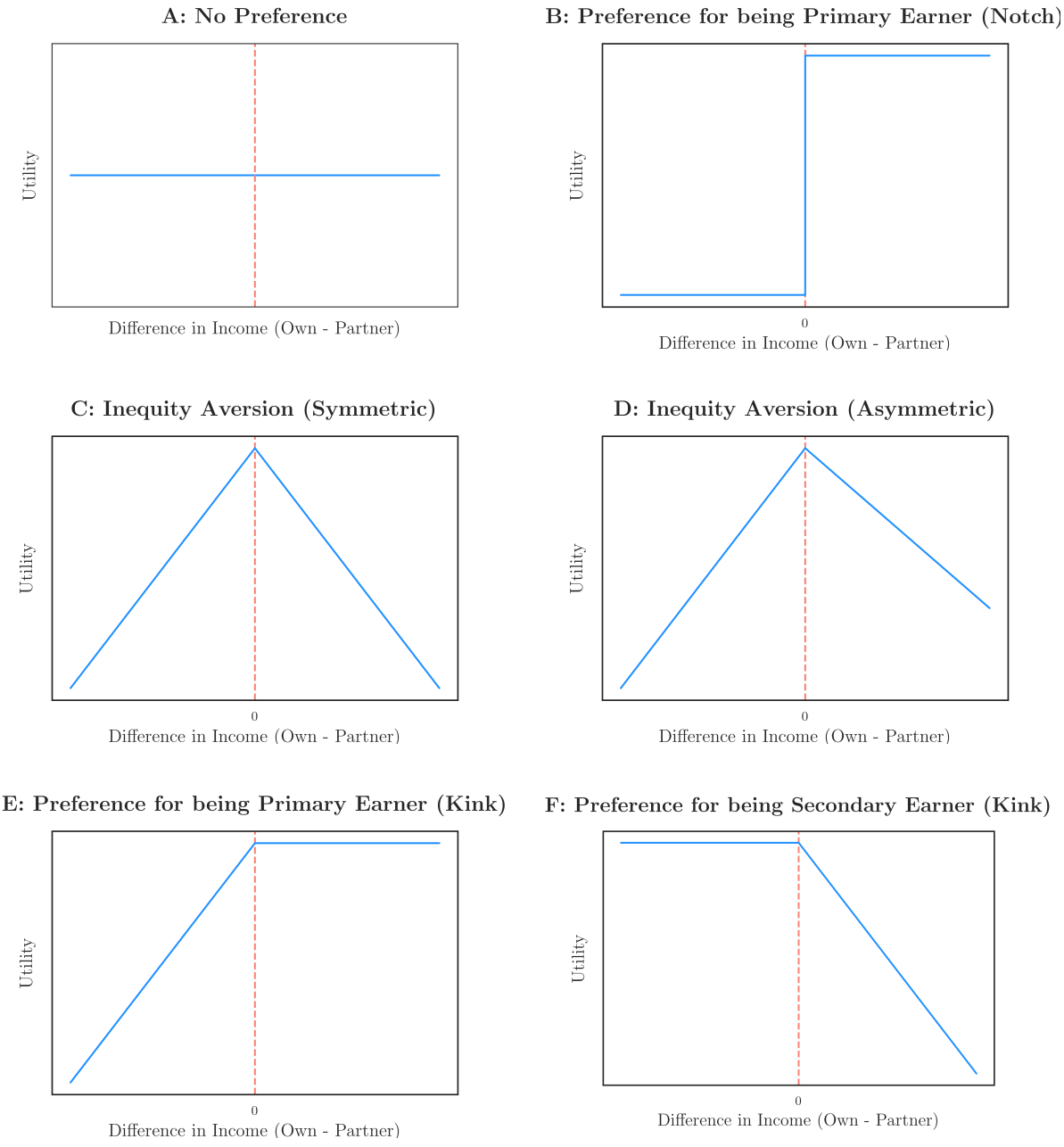
In sum, the evidence suggest that women's preferences over relative income exhibit symmetric inequality aversion. Men on the other hand show a preference for being the primary earner (or highly asymmetric inequality aversion). Furthermore, both men's and women's preferences are in form of a kink in utility at the 50% threshold rather than a differential notch.

Germany:

We find patterns similar to the United States when testing for differential notches at the 50% threshold of relative income and investigating more flexible functional forms (Table 1.13 and Figures 1.23 and 1.24).

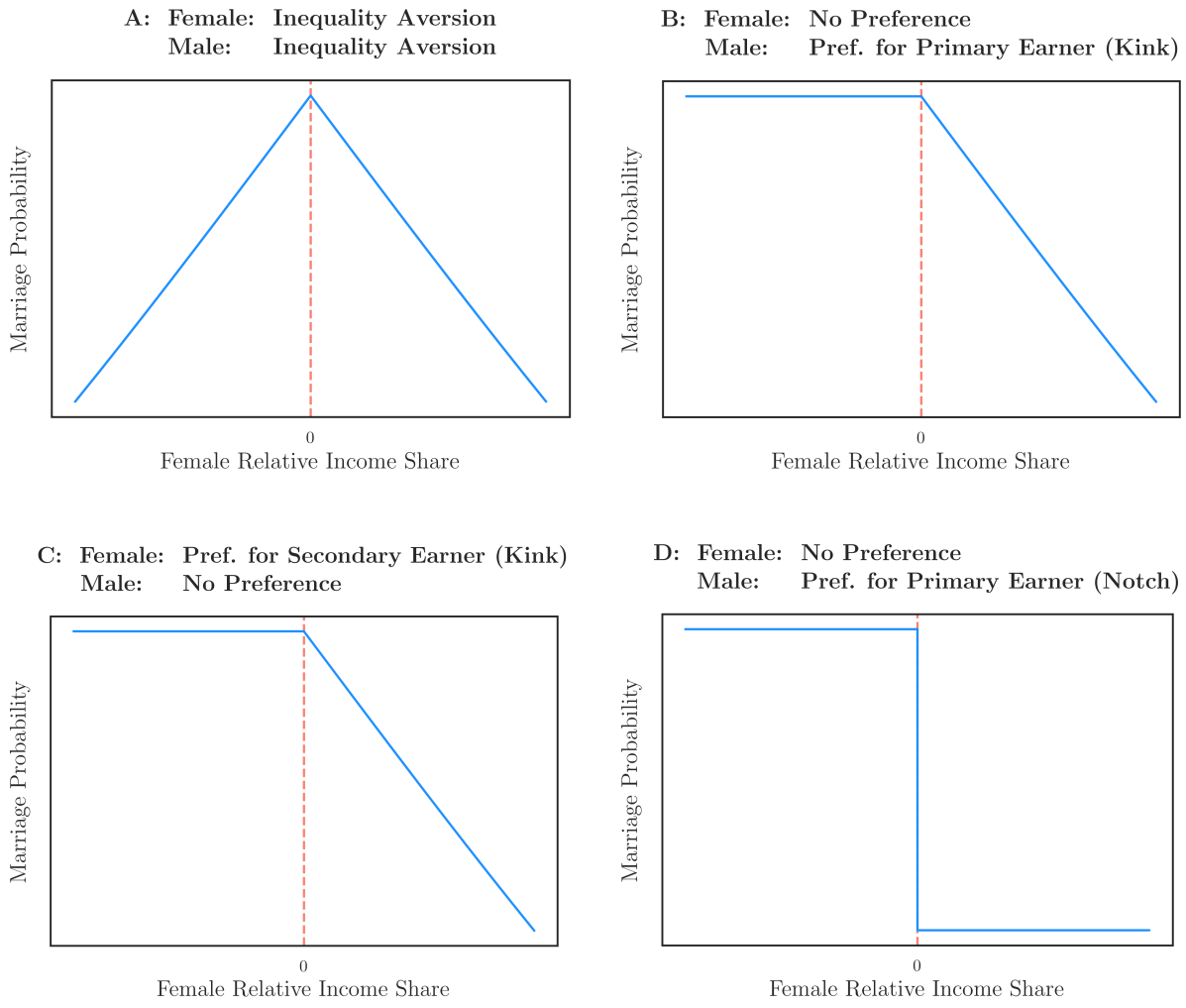
1.7 Figures and Tables

Figure 1.1: Preferences over Relative Income



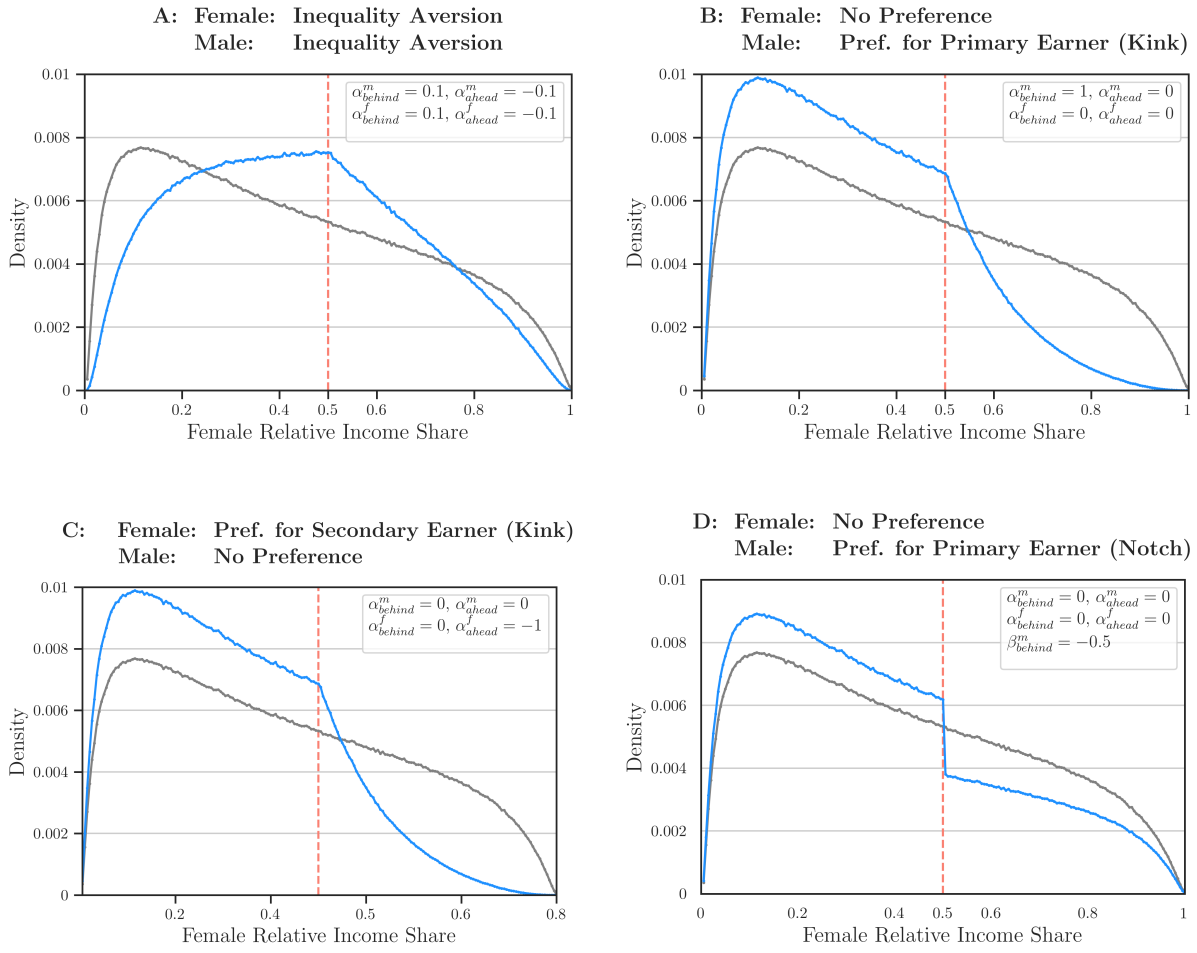
Notes: Figure 1.1 visualizes different preferences over relative income. The x-axis indicates relative income, i.e. the income difference between own and partner income, the y-axis the utility level.

Figure 1.2: Marriage Probabilities: Illustration



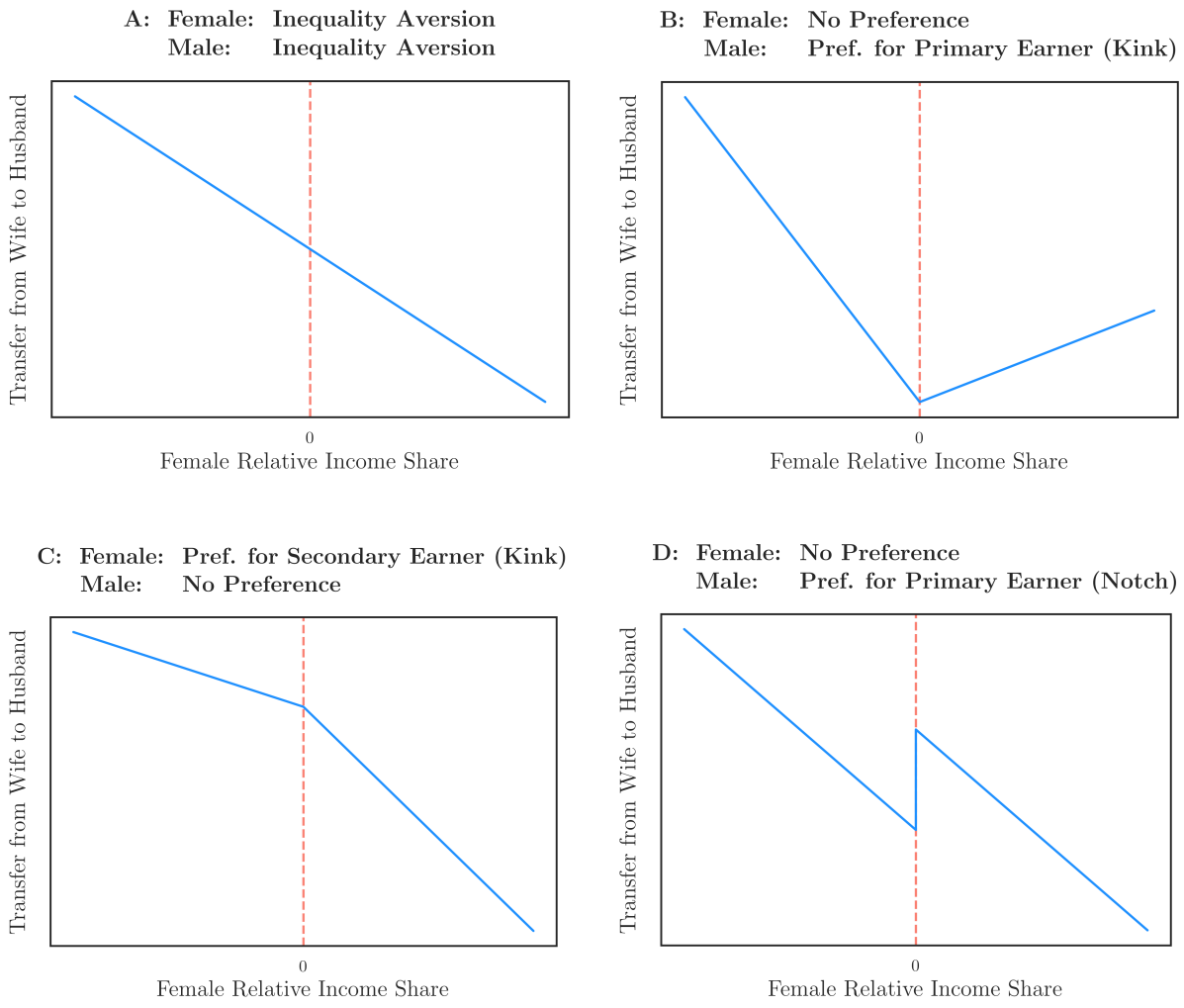
Notes: Figure 1.2 schematically illustrates marriage probabilities for different combinations of partners' preferences over relative income. Panel A assumes that both men and women feature symmetric inequality aversion. Panel B assumes that men feature a kinked preference for being the primary earner and women have no concerns over relative income. Panel C assumes that women feature a kinked preference for being the secondary earner and men have no concerns over relative income. Panel D assumes that men feature a notched preference for being the primary earner and women have no concerns over relative income.

Figure 1.3: Simulated Relative Income Distributions



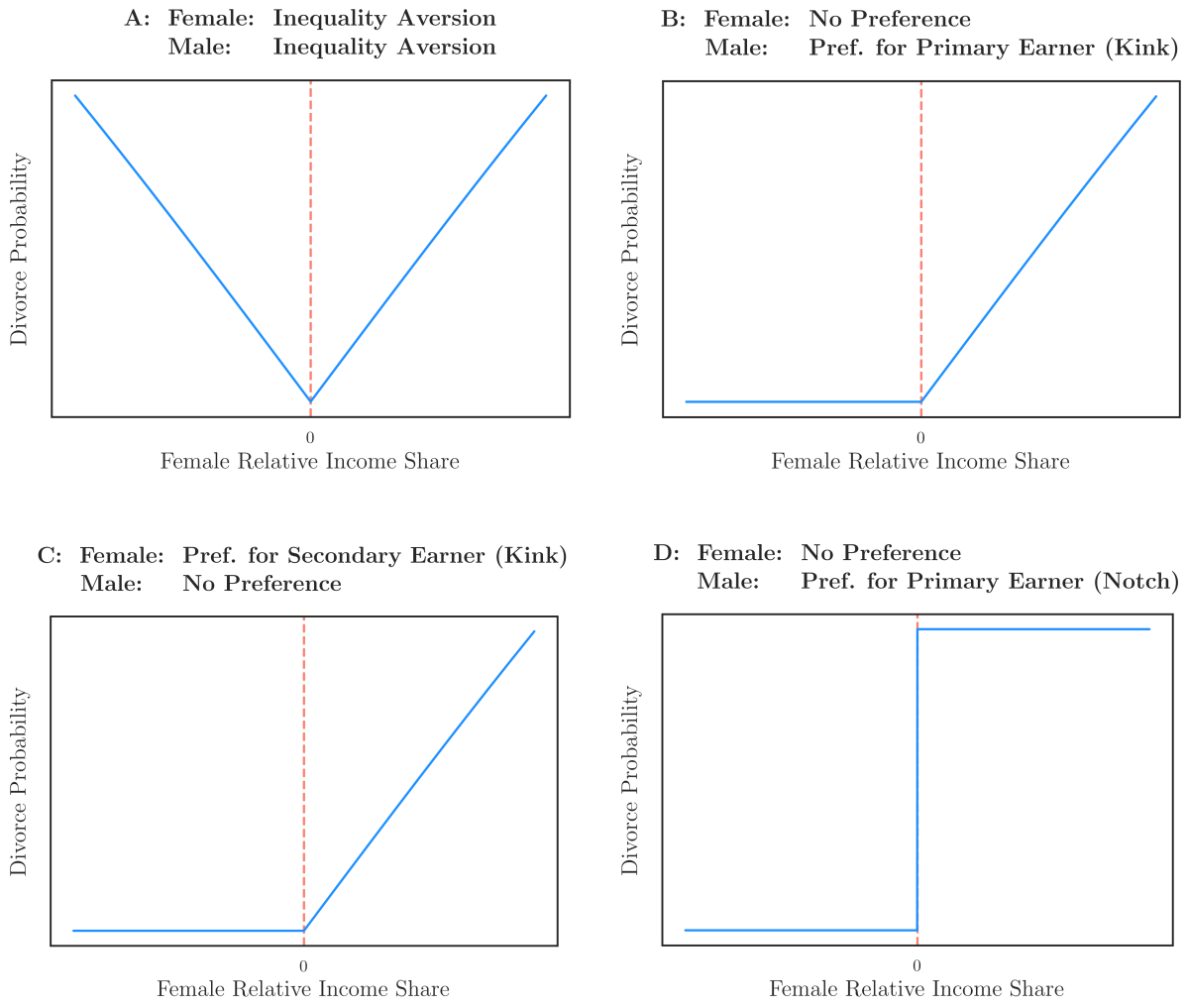
Notes: Figure 1.3 visualizes simulated relative income distribution under different assumptions on partners' preferences over relative income (blue distributions) and counterfactual distributions under the assumption of random matching (gray lines). We assume that male and female incomes are distributed log-normally with $\mu = 0$ or $\mu = 0.5$ respectively and $\sigma = 1$. For simplicity, we assume that utility from consumption is linear and excludable: $c^f(y^f, y^m) = c^f(y^f) = y^f$ and $c^m(y^m, y^f) = c^m(y^m) = y^m$. Panel titles indicate the combination partners' preferences over relative income. Preference parameters are listed within the panels.

Figure 1.4: Intra-household Transfers: Illustration



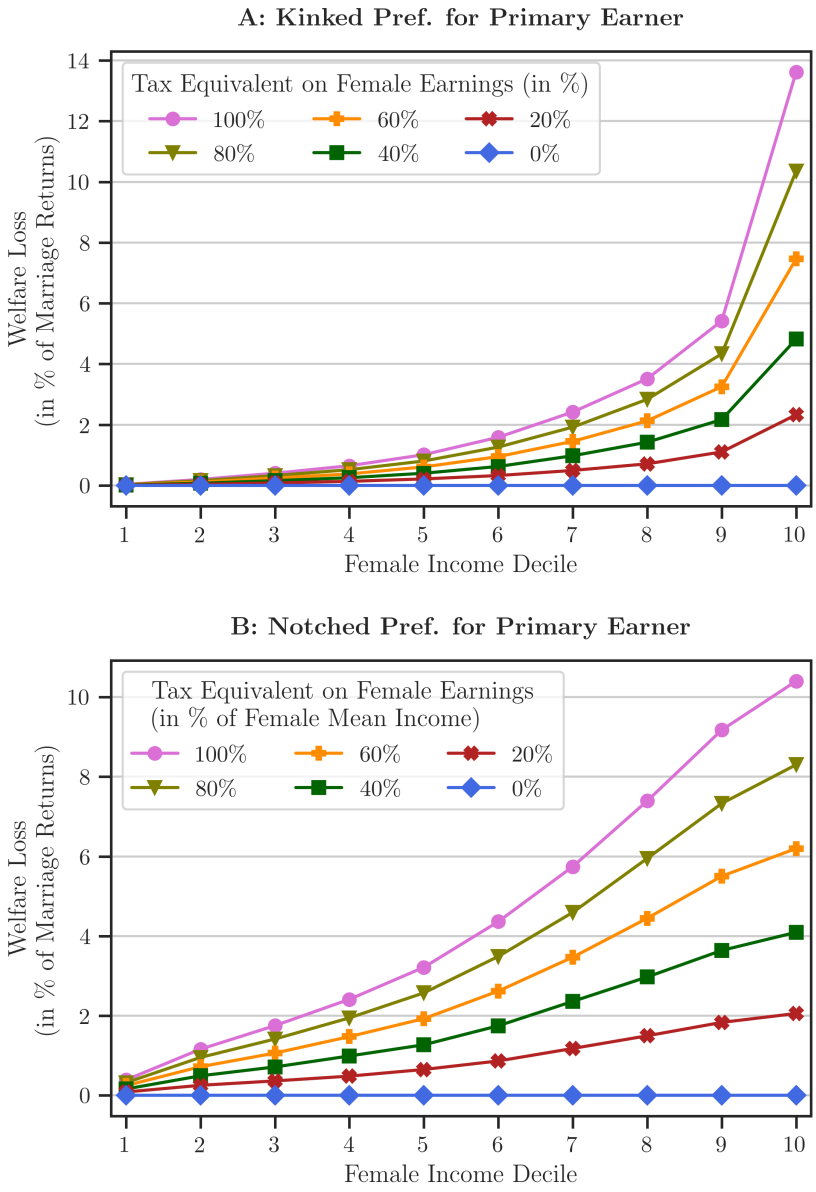
Notes: Figure 1.4 schematically illustrates intra-household transfers for different combinations of partners' preferences over relative income. Panel A assumes that both men and women feature symmetric inequality aversion. Panel B assumes that men feature a kinked preference for being the primary earner and women have no concerns over relative income. Panel C assumes that women feature a kinked preference for being the secondary earner and men have no concerns over relative income. Panel D assumes that men feature a notched preference for being the primary earner and women have no concerns over relative income.

Figure 1.5: Divorce Probabilities: Illustration



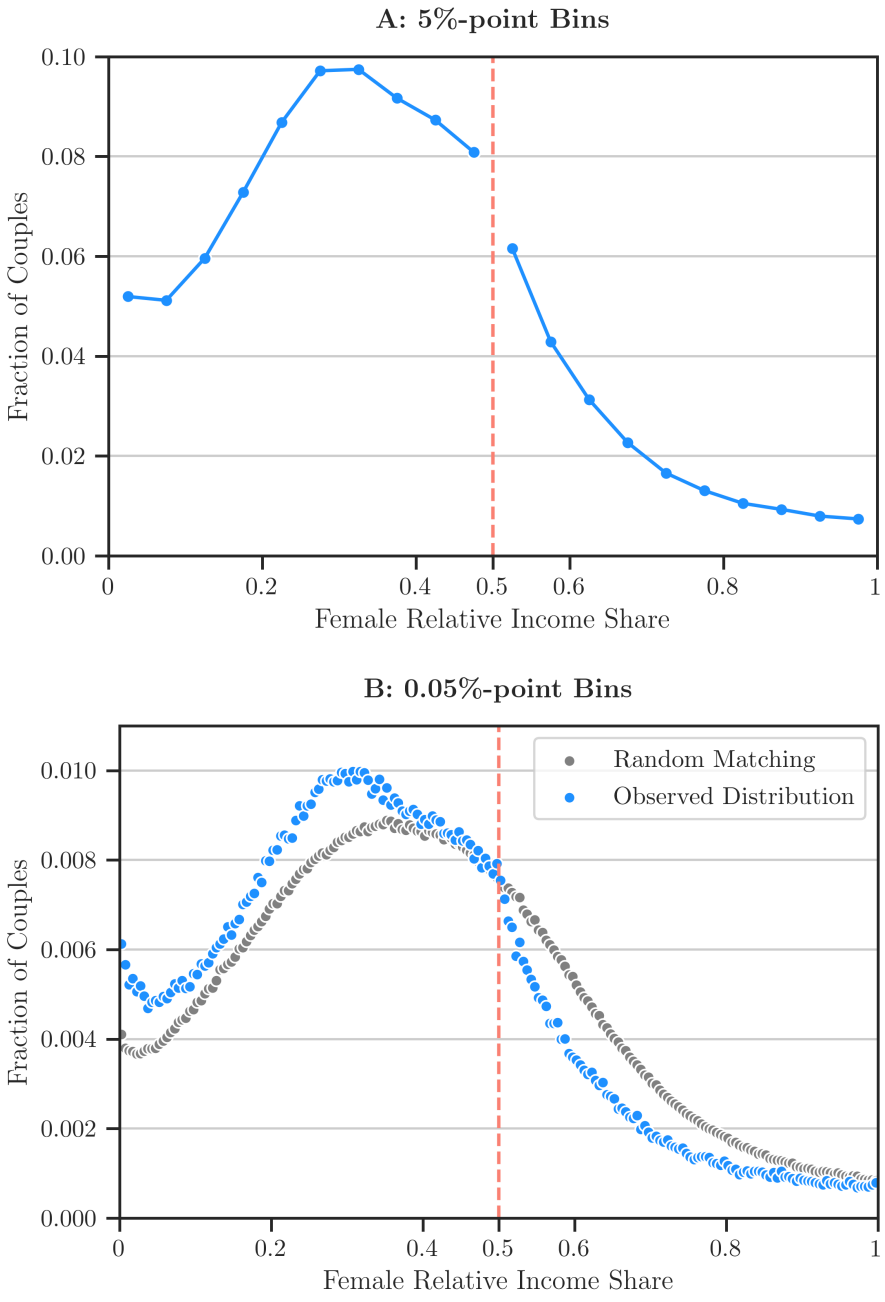
Notes: Figure 1.5 schematically illustrates divorce probabilities for different combinations of partners' preferences over relative income. Panel A assumes that both men and women feature symmetric inequality aversion. Panel B assumes that men feature a kinked preference for being the primary earner and women have no concerns over relative income. Panel C assumes that women feature a kinked preference for being the secondary earner and men have no concerns over relative income. Panel D assumes that men feature a notched preference for being the primary earner and women have no concerns over relative income.

Figure 1.6: Implications of Male Preferences for Being the Primary Earner for Women's Welfare



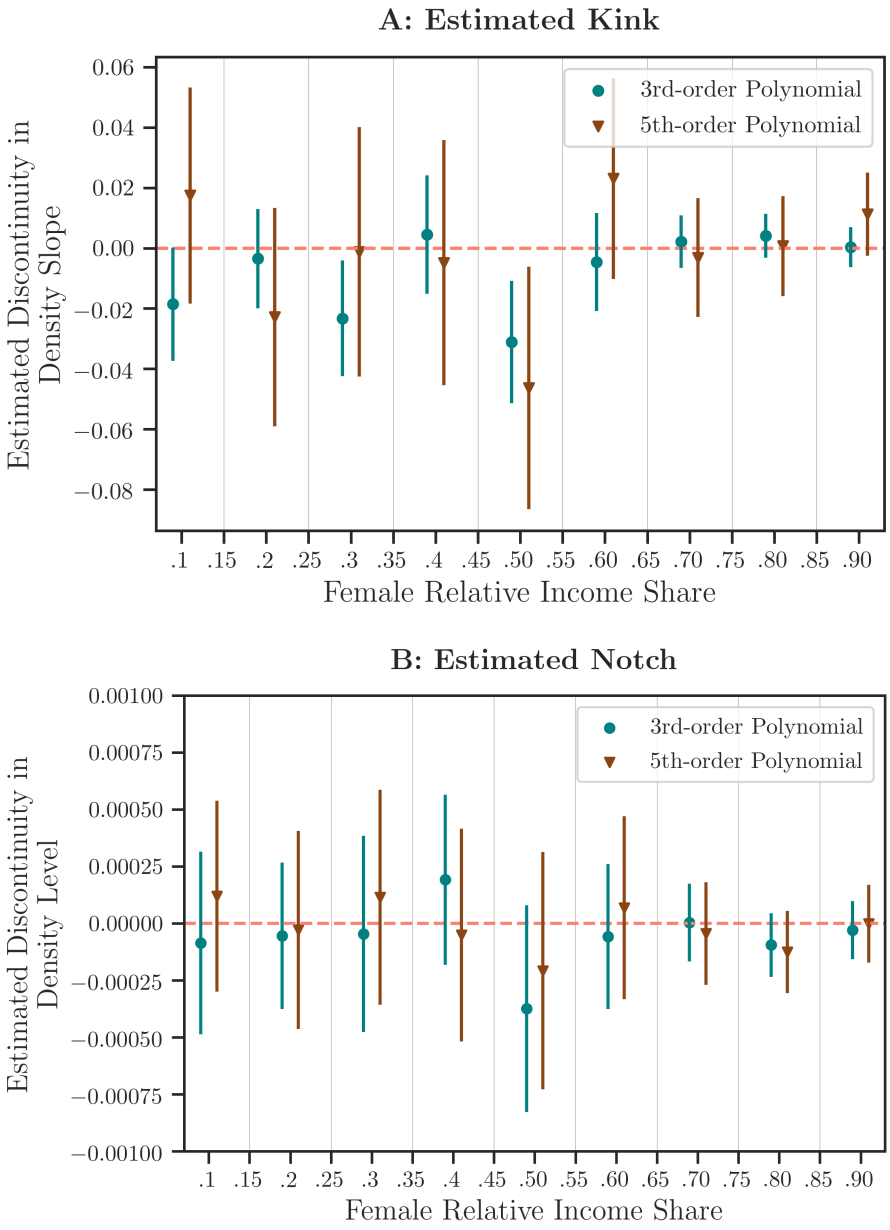
Notes: Figure 1.6 plots the welfare loss incured by women as a function of their income decile if men hold preferences for being the breadwinner either as a kink in utility (Panel A) or as a notch in utility (Panel B). For the calibration, we assume the gender-specific income distributions in Germany. We further assume, that utility from income is linear with slope coefficient one and taste shocks are assumed to follow a uniform distribution. We further assume that women exhibit no preferences over relative income. In Panel A, we assume that men's preferences over relative income are kinked with $\alpha_{\text{ahead}} = 0$ and $\alpha_{\text{behind}} \in \{0, 0.2, 0.4, 0.6, 0.8, 1\}$ which can be conceptualized as implicit taxes on women's earnings. In Panel B, we assume men's preferences to exhibit a notch that corresponds to different utility-equivalents in terms of women's average earnings.

Figure 1.7: Relative Income Distribution for Germany



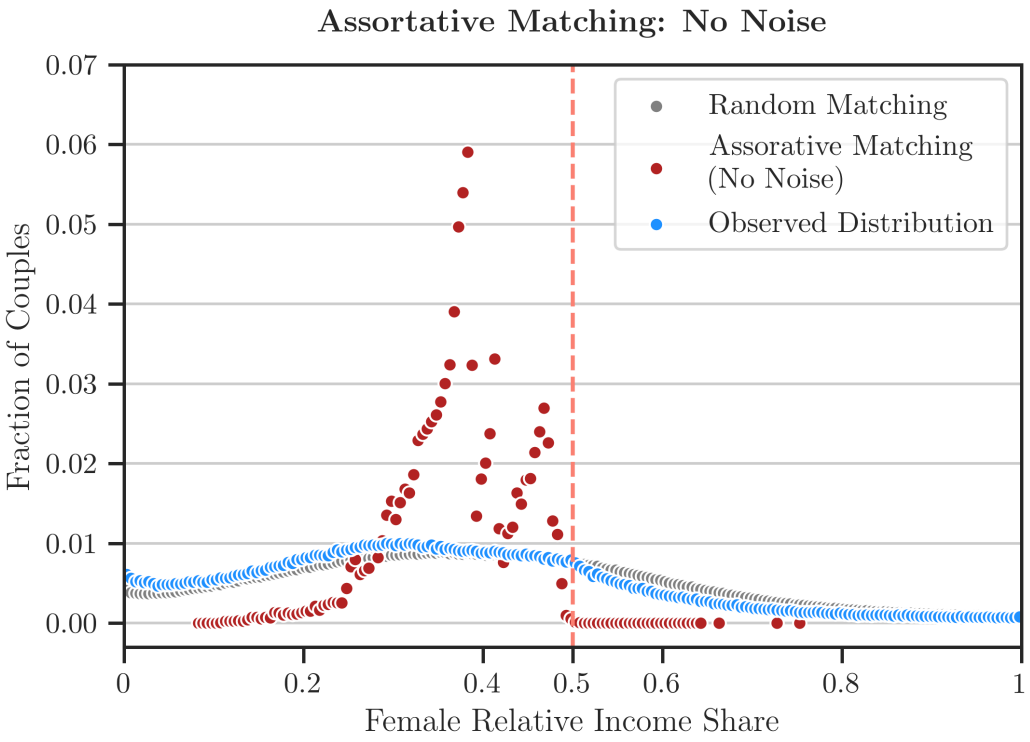
Notes: Figure 1.7 plots the relative income distribution using 5%-point bins (Panel A) and 0.5%-point bins (Panel B) for Germany (blue dots). Panel B additionally contains a counterfactual distribution arising from random matching of couples (gray dots). Random matching is performed within 10-year age bins and geographical regions. The red line marks the 50% threshold at which both spouses earn the same income.

Figure 1.8: Testing for Kink and Discontinuity along the Relative Income Distribution



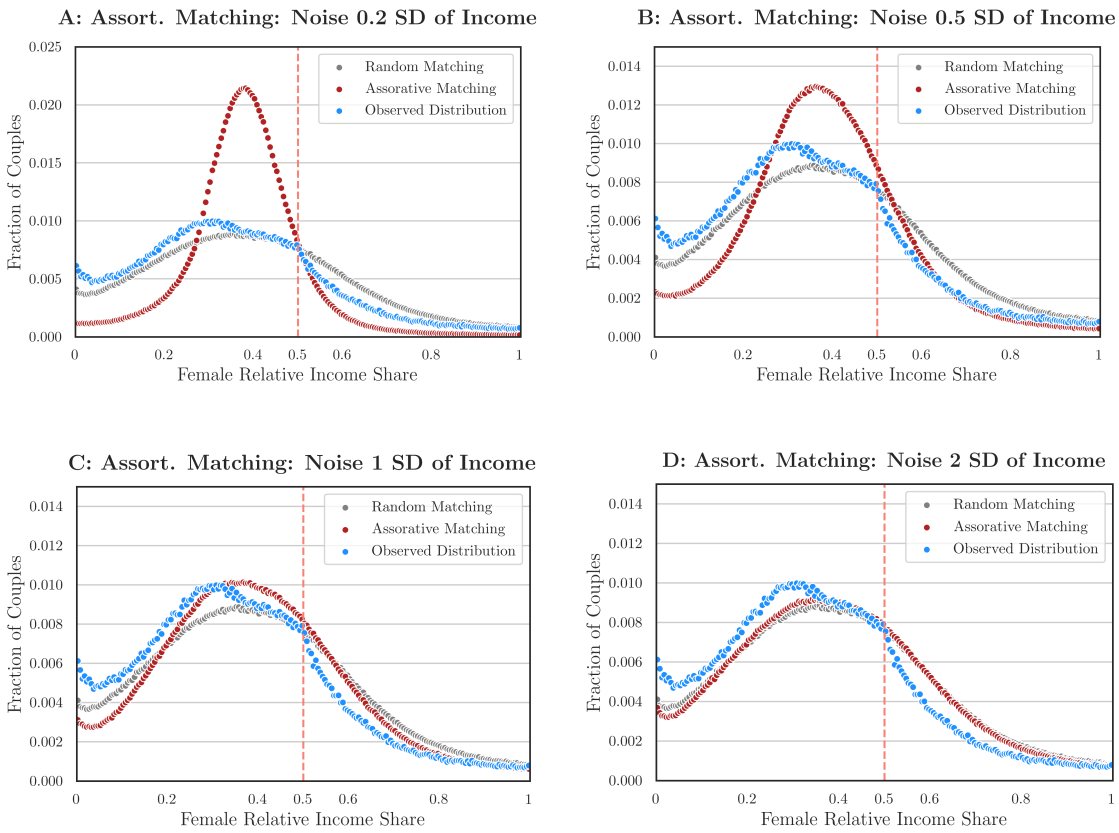
Notes: Figure 1.8, Panel A depicts estimated discontinuities in the slope for each 5%-threshold along the relative income distribution. A 3rd- and 5th-order polynomial is fitted to the relative income distribution within the $+/-10\%$-point range of the respective threshold, allowing for a slope change in the linear term. Following a "donut hole" approach, we exclude the observations just to the left and the right of each threshold. The figure depicts for different order polynomials the estimated coefficient on the slope change, including 99% confidence intervals. Figure 1.8, Panel B repeats this exercise but allowing for a discontinuity instead of a slope change at each threshold. The figure depicts for different order polynomials the estimated coefficient on the discontinuity, including 99% confidence intervals.

Figure 1.9: The Relative Income Distribution: Assortative Matching on Income Ranks



Notes: Figure 1.9 plots the relative income distribution resulting from assortative matching based on income ranks. Each female and male respondent is matched to the individual of the opposite gender with the same rank in the income distribution. We assume there is no noise in the matching process. The red line marks the 50% threshold at which both spouses earn the same income.

Figure 1.10: The Relative Income Distribution: Matching on Income Ranks with Noise

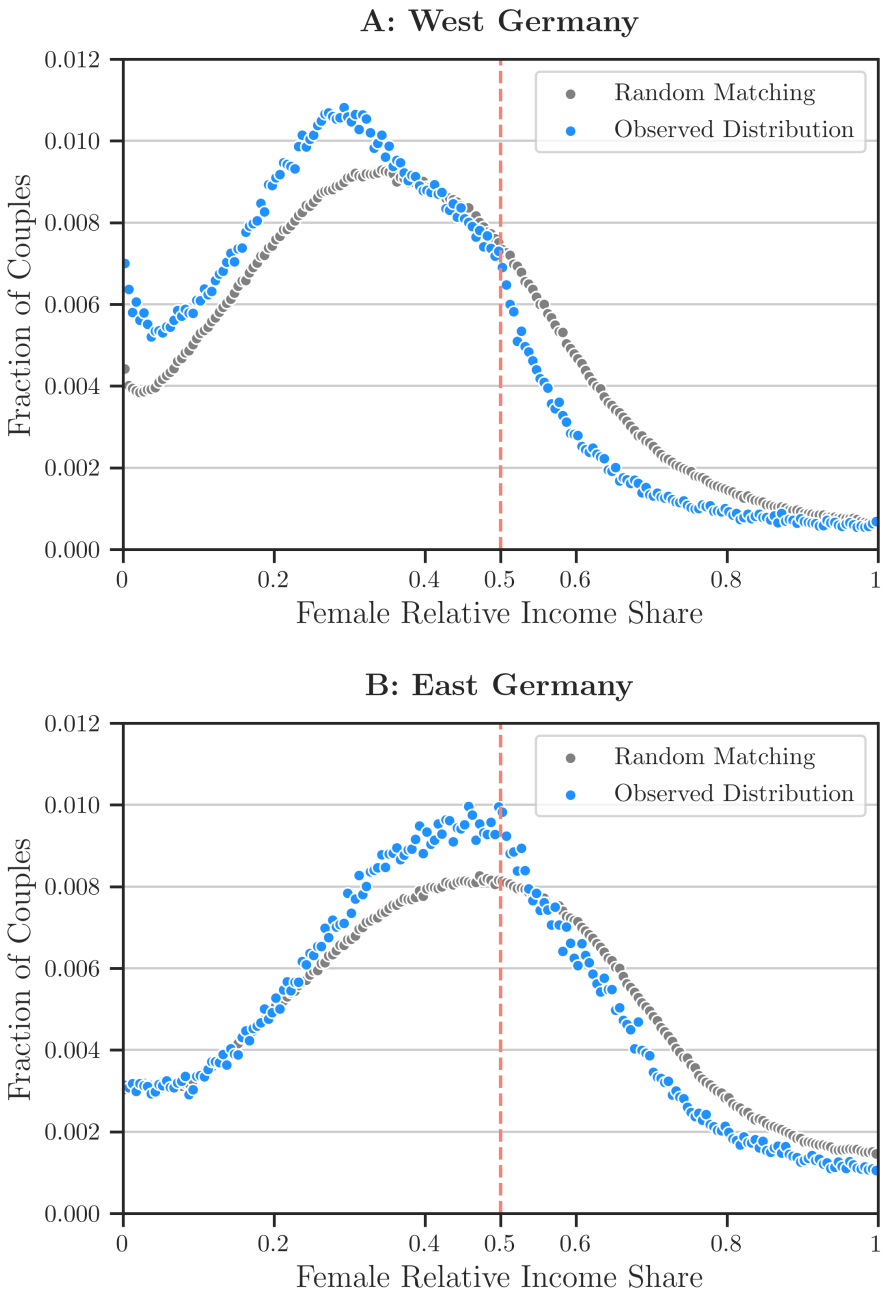


Notes: Figure 1.10 plots the relative income distribution resulting from matching based on income ranks distorted with different degrees of noise. For this purpose, female and male individuals are ranked according to their income level to which a noise term was added. The noise term is distributed according to a normal distribution with a mean of zero and a standard deviation expressed in terms of the standard deviation of the gender-specific income distribution (see panel titles). Each female and male respondent is then matched to the individual of the opposite gender with the same rank. The red line marks the 50% threshold at which both spouses earn the same income.

Figure 1.11: The Relative Income Distribution for Wage Earners

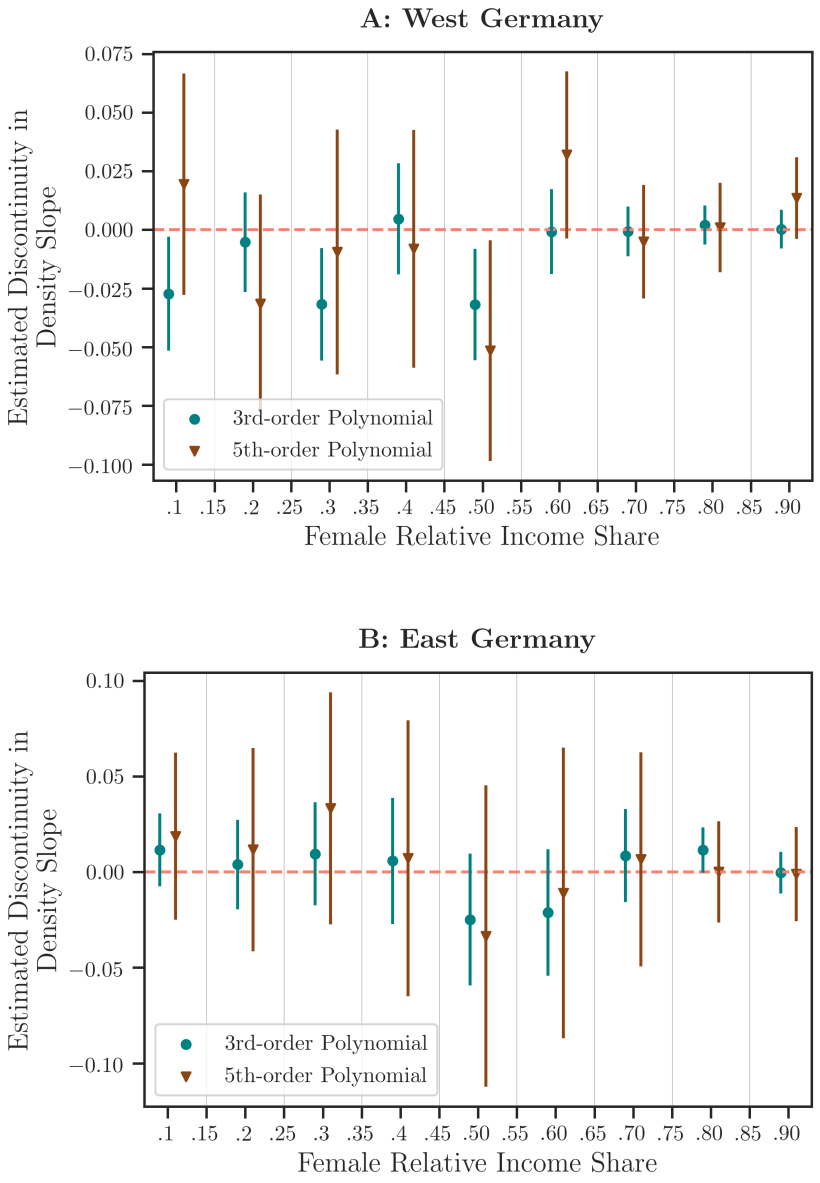
Notes: Figure 1.11 plots the relative income distribution using 0.5%-point bins. The sample is restricted to couples who only earn third-party reported wage income. The red line marks the 50% threshold at which both spouses earn the same income.

Figure 1.12: The Relative Income Distribution by Region



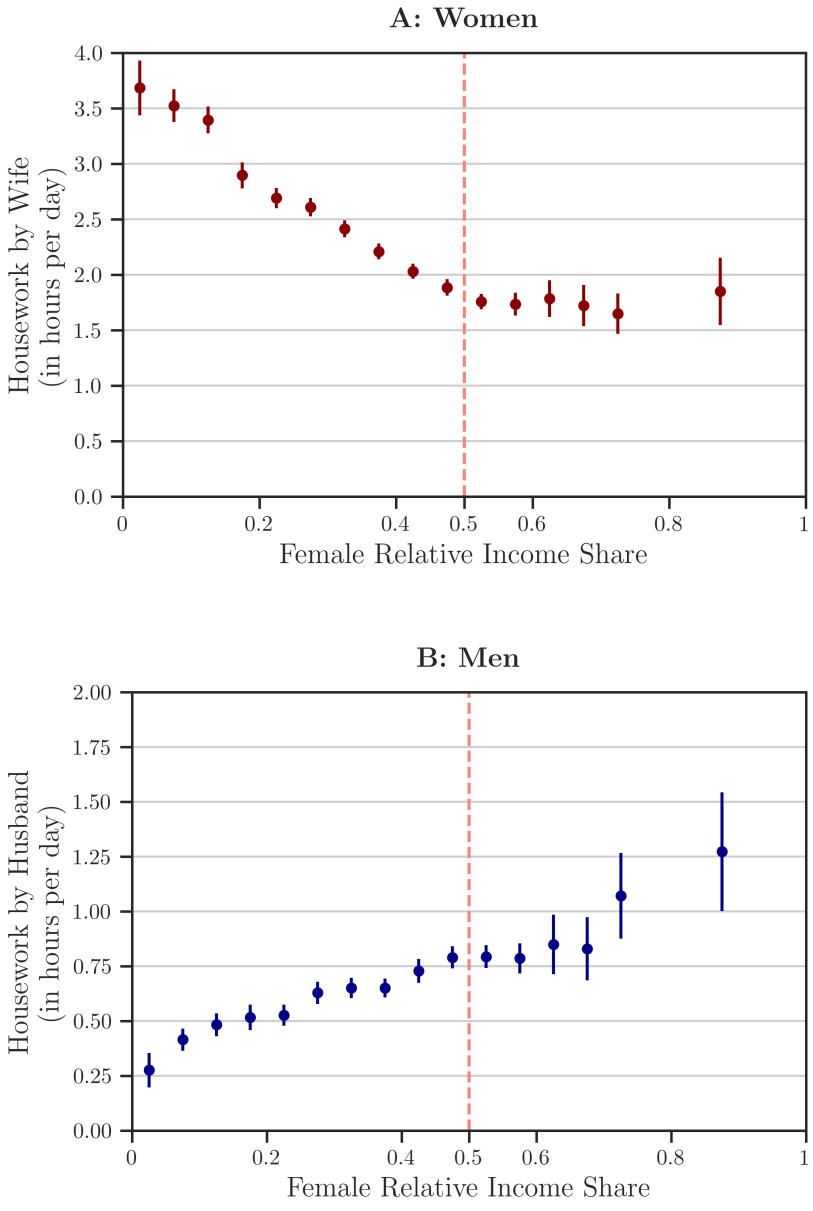
Notes: Figure 1.12 plots the relative income distribution using 0.5%-point bins for West Germany (Panel A) and East Germany (Panel B). The red line marks the 50% threshold at which both spouses earn the same income. Colored dots represent the actual distribution, gray dots represent the counterfactual distribution based on randomly matched couples. Random matching is performed within 10-year age bins and geographical regions.

Figure 1.13: Testing for Kink along the Relative Income Distribution: West and East Germany



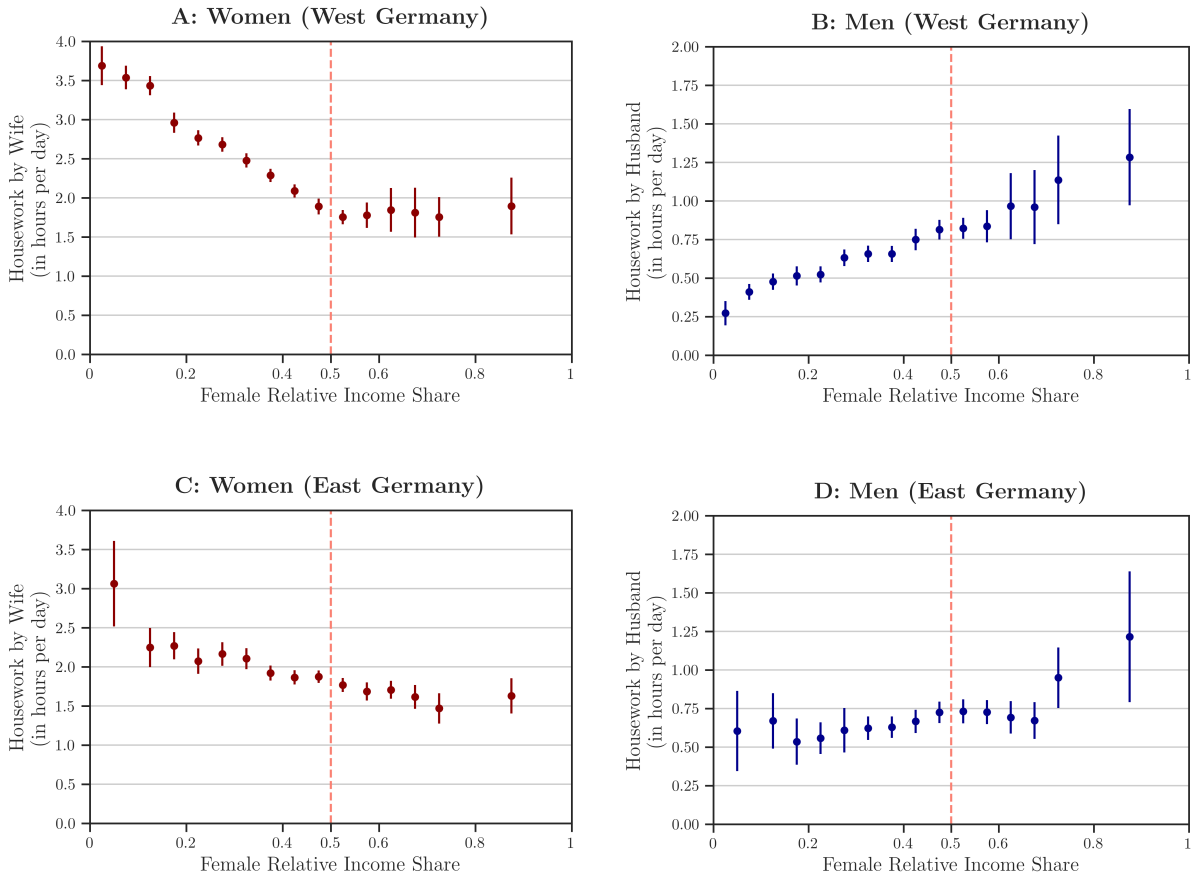
Notes: Figure 1.13 depicts estimated discontinuities in the slope for each 5%-threshold along the relative income distribution for West Germany (Panel A) and East Germany (Panel B). A 3rd- and 5th-order polynomial is fitted for the relative income distribution within the $+/-10$%-point range of the respective threshold, allowing for a slope change of the linear term. Following a "donut hole" approach, we exclude the observations just to the left and the right of each threshold. The figure depicts for different order polynomials the estimated coefficient on the slope change, including 99% confidence intervals.

Figure 1.14: Spouses' Housework as a Function of Female Relative Income Share



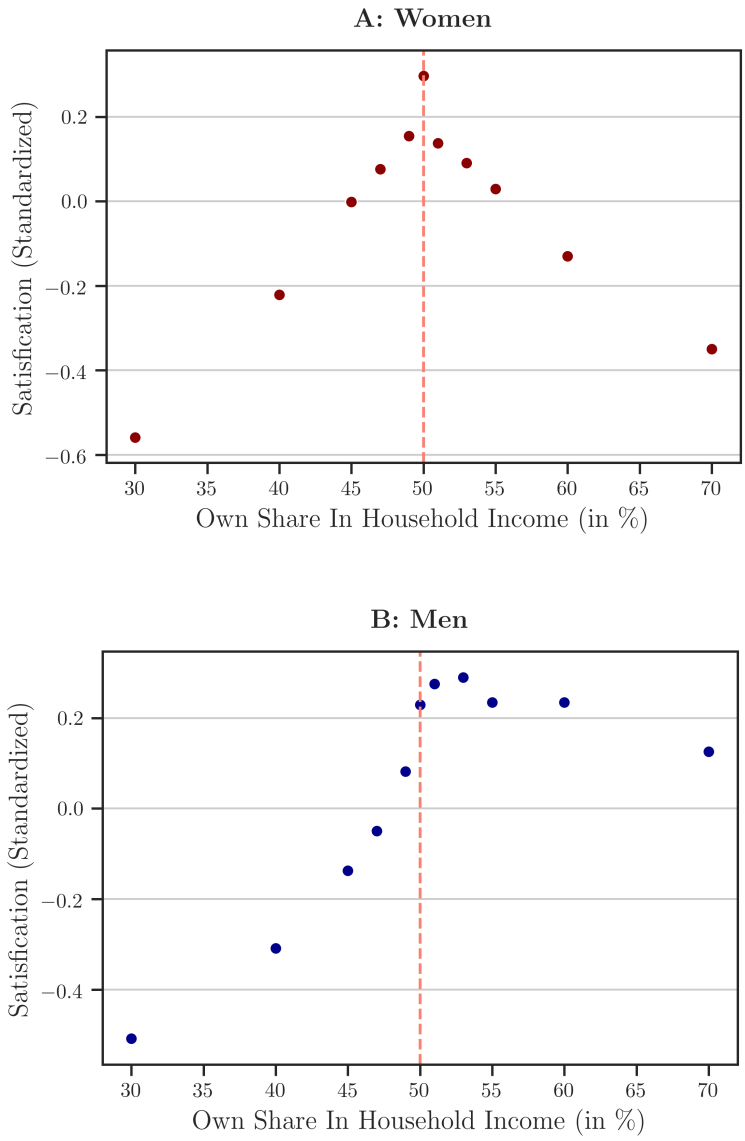
Notes: Figure 1.14 plots housework (in hours per day) done by wives (Panel A) and husbands (Panel B) as a function of the female relative share in household income. Point estimates are calculated with sampling weights provided by the GSOEP. The red line marks the 50% threshold at which both spouses earn the same income. Error bars indicate 95% confidence intervals obtained from standard errors clustered at the couple level.

Figure 1.15: Spouses' Housework as a Function of Female Relative Income Share: West and East Germany



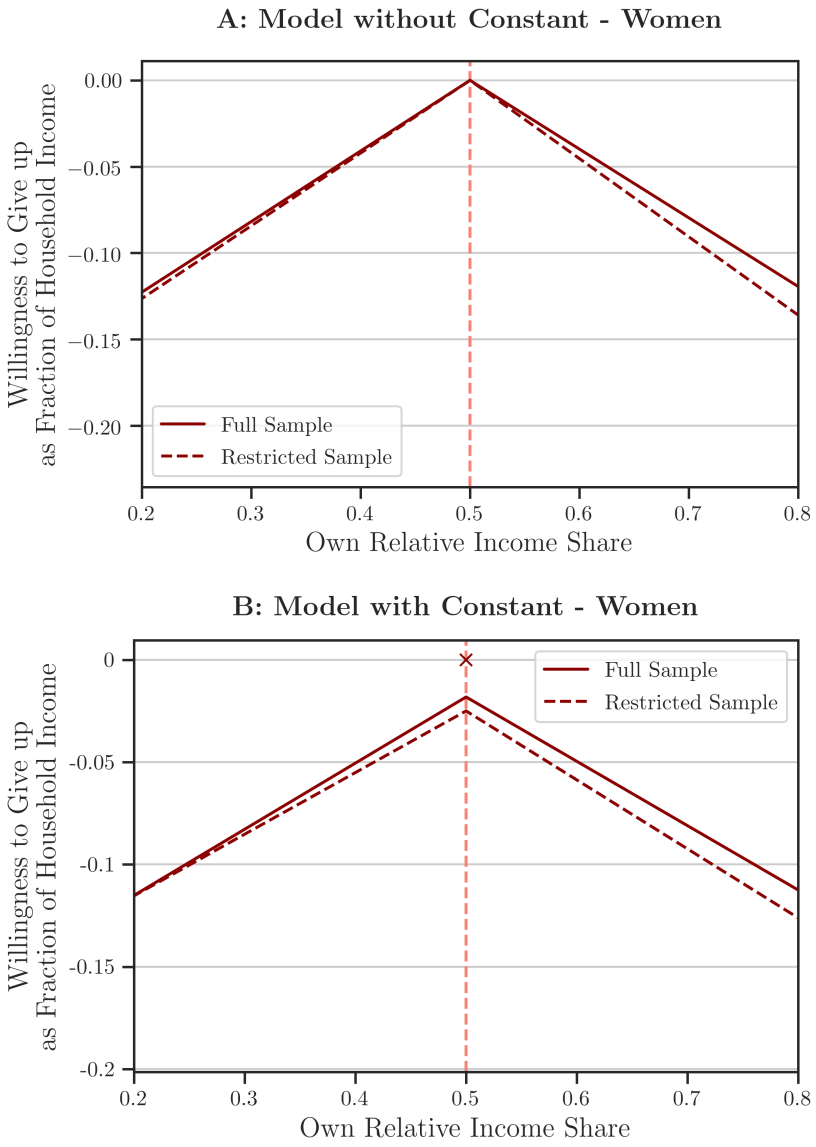
Notes: Figure 1.15 plots housework (in hours per day) done by wives and husbands as a function of the female relative share in household income separately for West and East Germany. Point estimates are calculated with sampling weights provided by the GSOEP. The red line marks the 50% threshold at which both spouses earn the same income. Error bars indicate 95% confidence intervals obtained from standard errors clustered at the couple level.

Figure 1.16: Qualitative Evidence on Preferences over Relative Income for United States



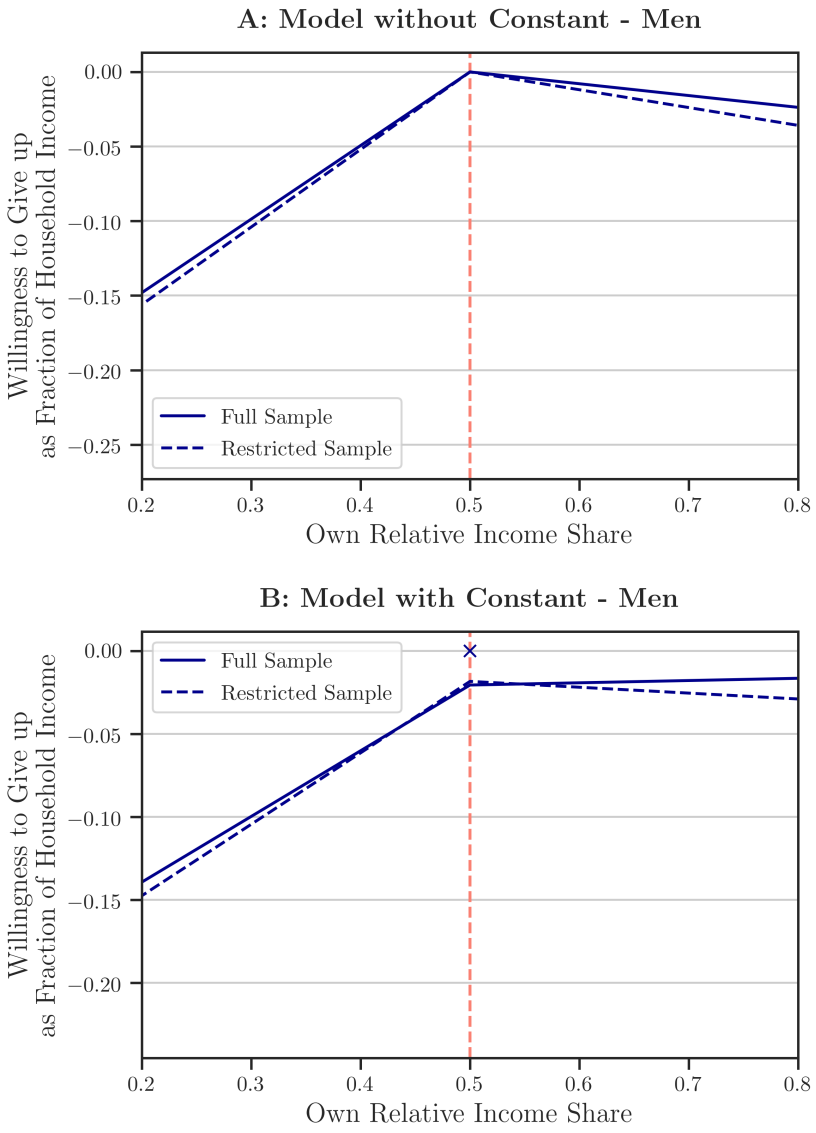
Notes: Figure 1.16 shows preferences over relative income for women (Panel A) and men (Panel B) for the United States. The x-axis indicates the own relative income share for a given level of household income, the y-axis a standardized satisfaction measure elicited on a 7-point Likert scale. For a given level of household income H and relative income fraction p the survey question read: *"Suppose now, you earned* $p\dot{H}$ *and your partner earned* $(1-p)\dot{H}$*. How satisfied would you be with this situation? Please answer on a scale from 1 (Not at all satisfied) to 7 (Very satisfied)."*

Figure 1.17: Preferences over Relative Income: Linear Model Fit for Women in the US



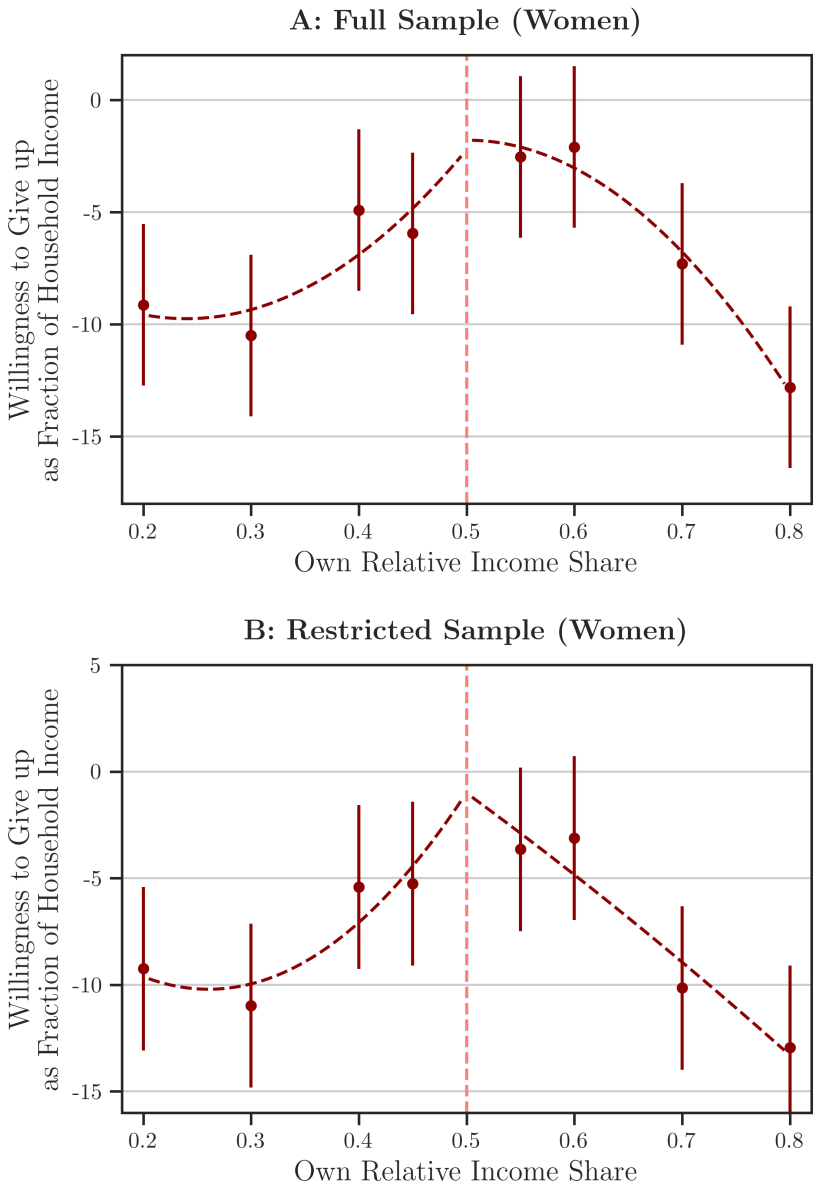
Notes: Figure 1.17 visualizes women's preferences over relative income in terms of total household income for the United States. Intuitively, the lines indicate as a function of the own relative income share the amount of total household income women are willing to give up for a 50%-50% composition of relative income. The prediction is obtained from estimating equation 1.2. We distinguish between the full sample as in Table 1.8 (solid lines) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (dashed lines). Panel A presents results from estimating specification 1.2 without a constant, Panel B presents results from estimating specification 1.2 with a constant.

Figure 1.18: Preferences over Relative Income: Linear Model Fit for Men in the US



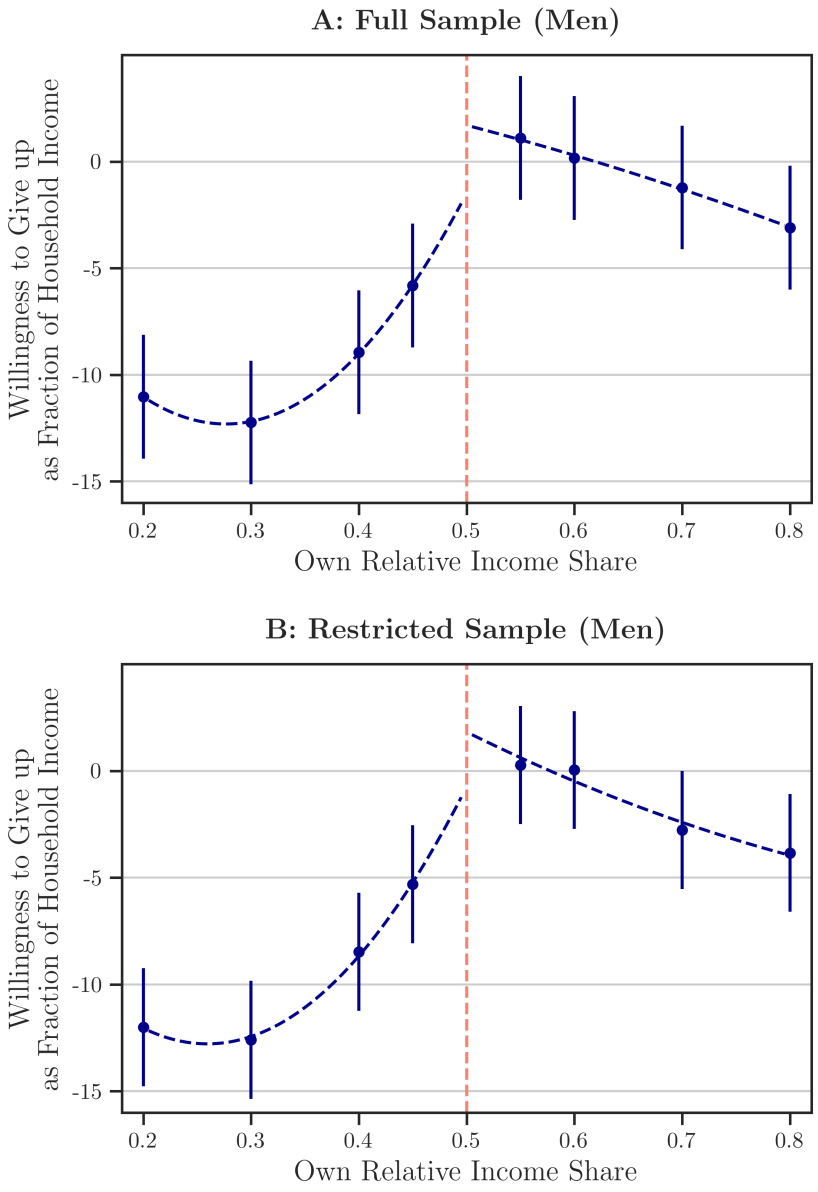
Notes: Figure 1.18 visualizes men's preferences over relative income in terms of total household income for the United States. Intuitively, the lines indicate as a function of the own relative income share the amount of total household income men are willing to give up for a 50%-50% composition of relative income. The prediction is obtained from estimating equation 1.2. We distinguish between the full sample as in Table 1.8 (solid lines) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (dashed lines). Panel A presents results from estimating specification 1.2 without a constant, Panel B presents results from estimating specification 1.2 with a constant.

Figure 1.19: Preferences over Relative Income: Alternative Functional Forms for Women in the US



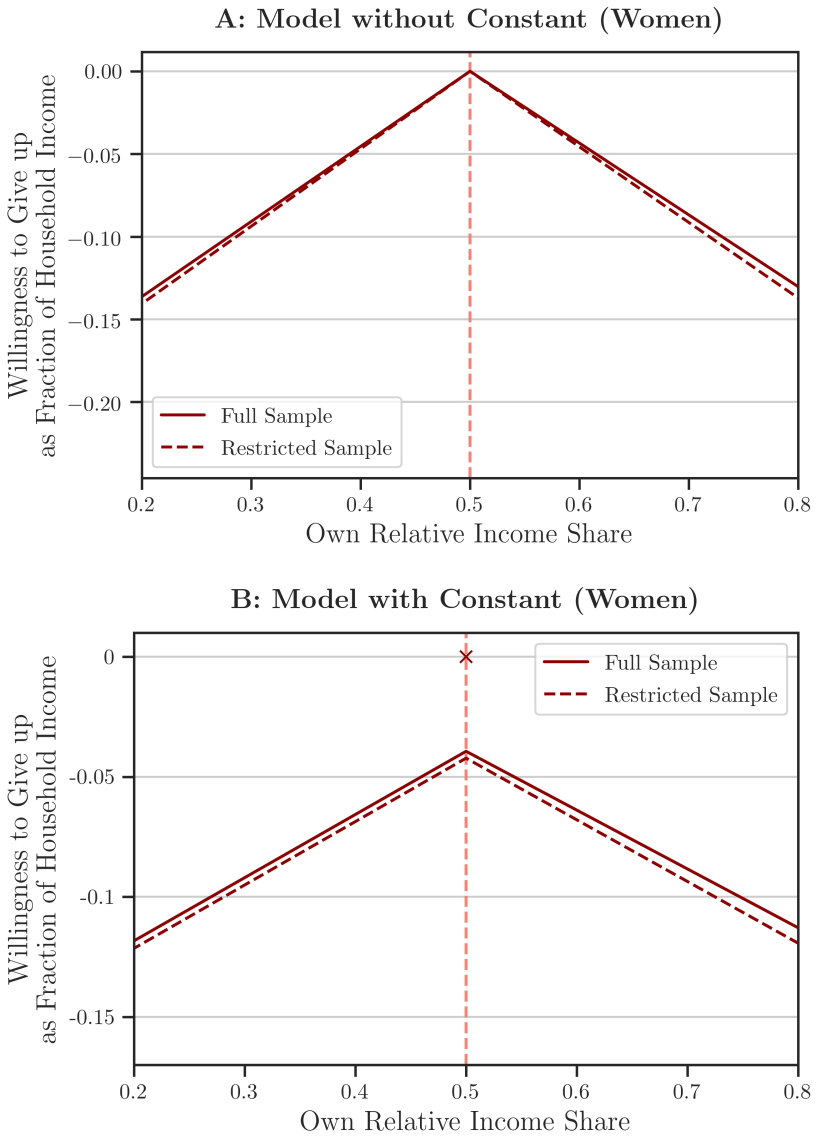
Notes: Figure 1.19 visualizes women's preferences over relative income in terms of total household income for the United States. Intuitively, the dots indicate as a function of the own relative income share the amount of total household income women are willing to give up for a 50%-50% composition of relative income. Standard errors are calculated through the delta-method. The dashed lines represent the quadratic fit from Table 1.9. We distinguish between the full sample as in Table 1.8 (Panel A) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (Panel B).

Figure 1.20: Preferences over Relative Income: Alternative Functional Forms for Men in the US



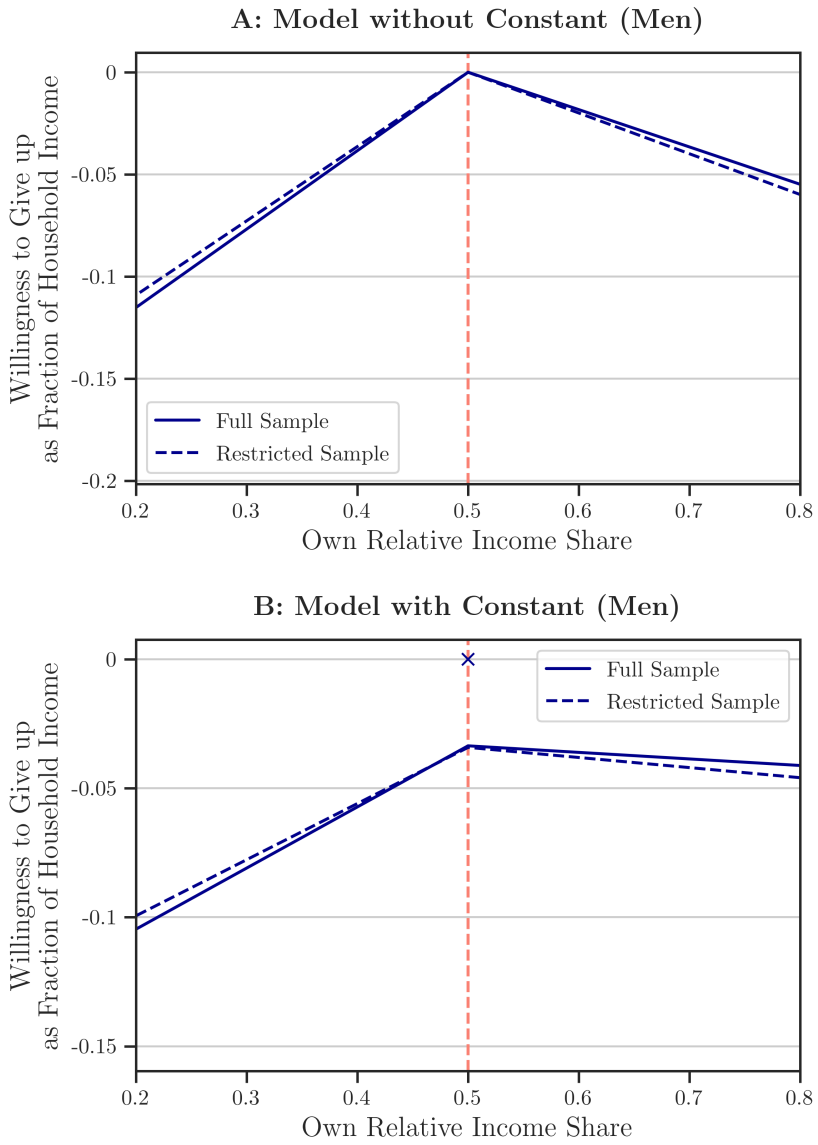
Notes: Figure 1.20 visualizes men's preferences over relative income in terms of total household income for the United States. Intuitively, the dots indicate as a function of the own relative income share the amount of total household income men are willing to give up for a 50%-50% composition of relative income. Standard errors are calculated through the delta-method. The dashed lines represent the quadratic fit from Table 1.9. We distinguish between the full sample as in Table 1.8 (Panel A) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (Panel B).

Figure 1.21: Preferences over Relative Income: Linear Model Fit for Women in Germany



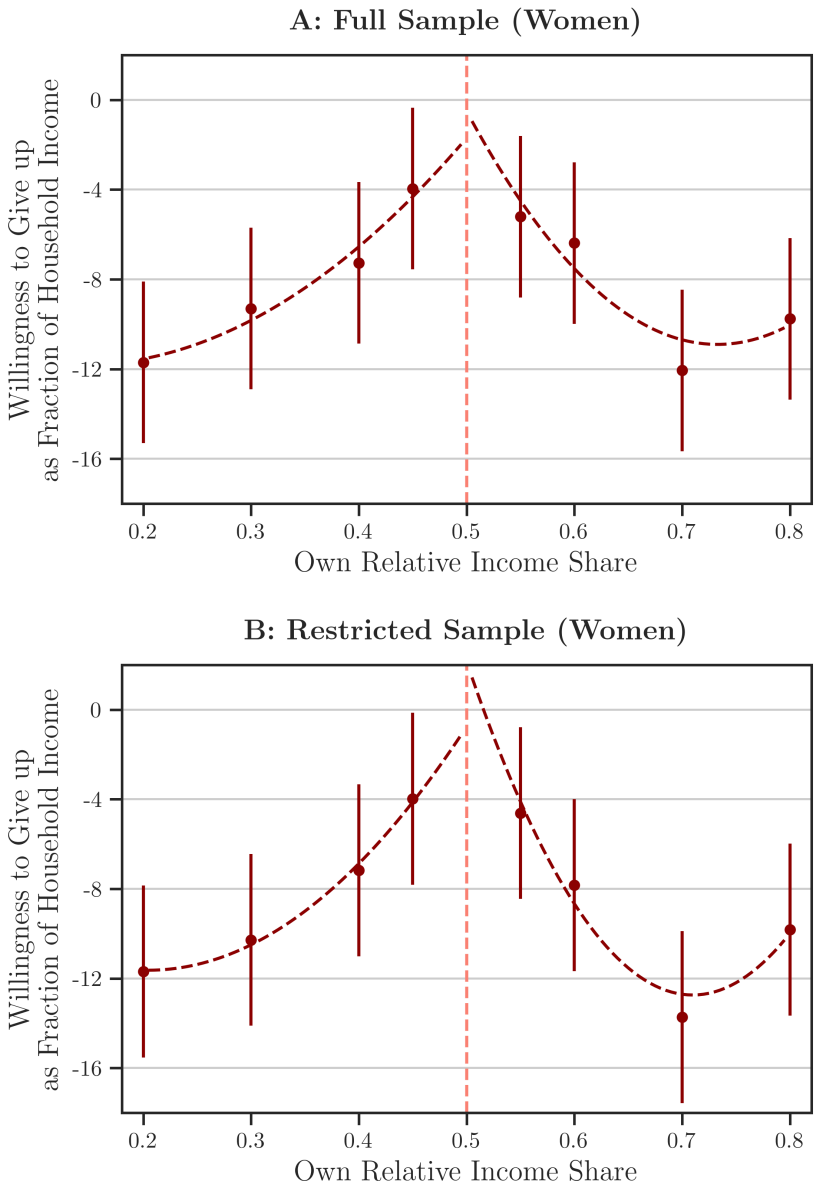
Notes: Figure 1.21 visualizes women's preferences over relative income in terms of total household income for Germany. Intuitively, the lines indicate as a function of the own relative income share the amount of total household income women are willing to give up for a 50%-50% composition of relative income. The prediction is obtained from estimating equation 1.2. We distinguish between the full sample as in Table 1.8 (solid lines) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (dashed lines). Panel A presents results from estimating specification 1.2 without a constant, Panel B presents results from estimating specification 1.2 without a constant.

Figure 1.22: Preferences over Relative Income: Linear Model Fit for Men in Germany



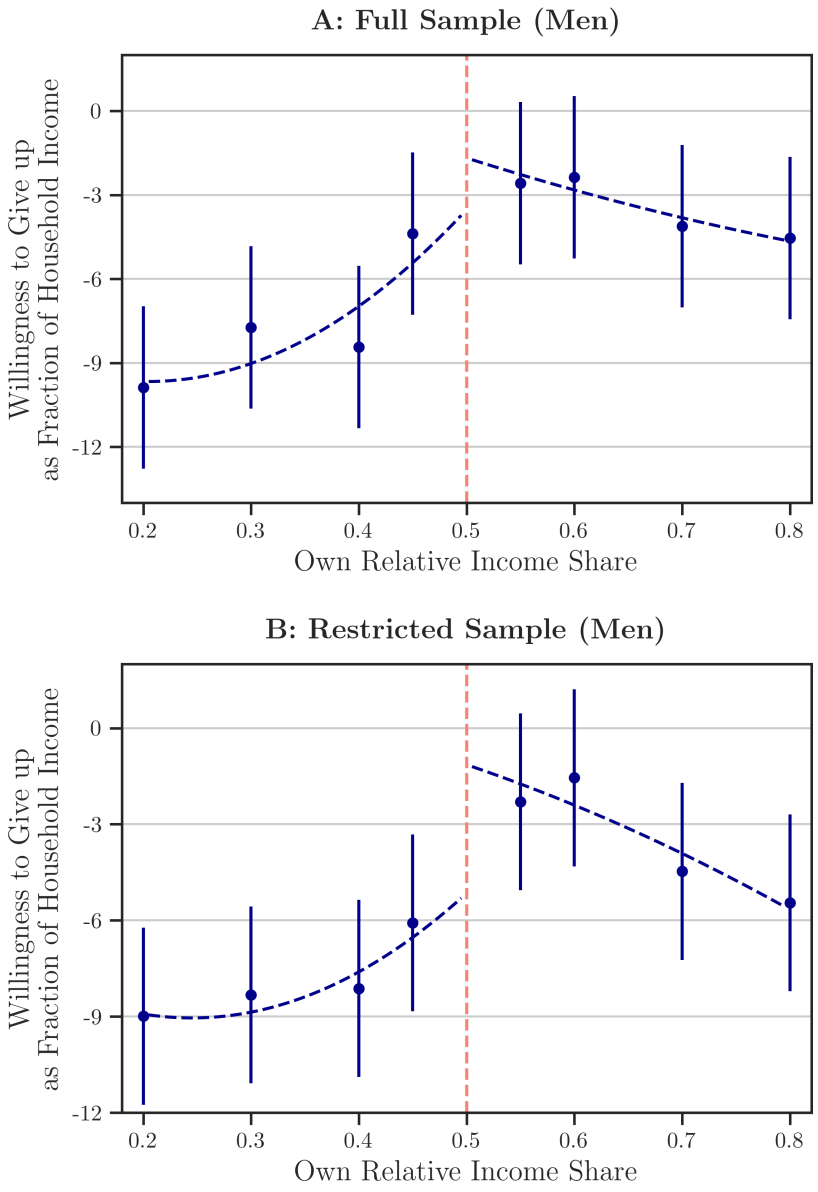
Notes: Figure 1.22 visualizes men's preferences over relative income in terms of total household income for Germany. Intuitively, the lines indicate as a function of the own relative income share the amount of total household income men are willing to give up for a 50%-50% composition of relative income. The prediction is obtained from estimating equation 1.2. We distinguish between the full sample as in Table 1.8 (solid lines) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (dashed lines). Panel A presents results from estimating specification 1.2 without a constant, Panel B presents results from estimating specification 1.2 without a constant.

Figure 1.23: Preferences over Relative Income: Alternative Functional Forms for Women in Germany



Notes: Figure 1.23 visualizes women's preferences over relative income in terms of total household income for Germany. Intuitively, the dots indicate as a function of the own relative income share the amount of total household income women are willing to give up for a 50%-50% composition of relative income. Standard errors are calculated through the delta-method. The dashed lines represent the quadratic fit from Table 1.13. We distinguish between the full sample as in Table 1.11 (Panel A) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (Panel B).

Figure 1.24: Preferences over Relative Income: Alternative Functional Forms for Men in Germany



Notes: Figure 1.24 visualizes men's preferences over relative income in terms of total household income for Germany. Intuitively, the dots indicate as a function of the own relative income share the amount of total household income men are willing to give up for a 50%-50% composition of relative income. Standard errors are calculated through the delta-method. The dashed lines represent the quadratic fit from Table 1.13. We distinguish between the full sample as in Table 1.11 (Panel A) and the sample restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares (Panel B).

Table 1.1: Studies Investigating the Relative Income Distribution

Study	Country	Data	Tested for jump	Detected jump	Tested for kink	Model of preferences over relative income
Bertrand et al. (2015)	US	SIPP/SSA/IRS gold standard files	Yes	Yes	No	No
Binder and Lam (2018)	US	SIPP/SSA/IRS gold standard files	Yes	No	No	No
Zinovyeva and Tverdostup (2018)	Finland	Administrative data	Yes	No	No	No
Hederos and Stenberg (2019)	Sweden	Administrative data	Yes	No	No	No
Sprengholz et al. (2019)	Germany	German Socio-economic Panel	Yes	Yes (for West Ger.)	No	No
Doumbia and Goussé (2019)	Canada	Survey on Labor and Income Dynamics	Yes	Yes	No	No

Notes: Table 1.1 provides an overview of studies investigating the distribution of relative income.

Table 1.2: Spouses' Household Public Good Provision

Panel A: Women	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	0.307***	0.254***	0.114***	0.0474	0.0615	0.0208
	(0.0467)	(0.0431)	(0.0404)	(0.0448)	(0.0428)	(0.0407)
Wife's Share	-3.765***	-3.312***	-1.524***	-4.101***	-3.615***	-1.726***
	(0.136)	(0.126)	(0.137)	(0.143)	(0.137)	(0.152)
(Wife's Share-0.5)				4.094***	3.163***	1.597***
× I(Wife's Share>0.5)				(0.380)	(0.364)	(0.343)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	30987	30987	30987	30987	30987	30987

Panel B: Men	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	0.0144	0.0381	-0.0337	-0.0175	-0.00118	-0.0336
	-0.0453	-0.0488*	-0.0294	-0.0751**	-0.0715**	-0.0444
	(0.0291)	(0.0287)	(0.0282)	(0.0344)	(0.0341)	(0.0321)
Wife's Share	0.948***	0.987***	0.546***	0.908***	0.950***	0.513***
	(0.0762)	(0.0799)	(0.0929)	(0.0736)	(0.0767)	(0.0937)
(Wife's Share-0.5)				0.470	0.372	0.259
× I(Wife's Share>0.5)				(0.397)	(0.398)	(0.352)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	29720	29720	29720	29720	29720	29720

Notes: Notes: Table 1.2 provides linear regressions of housework (hours per day) conducted by wives (Panel A) and husbands (Panel B) on wives' relative income, an indicator for whether the wife is the primary earner within the couple, and their interaction conditional on a set of control variables. All observations are weighted using sampling weights provided by the GSOEP. Standard errors in parentheses are clustered at the couple level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.3: Spouses' Household Public Good Provision for Relative income $\in$ [30%, 70%]

Panel A: Women	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	0.114**	0.0629	-0.0295	-0.0549	-0.0551	-0.0835*
	(0.0484)	(0.0441)	(0.0420)	(0.0516)	(0.0472)	(0.0449)
Wife's Share	-2.955***	-2.473***	-0.914***	-3.426***	-2.829***	-1.105***
	(0.204)	(0.183)	(0.189)	(0.214)	(0.197)	(0.207)
(Wife's Share-0.5)				3.703***	2.640***	1.241**
× I(Wife's Share>0.5)				(0.639)	(0.568)	(0.531)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	23870	23870	23870	23870	23870	23870

Panel B: Men	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	-0.0471	-0.0491	-0.0263	-0.0454	-0.0438	-0.0248
	(0.0322)	(0.0320)	(0.0318)	(0.0354)	(0.0352)	(0.0343)
Wife's Share	0.917***	0.948***	0.479***	0.922***	0.964***	0.484***
	(0.130)	(0.134)	(0.146)	(0.135)	(0.139)	(0.156)
(Wife's Share-0.5)				-0.0382	-0.118	-0.0352
× I(Wife's Share>0.5)				(0.428)	(0.436)	(0.408)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	22960	22960	22960	22960	22960	22960

Notes: Table 1.3 provides linear regression of housework (hours per day) conducted by wives (Panel A) and husbands (Panel B) on wives' relative income, an indicator for whether the wife is the primary earner within the couple, and their interaction conditional on a set of control variables. All specifications only include couples where the wife's relative income share lies between 30% and 70%. All observations are weighted using sampling weights provided by the GSOEP. Standard errors in parentheses are clustered at the couple level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.4: Spouses' Household Public Good Provision controlling for Couple Fixed Effects

Panel A: Women	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	0.151***	0.128***	0.102**	0.0670	0.0675*	0.0616
	(0.0444)	(0.0409)	(0.0402)	(0.0430)	(0.0405)	(0.0399)
Wife's Share	-2.151***	-1.728***	-1.047***	-2.554***	-2.050***	-1.272***
	(0.217)	(0.185)	(0.188)	(0.249)	(0.216)	(0.222)
(Wife's Share-0.5)				2.440***	1.820***	1.226***
× I(Wife's Share>0.5)				(0.449)	(0.418)	(0.403)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Couple Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	30987	30987	30987	30987	30987	30987

Panel B: Men	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	-0.0135	-0.0113	-0.00517	-0.0206	-0.0159	-0.00997
	(0.0314)	(0.0316)	(0.0315)	(0.0364)	(0.0362)	(0.0357)
Wife's Share	0.523***	0.497***	0.319***	0.489***	0.472***	0.291***
	(0.103)	(0.103)	(0.107)	(0.104)	(0.104)	(0.111)
(Wife's Share-0.5)				0.208	0.139	0.147
× I(Wife's Share>0.5)				(0.370)	(0.363)	(0.345)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Couple Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29720	29720	29720	29720	29720	29720

Notes: Table 1.4 provides linear regression of housework (hours per day) conducted by wives (Panel A) and husbands (Panel B) on wives' relative income, an indicator for whether the wife is the primary earner within the couple, and their interaction conditional on a set of control variables. All specifications include couple fixed effects. All observations are weighted using sampling weights provided by the GSOEP. Standard errors in parentheses are clustered at the couple level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.5: Wives' Household Public Good Provision: Geographic Heterogeneity

Panel A: West Germany	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	0.304***	0.260***	0.138***	0.0140	0.0839	0.0416
	(0.0618)	(0.0568)	(0.0528)	(0.0583)	(0.0566)	(0.0536)
Wife's Share	-3.804***	-3.111***	-1.522***	-4.129***	-3.363***	-1.703***
	(0.153)	(0.141)	(0.157)	(0.160)	(0.154)	(0.173)
(Wife's Share-0.5)				4.335***	2.747***	1.572***
× I(Wife's Share>0.5)				(0.476)	(0.466)	(0.438)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	22936	22936	22936	22936	22936	22936

Panel B: East Germany	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	0.0144	0.0381	-0.0337	-0.0175	-0.00118	-0.0336
	(0.0589)	(0.0547)	(0.0519)	(0.0589)	(0.0552)	(0.0521)
Wife's Share	-1.400***	-1.440***	-0.488**	-1.530***	-1.617***	-0.488**
	(0.224)	(0.199)	(0.190)	(0.265)	(0.241)	(0.239)
(Wife's Share-0.5)				0.729	0.923**	-0.00222
× I(Wife's Share>0.5)				(0.463)	(0.430)	(0.410)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	8051	8051	8051	8051	8051	8051

Notes: Table 1.5 provides linear regression of wives' housework (hours per day) on wives' relative income, an indicator for whether the wife is the primary earner within the couple, and their interaction conditional on a set of control variables. We distinguish between West Germany (Panel A) and East Germany (Panel B). All observations are weighted using sampling weights provided by the GSOEP. Standard errors in parentheses are clustered at the couple level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.6: Husbands' Household Public Good Provision: Geographic Heterogeneity

Panel A: West Germany	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	-0.0145	-0.0213	-0.0167	-0.0494	-0.0456	-0.0302
	(0.0384)	(0.0378)	(0.0363)	(0.0420)	(0.0417)	(0.0397)
Wife's Share	1.020***	1.072***	0.601***	0.980***	1.036***	0.574***
	(0.0861)	(0.0918)	(0.105)	(0.0831)	(0.0889)	(0.105)
(Wife's Share-0.5)				0.515	0.378	0.219
× I(Wife's Share>0.5)				(0.471)	(0.481)	(0.430)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	21955	21955	21955	21955	21955	21955

Panel B: East Germany	(1)	(2)	(3)	(4)	(5)	(6)
I(Wife's Share>0.5)	-0.0238	-0.0319	-0.00300	-0.0367	-0.0374	-0.0147
	(0.0449)	(0.0454)	(0.0458)	(0.0499)	(0.0499)	(0.0487)
Wife's Share	0.538***	0.585***	0.228	0.484**	0.560***	0.166
	(0.174)	(0.178)	(0.192)	(0.188)	(0.196)	(0.215)
(Wife's Share-0.5)				0.299	0.130	0.289
× I(Wife's Share>0.5)				(0.539)	(0.516)	(0.490)
Wave F.E.	No	Yes	Yes	No	Yes	Yes
Cubic in HH Income	No	Yes	Yes	No	Yes	Yes
Age F.E. for Husband & Wife	No	Yes	Yes	No	Yes	Yes
Number of Children	No	Yes	Yes	No	Yes	Yes
Job Hours Husband & Wife	No	No	Yes	No	No	Yes
Observations	7765	7765	7765	7765	7765	7765

Notes: Table 1.6 provides linear regression of husbands' housework (hours per day) on wives' relative income, an indicator for whether the wife is the primary earner within the couple, and their interaction conditional on a set of control variables. We distinguish between West Germany (Panel A) and East Germany (Panel B). All observations are weighted using sampling weights provided by the GSOEP. Standard errors in parentheses are clustered at the couple level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.7: Summary Statistics of Experimental Samples

United States (Qualitative Sample)			
	Mean	Std. Dev.	Obs.
Male	0.50	0.50	420
Age	37.78	10.29	420
Presence of Children	0.59	0.49	420
Married	0.60	0.49	420
College Degree	0.75	0.43	420
Personal Income (in USD)	50,142	33,455	420
Full-time employment	0.85	0.36	420
United States (Quantitative Sample)			
	Mean	Std. Dev.	Obs.
Male	0.49	0.50	736
Age	36.28	10.58	734
Presence of Children	0.50	0.50	736
Married	0.54	0.50	736
College Degree	0.77	0.42	736
Personal Income (in USD)	51,868	29,859	736
Full-time employment	0.88	0.33	736
Germany (Quantitative Sample)			
	Mean	Std. Dev.	Obs.
Male	0.54	0.50	262
Age	35.11	10.20	262
Presence of Children	0.36	0.48	262
Married	0.41	0.49	262
College Degree	0.53	0.50	262
Personal Income (in Euro)	42,652	25,388	262
Full-time employment	0.78	0.42	262

Notes: Table 1.7 shows summary statistics for the experimental samples.

Table 1.8: Estimates of Preferences over Relative Income for the United States

	(1)	(2)	(3)	(4)	(5)	(6)
	Model without constant			Model with constant		
	All	Women	Men	All	Women	Men
δ	10.85***	10.49***	11.51***	10.89***	10.51***	11.56***
[Weight on income]	(0.452)	(0.608)	(0.683)	(0.454)	(0.610)	(0.688)
α_{behind}	4.917***	4.289***	5.682***	3.928***	3.398***	4.576***
	(0.378)	(0.553)	(0.500)	(0.494)	(0.724)	(0.662)
α_{ahead}	-2.548***	-4.174***	-0.912**	-1.593***	-3.306***	0.157
	(0.327)	(0.478)	(0.449)	(0.447)	(0.638)	(0.625)
Constant				0.212***	0.191*	0.238**
				(0.0704)	(0.101)	(0.0983)
MRS (behind)	0.45	0.41	0.50	0.36	0.32	0.40
MRS (ahead)	-0.23	-0.40	-0.08	-0.15	-0.31	0.01
Observations	10304	5278	5026	10304	5278	5026
No. Individuals	736	377	359	736	377	359

Notes: Table 1.8 shows for the United States estimated preferences over relative income from specification 1.2 for the pooled sample (columns (1) and (4)), women (columns (2) and (5)), and men (columns (3) and (6)). Columns (1) to (3) include no constant, columns (4) to (6) include a constant. Standard errors in parentheses are clustered at the individual level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.9: Estimates for Preferences over Relative Income for the United States considering Alternative Functional Forms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Sample				Restricted Sample			
	Women		Men		Women		Men	
δ	10.56***	10.57***	11.71***	11.74***	13.40***	13.43***	16.94***	17.01***
	(0.612)	(0.613)	(0.696)	(0.696)	(0.848)	(0.848)	(0.958)	(0.958)
α_{behind}	2.013**	6.126	2.445***	11.37***	2.842**	10.35*	4.649***	17.02***
	(0.878)	(4.128)	(0.749)	(3.883)	(1.215)	(5.588)	(1.046)	(5.309)
α_{ahead}	-4.591***	0.0102	-1.929**	-1.546	-5.583***	-4.961	-3.091**	-4.243
	(0.816)	(3.798)	(0.784)	(4.045)	(1.058)	(5.014)	(1.209)	(5.762)
β_{ahead}	-0.0882	0.190	-0.224	-0.200	0.0987	0.136	-0.236	-0.309
	(0.150)	(0.263)	(0.144)	(0.275)	(0.188)	(0.331)	(0.214)	(0.388)
β_{behind}	0.490***	0.235	0.704***	0.174	0.587***	0.131	0.858***	0.127
	(0.149)	(0.273)	(0.131)	(0.243)	(0.192)	(0.358)	(0.184)	(0.341)
α^2_{behind}		11.77		25.44**		21.60		35.37**
		(12.10)		(11.28)		(16.39)		(15.33)
α^2_{ahead}		-13.23		-1.082		-1.795		3.230
		(11.01)		(11.36)		(14.45)		(16.46)
Observations	5278	5278	5026	5026	4179	4179	3843	3843
No. Individuals	377	377	359	359	344	344	312	312

Notes: Table 1.9 shows for the United States estimated preferences over relative income from specification 1.2 for women (columns (1) , (2), (5), (6)), and men (columns (3), (4), (7), (8)). All columns include dummies for being the primary earner $I(p_A < 0.5)$ or secondary earner $I(p_A > 0.5)$ in the situation with an unequal composition of relative income. Even-numbered columns additionally include a quadratic term for the distance in relative income between situation A and B. Columns (1) to (4) involve the full sample, columns (5) to (8) the restricted sample of individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares. Standard errors in parentheses are clustered at the individual level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.10: Estimates for Preferences over Relative Income for the United States in the Restricted Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Model without constant			Model with constant		
	All	Women	Men	All	Women	Men
δ	14.44***	13.24***	16.52***	14.54***	13.36***	16.63***
	(0.630)	(0.842)	(0.935)	(0.633)	(0.845)	(0.944)
α_{behind}	6.832***	5.579***	8.590***	5.394***	4.023***	7.162***
	(0.559)	(0.806)	(0.692)	(0.713)	(1.021)	(0.938)
α_{ahead}	-4.102***	-6.002***	-1.974***	-2.724***	-4.502***	-0.588
	(0.465)	(0.649)	(0.699)	(0.620)	(0.854)	(0.943)
Constant				0.307***	0.333***	0.305**
				(0.0936)	(0.129)	(0.139)
MRS (behind)	0.47	0.42	0.52	0.37	0.30	0.43
MRS (ahead)	-0.28	-0.45	-0.12	-0.19	-0.34	-0.04
Observations	8022	4179	3843	8022	4179	3843
No. Individuals	656	344	312	656	344	312

Notes: Table 1.10 shows for the United States estimated preferences over relative income from specification 1.2 for the pooled sample (columns (1) and (4)), women (columns (2) and (5)), and men (columns (3) and (6)). The sample is restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares. Columns (1) to (3) include no constant, columns (4) to (6) include a constant. Standard errors in parentheses are clustered at the individual level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.11: Estimates for Preferences over Relative Income for Germany

	(1)	(2)	(3)	(4)	(5)	(6)
	Model without constant			Model with constant		
	All	Women	Men	All	Women	Men
δ	13.43***	12.95***	14.02***	13.63***	13.20***	14.20***
	(0.850)	(1.193)	(1.232)	(0.881)	(1.232)	(1.277)
α_{behind}	5.583***	5.882***	5.383***	3.390***	3.474***	3.364***
	(0.607)	(1.096)	(0.670)	(0.727)	(1.247)	(0.854)
α_{ahead}	-3.798***	-5.622***	-2.564***	-1.518*	-3.234**	-0.361
	(0.636)	(1.047)	(0.816)	(0.789)	(1.281)	(0.990)
Constant				0.497***	0.520***	0.477***
				(0.129)	(0.192)	(0.168)
MRS (behind)	0.42	0.45	0.38	0.25	0.26	0.24
MRS (ahead)	-0.29	-0.43	-0.18	-0.11	-0.25	-0.03
Observations	3668	1680	1988	3668	1680	1988
No. Individuals	262	120	142	262	120	142

Notes: Table 1.11 shows for Germany estimated preferences over relative income from specification 1.2 for the pooled sample (columns (1) and (4)), women (columns (2) and (5)), and men (columns (3) and (6)). Columns (1) to (3) include no constant, columns (4) to (6) include a constant. Standard errors in parentheses are clustered at the individual level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.12: Estimates for Preferences over Relative Income for Germany in the Restricted Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Model without constant			Model with constant		
	All	Women	Men	All	Women	Men
δ	15.96***	14.13***	17.99***	16.32***	14.51***	18.35***
	(1.072)	(1.510)	(1.568)	(1.131)	(1.591)	(1.653)
α_{behind}	6.507***	6.622***	6.540***	3.880***	3.833**	3.994***
	(0.763)	(1.340)	(0.850)	(0.893)	(1.489)	(1.082)
α_{ahead}	-4.828***	-6.459***	-3.589***	-2.067**	-3.728**	-0.719
	(0.793)	(1.260)	(1.082)	(0.958)	(1.473)	(1.280)
Constant				0.614***	0.613***	0.627***
				(0.160)	(0.230)	(0.215)
MRS (behind)	0.41	0.47	0.36	0.24	0.26	0.22
MRS (ahead)	-0.30	-0.46	-0.20	-0.13	-0.26	-0.04
Observations	3066	1421	1645	3066	1421	1645
No. Individuals	246	115	131	246	115	131

Notes: Table 1.12 shows for Germany estimated preferences over relative income from specification 1.2 for the pooled sample (columns (1) and (4)), women (columns (2) and (5)), and men (columns (3) and (6)). The sample is restricted to individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares. Columns (1) to (3) include no constant, columns (4) to (6) include a constant. Standard errors in parentheses are clustered at the individual level (* p<0.10, ** p<0.05, *** p<0.01).

Table 1.13: Estimates for Preferences over Relative Income for Germany considering Alternative Functional Forms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Sample				Restricted Sample			
	Women		Men		Women		Men	
δ	13.20***	13.24***	14.24***	14.25***	14.53***	14.67***	18.60***	18.60***
	(1.227)	(1.231)	(1.279)	(1.281)	(1.580)	(1.592)	(1.635)	(1.641)
α_{behind}	3.849***	7.454	2.269**	5.918	4.410**	10.80	1.559	5.677
	(1.439)	(7.992)	(0.995)	(7.725)	(1.757)	(9.351)	(1.201)	(11.44)
α_{ahead}	-2.792*	-11.83	-1.355	-1.740	-3.051*	-20.81**	-2.918*	-2.121
	(1.517)	(8.421)	(1.189)	(6.964)	(1.769)	(10.14)	(1.557)	(9.326)
β_{ahead}	0.615**	0.0669	0.264	0.240	0.763***	-0.314	0.162	0.213
	(0.244)	(0.514)	(0.233)	(0.443)	(0.289)	(0.616)	(0.309)	(0.576)
β_{behind}	0.440*	0.225	0.735***	0.503	0.490	0.111	1.226***	0.959
	(0.262)	(0.517)	(0.228)	(0.509)	(0.317)	(0.612)	(0.255)	(0.721)
α^2_{behind}		10.36		10.00		18.27		11.13
		(23.29)		(21.02)		(27.32)		(30.69)
α^2_{ahead}		25.41		1.092		49.58*		-2.272
		(23.81)		(19.54)		(28.37)		(26.44)
Observations	1680	1680	1988	1988	1421	1421	1645	1645
No. Individuals	120	120	142	142	115	115	131	131

Notes: Table 1.13 shows for Germany estimated preferences over relative income from specification 1.2 for women (columns (1) , (2), (5), (6)), and men (columns (3), (4), (7), (8)). All columns include dummies for being the primary earner $I(p_A < 0.5)$ or secondary earner $I(p_A > 0.5)$ in the situation with an unequal composition of relative income. Even-numbered columns additionally include a quadratic term for the distance in relative income between situation A and B. Columns (1) to (4) involve the full sample, columns (5) to (8) the restricted sample of individuals who exhibit answering behavior that is consistent with non-negative marginal utility from higher household income conditional on relative income shares. Standard errors in parentheses are clustered at the individual level (* p<0.10, ** p<0.05, *** p<0.01).

Chapter 2

Relationship of Gender Differences in Preferences to Economic Development and Gender Equality

2.1 Introduction

Fundamental preferences, such as altruism, risk-taking, reciprocity, patience or trust, constitute the foundation of choice theories and govern human behavior. A growing literature in economics (Bertand, 2011; Croson and Gneezy, 2009) and psychology (Maccoby and Jacklin, 1974) documents important differences in preferences between women and men. These differences provide a key explanation for differential choices and outcomes between women and men in contexts such as occupational choice, financial investment, or educational decisions (DeLeire and Levy, 2004; Buser et al., 2014), among many others. In understanding the origins of gender differences in preferences and their variability across countries and cultures, an extensive literature discusses biological and evolutionary determinants (Buss, 1995; Geary, 2009) and the role of the social environment (Eagly, 1987; Eagly and Wood, 1999; Gneezy et al., 2009).

We contrast two competing hypotheses which make opposite predictions concerning the cross-country correlational patterns of gender differences in preferences with economic development and gender equality. Following social role theory, one may hypothesize that gender differences in preferences attenuate in more developed, gender-egalitarian countries (social role hypothesis). This hypothesis rests on two premises. First, economic development is a key determinant of societal progression towards gender equality (Duflo, 2012; Deopke and Tertilt, 2009), which is critical for the dissolution of traditional gender roles (Fernandez et al., 2004, 2009). Second, as discussed by a large body of literature (Eagly, 1987; Eagly and Wood, 1999; Gneezy et al., 2009), gender-specific roles instill distinct preferences in women and men and hence constitute a crucial component in explaining the gender preference gap. As a consequence, according to the social role hypothesis, higher economic development and gender equality, and the associated dissolution of traditional gender roles should lead to a narrowing of gender differences in preferences.

In contrast to the social role hypothesis, there is reason to expect that gender differences in preferences expand with economic development and gender equality (resource hypothesis). As suggested by post-materialist theory (Inglehart, 1977; Inglehart and Norris, 2003), a critical societal precondition for self-expression is the fulfillment of basic material needs. In line with this, existing research documents that the unrestricted expression of preferences hinges on the availability of sufficient material and social resources (Almas et al., 2016; Haushofer and Fehr, 2014; Tanaka et al., 2010; McLoyd, 1998). With respect to gender, differences in preferences should therefore manifest themselves only if both genders obtain sufficient access to these resources to independently develop and express their intrinsic preferences.[1] Specifically, greater availability of material resources eliminates the gender-neutral goal of subsistence. This creates scope for attending to gender-specific ambitions and desires. As a consequence, economic development may facilitate the unfolding of differences between women and men. More developed countries also feature higher levels of gender equality in political, social and economic domains (Duflo, 2012), which is a critical requirement for the acceptance of gender-specific desires and preferences. In particular, as women become less exposed and vulnerable to male influence, gender differentiation may be reinforced through women's greater opportunities of self-expression. In sum, greater availability of material and social resources to both genders may facilitate the independent development and expression of gender-specific preferences, and hence lead to an expansion of gender differences in more developed and gender-egalitarian countries.

2.2 Data and Measures

An empirical test of the two competing hypotheses requires data that meet three critical conditions: (i) reliability of preference measures, (ii) extensive cultural variation as well as comprehensive global coverage, and (iii) representativeness of country samples. Our investigation used the Global Preference Survey (GPS) (Falk et al., 2018) which is described in the following.[2] The GPS was collected as part of the Gallup World Poll 2012 and contains measures of six fundamental preferences with regards to social and non-social domains: willingness to take risks; patience, which captures preferences over the inter-temporal timing of rewards; altruism; trust;[3] as well as positive and negative reciprocity, which capture the costly willingness to reward kind actions, or to punish unkind actions, respectively.

Before the launch of the international survey, multiple survey items were selected for these preferences through an ex-ante experimental validation (Falk et al., 2015). For each preference, subjects responded to a large set of survey items and participated in incentivized choice experiments.

[1] One may be agnostic about the ultimate determinants of gender-specific preferences. They may either be acquired through cross-culturally universal gender roles or due to biological and evolutionary differences between women and men.

[2] For further details on the Gallup World Poll see `http://www.gallup.com/analytics/213704/world-poll.aspx`.

[3] We note that trust is not a preference but a composite trait, including beliefs about others' behavior, prosocial preferences and preferences for risk tasking. Given its importance, however, we decided to include it in our analysis. The results remained unchanged when excluding trust from the analysis, see Appendix 2.5.

The subset of survey items that maximized adjusted R-squared in predicting incentivized behavior in the corresponding experiment was selected for the international survey. The selected items, which are described in Appendix 2.5, comprise a combination of qualitative self-assessments and quantitative items that involve economic trade-off decisions. The qualitative items elicit participants' subjective assessment of their willingness to act in a certain way, such as whether participants are generally willing to take risks. Complementarily, the quantitative items provide revealed preference measures by using participants' choices in monetary tradeoff decisions. As an example, the quantitative item for risk taking provides the participants with a sequence of five interdependent choices between a fixed and a risky payment (lottery). This allows one to progressively approach the point of indifference between the fixed payment and the lottery, which serves as a revealed preference measure for risk taking behavior. The presence of both qualitative and quantitative items allows for robustness tests with respect to potential culture-specific response behavior. To make survey items comparable across cultures, all items were translated back and forth by professionals and monetary values mentioned in the survey questions were adjusted along median household income across countries. To guarantee cross-cultural validity, the survey items were pre-tested in 22 countries of various cultural heritage as part of the Gallup World Poll 2012 pre-test conducted in late 2011.

After the ex-ante experimental validation and pre-tests, the international survey was implemented in a total of 76 countries, representing about 90 percent of the global population and global GDP. To provide geographic representativeness as well as developmental and cultural variation, the countries were selected to include all continents and a very broad range of economic development levels. To allow generalizable inferences, for each country the data contain samples representative of the resident population aged 15 and older, with a median sample size of 1,000 participants per country. In total, the data include preference measures for about 80,000 participants.

After implementation of the worldwide survey, the measures for the six preferences were generated according to the following procedure. First, each of the survey items was standardized using the mean and variance of the entire worldwide sample. Then, to obtain the preference measures, the relevant z-scores were averaged using weights developed in the experimental validation.

The data allow one to assess the existence and quantitative relevance of gender differences in preferences at the global level (Falk et al., 2018). For this purpose, global gender differences were calculated as follows: each preference measure was standardized at the global level to exhibit a mean of zero and a standard deviation of one. Then, for each preference, an OLS regression was performed on the worldwide sample using as independent variable a gender indicator in which male is the reference category, controlling for age, age squared, subjective math skills, education level, household income quintile, and country fixed effects. Standard errors were clustered at the country level. The estimated coefficient on the gender indicator served as the gender difference in the respective preference. On the global level, all six preferences featured significant gender differences (Figure 2.1): women tended to be more prosocial and less negatively reciprocal than men with differences in standard deviations of 0.106 for altruism ($p < 0.0001$), 0.064 for trust ($p < 0.0001$), 0.055 for positive ($p < 0.0001$) and 0.129 for negative reciprocity ($p < 0.0001$), respectively. Turning to non-social preferences, women were less risk taking by 0.168 standard

deviations ($p < 0.0001$), and less patient by 0.050 standard deviations ($p < 0.0001$).[4] The observed differences in preferences set the stage for our analysis.

2.3 Empirical Results

To test the competing hypotheses, we computed country-level gender differences for each preference. For this purpose, we standardized each preference measure at the country level to exhibit a mean of zero and a standard deviation of one. We then performed for each preference and country a separate OLS regression using as independent variable a gender indicator in which male is the reference category. We also included several controls to isolate the gender effect from potentially confounding factors which differ between women and men. These controls are age, age squared, subjective math skills, education level, and household income quintile. The obtained coefficient on the gender indicator served as measure of the gender difference in the respective preference and country.

Using the country-level estimates of gender differences in preferences, we examined variation along levels of economic development and gender equality. As the measure of economic development, we used GDP per capita. To assess the role of gender equality, we created a Gender Equality Index as a joint measure of four indices of gender equality: (A) the Global Gender Gap Index of the World Economic Forum (WEF), (B) the Gender Equality Index of the United Nations (UN),[5] (C) the ratio of female and male labor force participation rates, and (D) years since women's suffrage. The Gender Equality Index was constructed as the predicted main component from a principal component analysis of the four indices.

To study the effect of economic development, we first sorted the 76 countries into four bins according to their level of development, measured by GDP per capita. We then computed for each bin the average country-level gender difference in each preference. Gender differences in all six preferences increased with a country's level of development (Figure 2.2, Panel A). The positive correlations between log GDP per capita and country-level gender differences were large and statistically significant for all six preferences (0.58 for altruism ($p < 0.0001$), 0.59 for trust ($p < 0.0001$), 0.31 for positive reciprocity ($p = 0.0067$), 0.35 for negative reciprocity ($p = 0.0017$), 0.37 for risk taking ($p = 0.0011$), and 0.38 for patience ($p = 0.0006$)) (Figure 2.3). We also analyzed a summary index of gender differences for all preferences jointly. For this purpose, we first performed a principal component analysis of the country-level gender differences in the six preferences. We then created an index of gender differences in preferences as the predicted first main component. This index exhibited a correlation of 0.67 ($p < 0.0001$) with log GDP per capita (Figure 2.2, Panel B).[6]

[4]The raw gender differences without controls are qualitatively very similar (Table 2.1).

[5]The United Nations provides a Gender Inequality Index (GII). We invert this index to obtain a "Gender Equality Index" which we use in the analysis.

[6]This relationship remained robust when controlling for country-specific differences such as geographic, demographic, and historical factors (Table 2.2). A complementary analysis further showed that gender differentiation in preferences was driven by those components of economic development which disproportionately benefit females rel-

To study the effect of gender equality, we ran the same analysis as for economic development using the Gender Equality Index as the explanatory variable. Gender differences in preferences were found to increase with gender equality both for each preference separately (Figure 2.2, Panel C) as well as for the index of gender differences in preferences (Figure 2.2, Panel D). For the individual preferences the correlation coefficients were 0.51 for altruism ($p < 0.0001$), 0.41 for trust ($p = 0.0005$), 0.13 for positive reciprocity ($p = 0.2875$), 0.40 for negative reciprocity ($p = 0.0005$), 0.34 for risk taking ($p = 0.0036$), and 0.43 for patience ($p = 0.0002$) (Figure 2.4). The summary index of gender differences in preferences exhibited a correlation of 0.56 ($p < 0.0001$) with the Gender Equality Index. Reassuringly, the positive relationship between the index of gender differences in preferences and gender equality was also found for the four individual indicators of gender equality (Figure 2.5).

Economic development and gender equality are strongly intertwined (Duflo, 2012). To isolate the separate impacts of economic development and gender equality on gender differences in preferences, we therefore conducted a conditional analysis. We constructed partial regression plots illustrating the relationship between the index of gender differences in preferences and log GDP per capita conditional on the Gender Equality Index (Figure 2.6, Panel A) and vice versa (Figure 2.6, Panel B). The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. Hence, the slope coefficients can be interpreted as the standard deviation change in the dependent variable in response to a one standard deviation change in the independent variable.

There was a quantitatively large and statistically significant association of gender differences with log GDP per capita conditional on the Gender Equality Index. The estimated slope coefficient was 0.53 ($p < 0.0001$). Likewise, gender differences were strongly associated with the Gender Equality Index conditional on log GDP per capita with a somewhat smaller slope coefficient of 0.32 ($p = 0.0033$) (see also column 7 in Table 2.4). When conducting an F-test for equality of both coefficients, we failed to reject at $p = 0.2537$, indicating that the strength of the relationships between the index of gender differences in preferences and log GDP per capita and the Gender Equality Index were not statistically different. These findings imply that both economic development and gender equality exhibited an independent and significant association with gender differences in preferences.[7] Conditional on log GDP per capita, differences in preferences were also significantly and positively associated with the four individual measures of gender equality (Figure 2.6, Panels C to F). Slope coefficients were 0.23 ($p = 0.0084$) for the WEF Global Gender Gap Index, 0.29 ($p = 0.0515$) for the UN Gender Equality Index, 0.25 ($p = 0.0123$) for ratio of female to male labor force participation, and 0.30 ($p = 0.0023$) for years since women's suffrage.

In sum, these findings provide evidence in favor of the resource hypothesis that higher levels of economic development and gender quality are associated with stronger gender differentiation in

atively to males (Table 2.3).

[7] We also investigated, separately for each preference, the relationship between gender differences and economic development conditional on gender equality and vice versa. For each preference, gender differences were found to be strongly associated with log GDP per capita conditional on the Gender Equality Index (Figure 2.7). Likewise, gender differences were found to be highly associated with the Gender Equality Index conditional on log GDP per capita (Figure 2.8).

preferences.

A potential concern regarding the reported results involves bias due to culture-specific survey response behavior (Yuki, 2003; Guimond et al., 2006, 2007; Guimond, 2008). Note that our data contain two types of items, qualitative self-assessments and quantitative choice measures. Qualitative self-assessments might be affected by response biases such as scaling effects which might vary across cultures introducing systematic measurement error.[8] In contrast, the quantitative items present trade-offs that are well-defined in terms of stakes and probabilities yielding revealed preferences measures that facilitate a culturally fair comparison. To test for robustness with regards to the elicitation method, we constructed two separate indices of gender differences using either qualitative or quantitative items only (in an analogous way as the main index). The correlations of the indices with log GDP per capita were found to be very similar, with values of 0.551 ($p < 0.0001$) for qualitative and 0.516 ($p < 0.0001$) for quantitative items (Figure 2.9, Panel A and B). A test of the null hypothesis of equality of the correlation coefficients failed to reject at conventional significance levels ($p = 0.744$). Likewise, correlations with the Gender Equality Index were 0.480 ($p < 0.0001$) for qualitative and 0.479 ($p < 0.0001$) for quantitative items (Figure 2.9, Panel C and D). Testing equality of the coefficients failed to reject ($p = 0.991$), thus providing no support that culture-specific response behavior contaminated the results.

To further test for the robustness of our results, we conducted several additional analyses. First, as trust reflects a composite trait that captures beliefs about others' behavior, prosocial preferences and preferences for risk taking, we repeated our analysis excluding the trust dimension. To do so, we constructed an alternative index of gender differences in preferences in a procedure parallel to the main index but using only the five remaining preferences. Similar to our main results, this alternative index exhibited a quantitatively large association with economic development and measures of gender equality (Tables 2.5 and 2.6). Second, we tested whether the level of standardization affected our results. We repeated our analysis employing preference measures standardized at the global rather than the country level. The results using preferences standardized at the global level were similar to our main results (Tables 2.7 and 2.8, Figure 2.10). Third, we repeated our analysis without using individual-level controls when calculating gender differences, yielding similar results (Tables 2.9 and 2.10, Figure 2.11). Fourth, a common concern in cross-country analysis involves measurement error. As the experimental validation was conducted in Germany, more linguistically similar countries might exhibit smaller measurement error. To test for robustness against this potential confound, we additionally controlled for linguistic distance to German, which left the results qualitatively unchanged (Tables 2.11 and 2.12). Fifth, to address concerns of aggregation bias, we tested for the relationship between household income and gender differences in preferences in individual-level regressions finding a significant relationship for each preference (Table 2.13). Finally, we tested for a non-linear relationship with economic development. A closer in-

[8] A specific concern involves cross-cultural differences in gender-specific social comparison (Yuki, 2003; Guimond et al., 2006, 2007; Guimond, 2008): survey respondents in less developed, less gender-egalitarian countries may be inclined to define their self relative to members of their own gender (intra-group social comparison). In contrast, those in more developed and gender-egalitarian countries may be likely to compare themselves to members of both genders (inter-group social comparison). As a consequence, gender differences estimated through self-assessments may be understated in less developed countries.

spection of Figure 2.2, Panel B suggested a non-linear, convex relationship, which is confirmed by regression analysis (column 2 in Table 2.14). This pattern originated from the fact that richer countries are over-proportionally more gender-equal. Therefore, when we investigated the relationship between the index of gender differences in preferences and log GDP per capita after residualizing both variables with respect to the Gender Equality Index, the relationship was found to be linear (Table 2.14). For details on the robustness tests, see Appendix 2.5.

2.4 Discussion

The reported evidence indicates that higher levels of economic development and gender equality are associated with stronger gender differentiation in preferences. These findings may also relate to other personality traits, such as the Big Five (Costa et al., 2001; Schmitt et al., 2008) or value priorities (Schwartz and Rubel, 2005). Our findings do not rule out an influence of gender-specific roles that drive gender differences in preferences. They also do not preclude a role for biological or evolutionary determinants of gender differences.[9] Our results highlight, however, that theories not attributing a significant role to the social environment are incomplete.[10]

In this regard, our findings point towards the critical role of availability of and equal access to material and social resources for both genders in facilitating the independent formation and expression of gender-specific preferences across countries. As suggested by the resource hypothesis, greater availability of material resources removes the human need of subsistence, and hence provides the scope for attending to gender-specific preferences. A more egalitarian distribution of material and social resources enables both genders to independently express gender-specific preferences.

[9] An example for the biological role in shaping human preferences comes from twin studies (Cesarini et al., 2009; Zethraeus et al., 2009; Cesarini et al., 2008; Wallace et al., 2007).

[10] For instance, our results can be accommodated by approaches suggesting interactions of evolutionary or biological determinants with the social environment (Geary, 1999).

2.5 Appendix II

Details on GPS data

Experimental Selection of Survey Items and Construction of Preference Measures

Survey items included in the GPS data were selected in an ex-ante experimental validation procedure at the Laboratory for Experimental Economics of the University of Bonn in winter 2010/2011. In this procedure, 402 subjects participated in incentivized choice experiments and responded to a large set of survey items which were either newly developed or taken from existing surveys (Falk et al., 2015).

Incentivized choice experiments were conducted to obtain an incentivized behavioral measure for each preference: risk taking was measured as the average response to two multiple price lists in which subjects choose between a lottery and varying safe options. Patience was measured as the average response to two multiple price lists in which subjects choose between receiving a payment at the day of the experiment or a larger payment 12 days later. Trust was measured as the average amount sent as a first mover in two investment games. Altruism was measured as first mover behavior in a dictator game with a charitable organization as recipient. Positive reciprocity was measured as the average amount sent back as a second mover in two investment games. Negative reciprocity was measured as the average amount invested into punishment after unilateral defection of the opponent in a prisoner's dilemma and the minimum acceptable offer in an ultimatum game.

For each preference, those survey items were selected for constructing the GPS which exhibited the highest predictive power for the corresponding incentivized behavioral measure (Falk et al., 2015). Formally, for each preference the behavioral measure was regressed on different combinations of the survey items. The combination which maximized adjusted R-squared was then selected for the respective preference.

12 survey questions were selected for the GPS which comprised a mixture of qualitative items, measured on an 11-point Likert scale, and quantitative items involving economic tradeoff decisions: risk taking was elicited by (i) an item determining the indifference point between a lottery with 50% chance of winning and receiving a fixed certain payment and (ii) the response to the question *"Please tell me, in general, how willing or unwilling you are to take risk"*. Patience was elicited by (i) an item determining the indifference point between receiving a fixed monetary amount at the day of the survey and a larger amount 12 months later and (ii) the response to the question *"How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future?"* Positive reciprocity was elicited by (i) an item asking for the value of a thank-you gift the respondent is willing to give in return to help by a stranger and (ii) the response to the question *"When someone does me a favor I am willing to return it"*. Negative reciprocity was elicited by responses to the questions (i) *"If I am treated very unjustly, I will take revenge at the first occasion, even if there is a cost to do so"*, (ii) *"How willing are you to punish someone who treats you unfairly, even if there may be costs for you?"*, and (iii) *"How willing are you to punish someone who treats others unfairly, even if there may be costs for you?"*. Altruism was elicited by (i) the quantitative value in response to the question *"Imagine the following situ-*

ation: Today you unexpectedly received 1,000 Euro. How much of this amount would you donate to a good cause?" and (ii) the response to the question *"How willing are you to give to good causes without expecting anything in return?"*. Trust was elicited by the response to the question *"I assume that people have only the best intentions"*. For each preference, the final survey measure was given as the weighted average of the z-scores of the corresponding survey items. The weights were calculated as the coefficients in OLS regressions of the incentivized behavioral measures on the respective survey items.

Selection of Countries, Translation of Survey Items, and Pretest

For the GPS, 76 countries were selected with the goal to provide representative coverage of the global population. As a key criterion, the selected countries covered all development levels and geographic regions, including 24 in Europe, 22 in Asia, 1 in Oceania, 14 in Africa and 15 in the Americas. Further, the selection process aimed at maximizing variation along country characteristics such as language, historical, political, and ecological conditions and favored culturally distinct and non-neighboring countries.

For each country, the selected survey items were translated into the country's major languages involving at least three translators for each language. A first translator suggested, dependent on the region of the target language, an English, French, or Spanish version of the item. A second translator conducted the translation into the target language. A third translator conducted a translation back to the original language. If a discrepancy occurred, the process was iterated until all translators agreed. Furthermore, monetary amounts used in the survey questions were adjusted to correspond to the same share in the median income of the target countries.

The survey items were pretested as part of the Gallup World Poll 2012 pre-test, conducted at the end of 2011 in 22 countries with a sample size of 10 to 15 respondents per country. No respondent indicated problems in understanding the wording or the quantitative content of the survey items. Some respondents suggested rewording which was incorporated through minor adjustments of some survey items.

Sampling and Selection of Respondents

The GPS was included as part of the Gallup World Poll 2012 through the infrastructure of Gallup. Respondents were sampled to achieve national representativeness of the resident population aged 15 and older. Telephone interviews were conducted where at least 80% of the country's population is covered by telephone or where it is the customary survey methodology. Otherwise, face-to-face interviews were conducted.

The selection of households in countries with telephone interviews employed either a random-digit-dialing method or nationally representative lists of phone numbers. In countries with face-to-face interviews, primary sampling units were stratified by population size and/ or geography. To select sampled households, a random-route procedure was employed. Respondents were selected randomly by either the latest birthday or Kish grid method.

Definition of Country-Level Variables (Including Sources)

Time since women's suffrage. Taken from the Inter-Parliamentary Union Website (http://www.ipu.org/wmn-e/suffrage.htm#Note1). For countries where data were missing data were added from the World Economic Forum Global Gender Gap Report 2006 (http://www3.weforum.org/docs/WEF_GenderGap_Report_2006.pdf).

WEF Global Gender Gap Index. Taken from the World Economic Forum Global Gender Gap Report 2015 (http://reports.weforum.org/global-gender-gap-report-2015/rankings/).

UN Gender Inequality Index. Taken from the Human Development Report 2015 (http://hdr.undp.org/en/composite/GII). Values inverted to create an index of equality.

Ratio of female and male labor force participation. Average International Labour Organization estimates from 2003 to 2012 taken from the World Bank database (http://data.worldbank.org/indicator/SL.TLF.CACT.FM.ZS).

Male and female GNI p/c. Taken from the Human Development Report 2015 (http://hdr.undp.org/en/composite/GDI).

Longitude, absolute latitude, area. Taken from the CEPII geo database.

Mean of elevation. Elevation in km above sea level, taken from Ashraf and Galor (2013). Data originally based on geospatial elevation data reported by the G-ECON project (Nordhaus, 2006).

Percentage in (sub-)tropical zones. Percentage of area within a country which forms part of each of the tropical or sub-tropical climatic zones. Data taken from John Luke Gallup (http://www.pdx.edu/econ/jlgallup/country-geodata).

Percentage of arable land. Fraction of land within a country which is arable, taken from the World Bank Development Indicators.

Land suitability for agriculture. Index of the suitability of land for agriculture based on eco-logical indicators of climate suitability for cultivation, such as growing degree days and the ratio of actual to potential evapotranspiration, as well as eco-logical indicators of soil suitability for cultivation, such as soil carbon density and soil pH, taken from Michalopoulos (2012).

Precipitation. Average monthly precipitation of a country in mm per month, 1961-1990, taken from Ashraf and Galor (2013). Data originally based on geospatial average monthly precipitation data for this period reported by the G-ECON project (Nordhaus, 2006).

Temperature. Average monthly temperature of a country in degree Celsius, 1961- 1990, taken from Ashraf and Galor (2013). Data originally based on geospatial average monthly temperature data for this period reported by the G-ECON project (Nordhaus, 2006).

Percentage at risk of malaria. The percentage of population in regions of high malaria risk (as of 1994), multiplied by the proportion of national cases involving the fatal species of the malaria pathogen, P. falciparum. This variable was originally constructed by Ashraf and Galor (2013) and is part of Columbia University's Earth Institute data set on malaria. Data taken from Nordhaus (2006).

Predicted genetic diversity. Predicted genetic diversity of the contemporary population, ad-justed for post-Columbian migration flows and genetic distance between ethnic groups. See Ashraf and Galor (2013). Median age. Taken from the World Bank database.

Ethnic, linguistic, and religious fractionalization. Indices due to Alesina et al. (2003) capturing the probability that two randomly selected individuals from the same country will be from different ethnic (religious) groups.

Linguistic distance to Germany. Computed as the linguistic distance of a country's major language to German based on the ASJP Database, version 18 (http://asjp.clld.org).

Share of atheists. Source: Religion Adherence Data by Robert Barro (`http://scholar.harvard.edu/barro/publications/religion-adherence-data`).

Colonization indicator. Indicator equal to one if the respective country had at least one colonizer over a long period of time and with substantial participation in governance. Source: the CEPII geo database.

Years of civil and interstate conflict between 1800 and 2007. Taken from the Correlates of War database.

GDP per capita. Average annual GDP per capita over the period 2003 - 2012, in 2005 US$. Source: World Bank Development Indicators.

Details on Statistical Analysis

This section describes details of the statistical analysis. We first describe the construction of measures of gender differences in preferences. Then, we provide details on the construction of figures using residualized variables.

Computation of Country-Level Gender Differences in Preferences

On the country level, gender differences for each of the six preferences (p) were computed as follows. First, each preference was standardized at the country level. Second, for each preference the following individual-level OLS regression was performed separately for each country (c),

$$\begin{aligned} p_i &= \beta_1^c \text{female}_i + \beta_2^c \text{age}_i + \beta_3^c \text{age}_i^2 + \beta_4^c \text{education level}_i \\ &\quad + \beta_5^c \text{income quintile}_i + \beta_6^c \text{subjective math skills}_i + \varepsilon_i \end{aligned}$$

The obtained coefficient β_1^c on the dummy for female (female_i) served as measure of the country-level gender difference for country c in the respective preference. Including controls in the estimation isolates the gender difference from potentially confounding factors which differ between women and men.

Summary Index of Country-Level Gender Differences in Preferences

The country-level summary index of country-level gender differences in preferences was computed as follows. First, we performed a principal component analysis of the country-level gender differences in the six preferences. The predicted first main component then served as the summary index of average gender differences in preferences.

Global Gender Differences in Preferences

On the global level, gender differences for each of the six preferences (p) and associated confidence intervals (2.1) were computed as follows. First, each preference was standardized at the global level. Second, for each preference the following individual-level OLS regression with country fixed effects (c_i) was performed on the global sample,

$$\begin{aligned} p_i &= \beta_1 \text{female}_i + \beta_2 \text{age}_i + \beta_3 \text{age}_i^2 + \beta_4 \text{education level}_i \\ &\quad + \beta_5 \text{income quintile}_i + \beta_6 \text{subjective math skills}_i + c_i + \varepsilon_i \end{aligned}$$

The obtained coefficient β_1 on the dummy for female (female_i) served as measure of the global gender difference in the respective preference. Including controls in the estimation isolates the gender difference from potentially confounding factors which differ between women and men. Confidence intervals were computed from standard errors clustered at the country level. In alternative specifications we calculated unconditional gender differences in a parallel way without using controls. Gender differences obtained from this alternative approach were found to be similar (Table 2.1).

Construction of Partial Regression Plots

The visualization of results employed partial regression plots which show the relationship of residualized variables. Intuitively, a partial regression plot of residual values of variables y and x using for the residualization variable z shows the relationship between variables y and x controlling for z. Technically, for constructing such a figure, we first performed two OLS regressions regressing y on z and x on z. We then calculated the residuals r_x=$x - \tilde{x}$ and $r_y = y - \tilde{y}$, where $\tilde{x}$ and $\tilde{y}$ are the predicted values based on the OLS regressions. The partial regression plot of residual values of variables y and x using for the residualization variable z then shows the relationship of r_y and r_x.

Additional Results

This section describes the details of the supplemental analysis. There were two main purposes of the supplemental analysis: first, to further analyze the relationship with economic development and gender equality for the six preference measures separately, and second, to test for robustness against potential confounds.

Results on Individual Preferences

For all preferences, gender differences featured a quantitatively large and significant relationship with log GDP p/c (Figure 2.3). The correlations were particularly large for trust (0.5918, $p < 0.0001$) and altruism (0.5847, $p < 0.0001$). The correlations were smaller but statistically significant for positive reciprocity (0.3086, $p = 0.0067$), negative reciprocity (0.3542, $p = 0.0017$), risk taking (0.3685, $p = 0.0011$), and patience (0.3837, $p = 0.0006$).

We also investigated the relationship of gender differences in preferences with the Gender Equality Index (Figure 2.4). The correlations were large and significant for five out of six preferences: trust (0.4050, $p = 0.0005$), altruism (0.5073, $p < 0.0001$), negative reciprocity (0.4035, $p = 0.0005$), risk taking (0.3412, $p = 0.0036$), patience (0.4257, $p = 0.0002$). The correlation was smaller and insignificant for positive reciprocity (0.1280, $p = 0.2875$).

To separate the impacts of economic development and gender equality, we conducted a residual analysis. We first conducted this analysis for economic development residualizing with respect to the Gender Equality Index. To do so, we first regressed the country-level gender differences in the respective preference on the Gender Equality Index. We then predicted the residual values of the gender differences in the respective preference. Next, we regressed log GDP p/c on the Gender Equality Index and predicted the residual values of log GDP p/c. The correlation between the residualized values of gender differences and log GDP p/c represents the relationship controlling for the Gender Equality Index. Similar to the unconditional results, they were particularly large for trust (0.4574, $p = 0.0001$) and altruism (0.4751, $p < 0.0001$). Correlations were found to be smaller but statistically significant for positive reciprocity (0.2771, $p = 0.0193$), negative reciprocity (0.2444, $p = 0.0400$), risk taking (0.2868, $p = 0.0153$), and patience (0.2621, $p = 0.0273$) (Figure 2.7).

In an analogous way, we conducted a residual analysis for the Gender Equality Index. To do so, we residualized the gender differences in each preference as well as the Gender Equality Index with respect to log GDP p/c. The correlations of residualized values (Figure 2.8) were positive and statistically significant (at least at the 10% level) for trust (0.2050, $p = 0.0863$), altruism (0.3304, $p = 0.0049$), negative reciprocity (0.2788, $p = 0.0185$), risk taking (0.1973, $p = 0.0991$), and patience (0.2967, $p = 0.0120$). Positive reciprocity exhibited no systematic correlation (-0.0115, $p = 0.9242$).

Results Excluding Trust

Trust is by definition not a preference but a joint measure capturing beliefs about others' behavior as well as prosocial preferences and preferences for risk taking. However, given its importance we included it in our main analysis. To test for robustness, we created a country-level summary index of gender differences in preferences excluding trust. This alternative index was constructed in a parallel way as the main index but using gender differences for the five remaining preferences only (excluding trust).

Results on the relationship with economic development and gender equality using this alternative index (Tables 2.5 and 2.6) confirmed our main findings and led to results similar both in terms of the size of the coefficients as well as in terms of statistical significance.

Results Using Preferences Standardized at the Global Level

In the main specifications, country-level gender differences for each preference were calculated after standardizing each preference on the country level. In alternative specifications, we calculated country-level gender differences after standardizing each preference on the global level. The relationship between these alternative estimates and log GDP p/c (Figure 2.10) was similar

to our main results in terms of magnitude and statistical significance for all preferences: trust (0.5787, $p < 0.0001$), altruism (0.5505, $p < 0.0001$), positive reciprocity (0.2819, $p = 0.0136$), negative reciprocity (0.2980, $p = 0.0089$), risk taking (0.2974, $p = 0.0091$), and patience (0.4391, $p = 0.0001$).

Using these alternative estimates of gender differences, we additionally constructed an alternative summary index of gender differences in preferences in a parallel way as the main index. Results on the relationship with economic development and gender equality using this alternative index (Tables 2.7 and 2.8) confirmed our main findings and led to results similar both in terms of the size of the coefficients as well as in terms of statistical significance.

Results without Controls

In the main specifications, country-level gender differences for each preference were calculated conditional on individual-level controls. In alternative specifications, we calculated country-level gender differences without using individual-level controls.

The relationship between these alternative estimates and log GDP p/c (2.11) was similar to our main results in terms of magnitude and statistical significance for all preferences: trust (0.5434, $p < 0.0001$), altruism (0.5808, $p < 0.0001$), positive reciprocity (0.2748, $p = 0.0163$), negative reciprocity (0.4038, $p = 0.0003$), risk taking (0.3860, $p = 0.0006$), and patience (0.4830, $p < 0.0001$).

Using these alternative estimates of gender differences, we additionally constructed an alternative summary index of gender differences in preferences in a parallel way as the main index. Results on the relationship with economic development and gender equality using this alternative index (Tables 2.9 and 2.10) confirmed our main findings and led to results similar both in terms of the size of the coefficients as well as in terms of statistical significance.

Results Controlling for Linguistic Distance to Germany

In further specifications, we tested whether results were driven by linguistic differences with Germany, where the experimental validation of survey items took place. Therefore, we repeated our analysis controlling for a country's linguistic distance to Germany. The results were found to be qualitatively very similar (Tables 2.11 and 2.12).

Results from Individual-Level Regressions

The main analysis was conducted on the country level. To address concerns of aggregation bias, we conducted additional individual-level analysis. In particular, we regressed each preference (p), standardized at the country-level, on a gender indicator with male as the reference category, log household income per capita, and their interaction. Log household income per capita was standardized to exhibit a mean of zero and standard deviation of one. Furthermore, we included as controls age, age squared, subjective math skills, education level, and country fixed effects c_i.

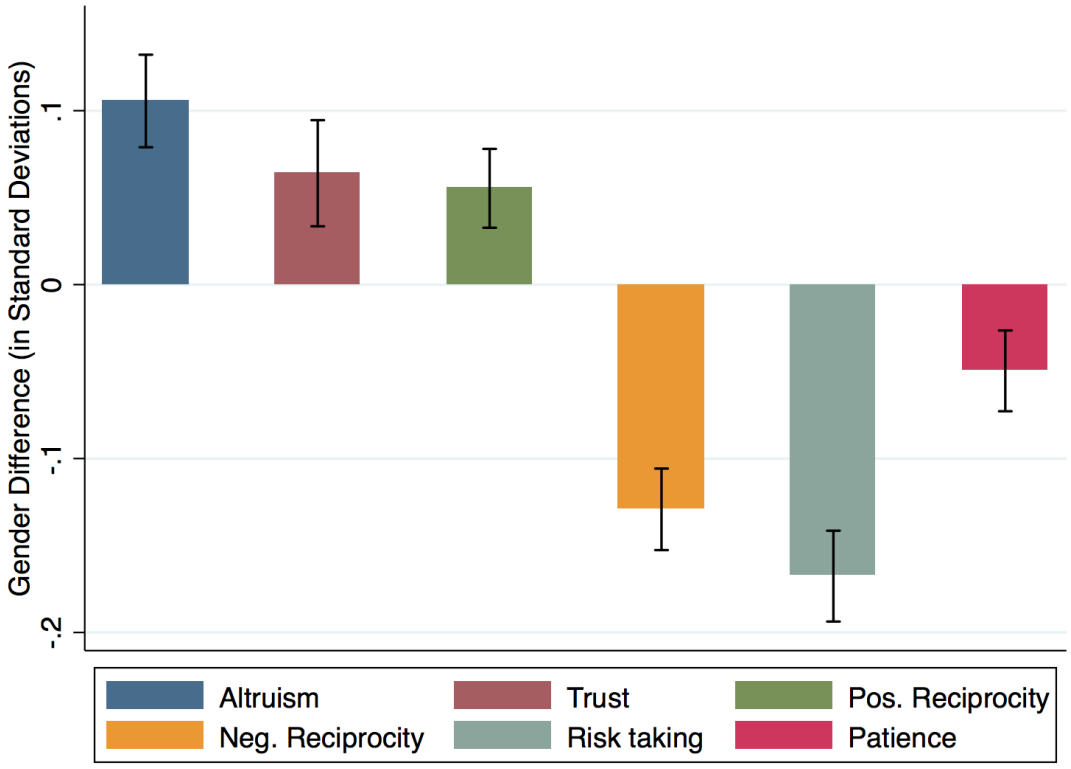
$$\begin{aligned} p_i &= \beta_1 \text{female}_i + \beta_2 \text{female}_i \times \log[\text{household income p/c}_i] + \beta_3 \log[\text{household income p/c}_i] \\ &\quad + \beta_4 \text{age}_i + \beta_5 \text{age}_i^2 + \beta_6 \text{subjective math skills}_i + \beta_7 \text{education level}_i + c_i + \varepsilon_i \end{aligned}$$

Standard errors were clustered at the country level. Results from the individual-level regressions (Table 2.13) were similar to the country-level results: for the average individual, gender differences were 0.072 ($p < 0.001$) for trust, 0.110 ($p < 0.001$) for altruism, 0.056 ($p < 0.001$) for positive reciprocity, -0.137 ($p < 0.001$) for negative reciprocity, -0.179 ($p < 0.001$) for risk taking, and -0.049 ($p < 0.001$) for patience.

Most importantly, gender differences were found to significantly increase with an increase in household income per capita. In particular, a one-standard deviation increase in log household income per capita magnified gender differences in standard deviations by 0.069 ($p < 0.001$) for trust, 0.060 ($p < 0.001$) for altruism, 0.017 ($p = 0.066$) for positive reciprocity, 0.024 ($p = 0.028$) for negative reciprocity, 0.028 ($p = 0.025$) for risk taking, and 0.040 ($p < 0.001$) for patience.

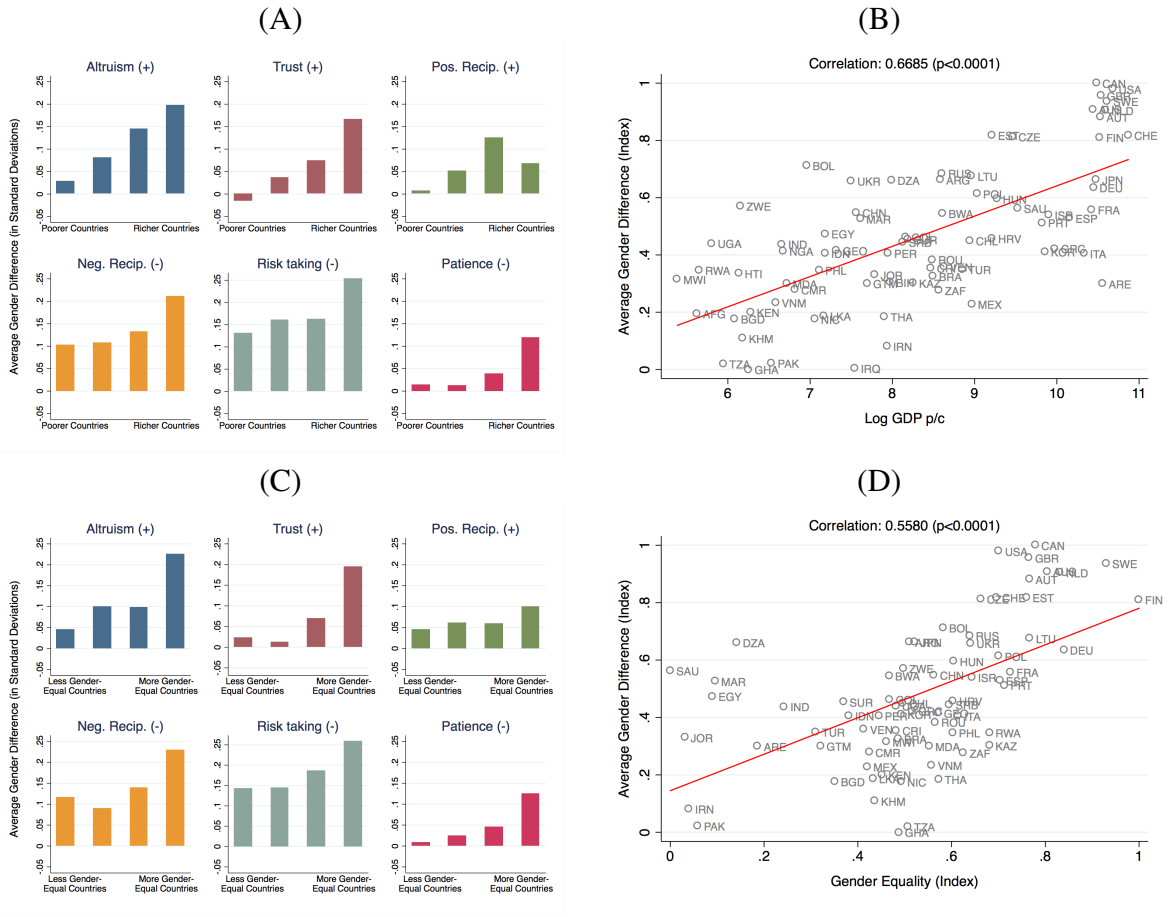
2.6 Figures and Tables

Figure 2.1: Gender Differences in Preferences on the Global Level



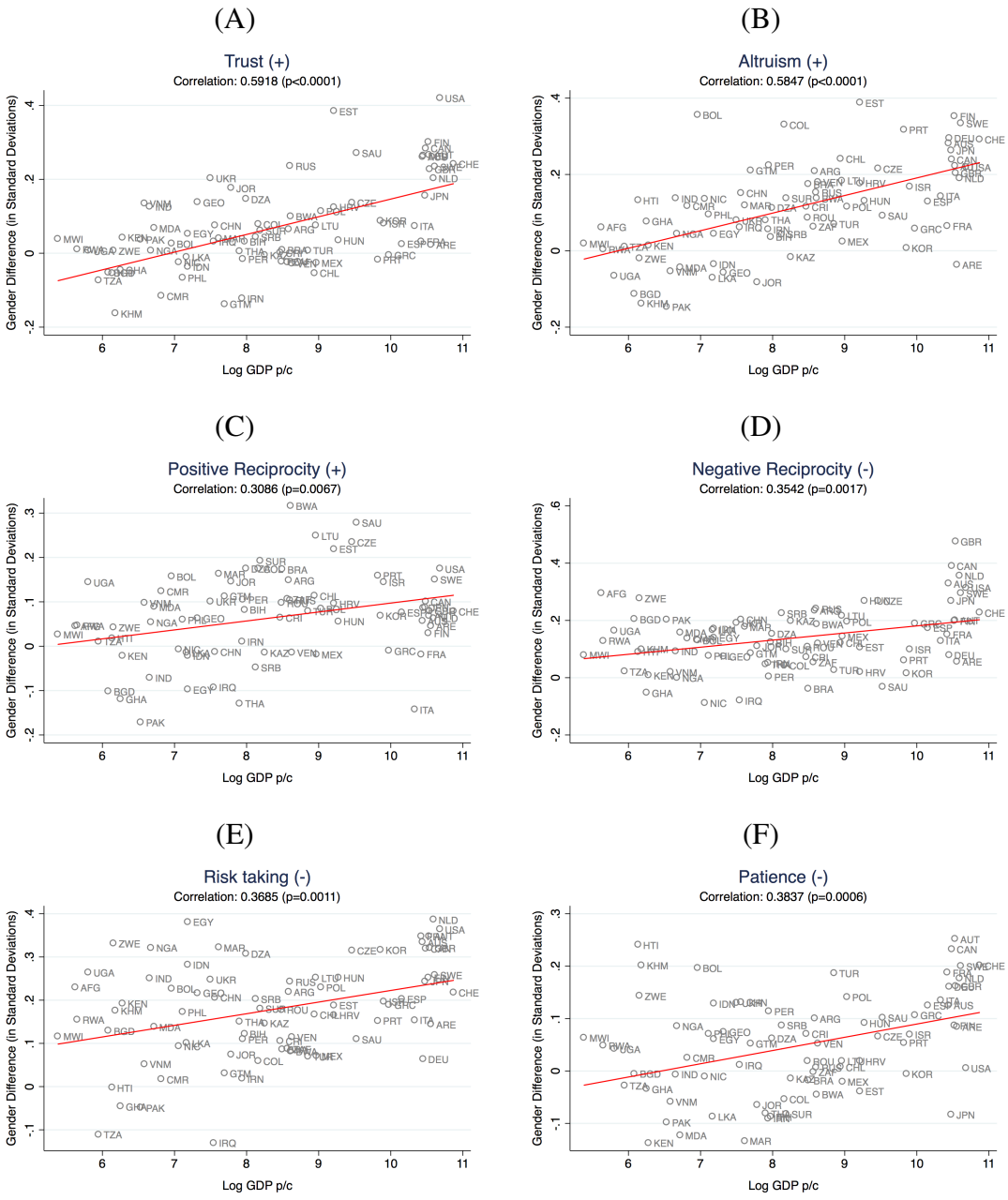
Notes: Figure 2.1 shows gender differences in preferences on the global level. Positive values indicate that women exhibited higher levels of the respective preference, negative values indicate that women exhibited lower levels of the respective preference. For each preference, the gender difference was calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator, controlling for age, age squared, subjective math skills, education level, household income quintile, and country fixed effects on the worldwide sample. Error bars indicate 95% confidence intervals obtained from standard errors clustered at the country level.

Figure 2.2: Analysis of Gender Differences in Relation to Economic Development and Gender Equality



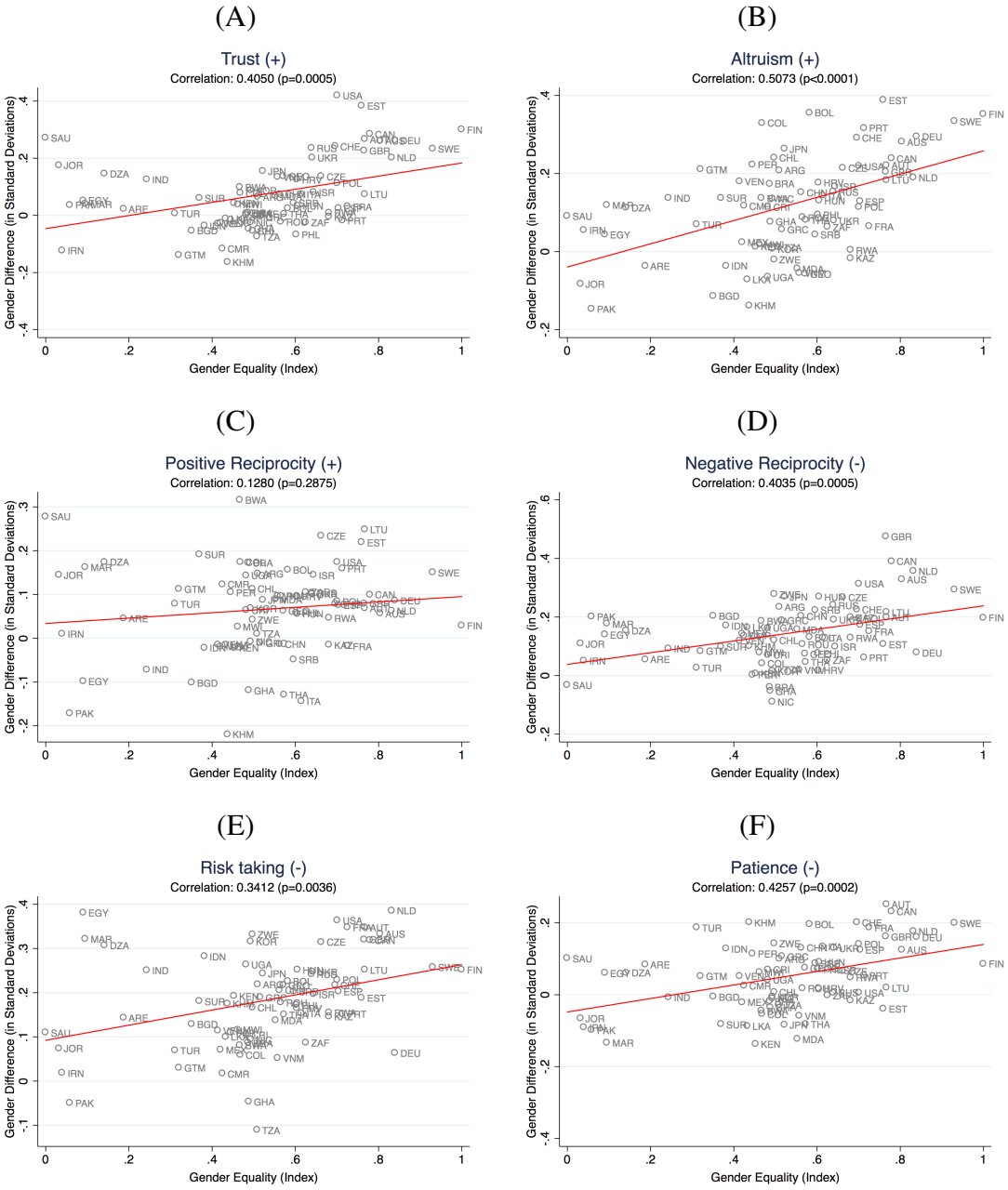
Notes: In Figure 2.2, Panel A shows mean country-level gender difference in altruism, trust, positive reciprocity, negative reciprocity, risk taking, and patience by development level. Countries were sorted into 4 bins according to their GDP per capita quartile. The symbols (+)/(-) in the panel titles indicate the sign of the difference for each preference. (+) indicates that positive differences correspond to women exhibiting higher levels of the respective preference. (-) indicates that positive differences correspond to women exhibiting lower levels of the respective preference. Panel B shows the relationship between the aggregate index of gender differences in all six preferences and log GDP per capita. Panels C and D show the same relationships for the Gender Equality Index.

Figure 2.3: Gender Differences and Economic Development by Preference and Country



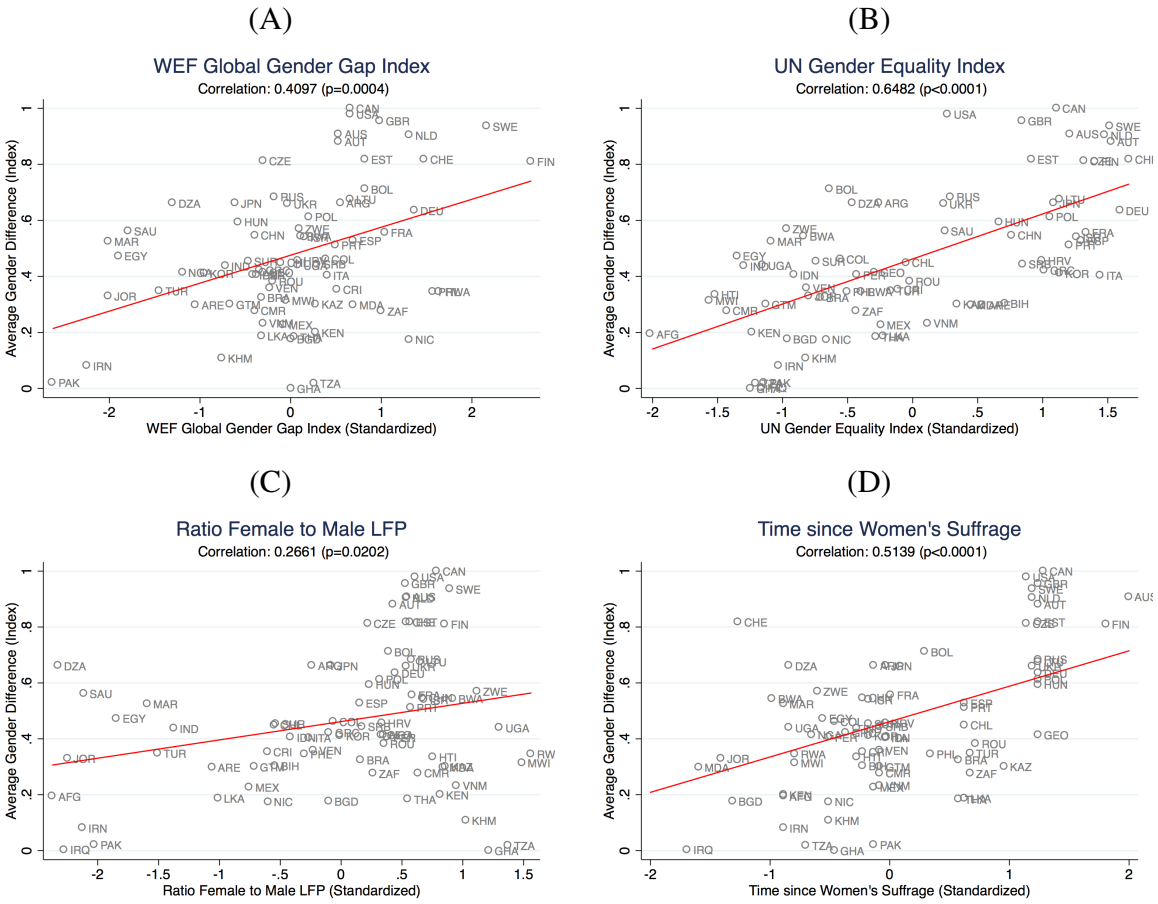
Notes: In Figure 2.3, each panel shows the relationship between country-level gender differences in a particular preference and the level of economic development measured by log GDP p/c, including a linear fit. For each preference, the symbols (+)/(-) in the panel titles indicate the direction of the difference. (+) indicates that women exhibited higher levels of the respective preference if the difference was positive. (-) indicates that men exhibited higher levels of the respective preference if the difference was positive. For each preference and country, the gender difference was calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator, controlling for age, age squared, subjective math skills, education level, household income quintile for the particular country sample.

Figure 2.4: Gender Differences and Gender Equality by Preference and Country



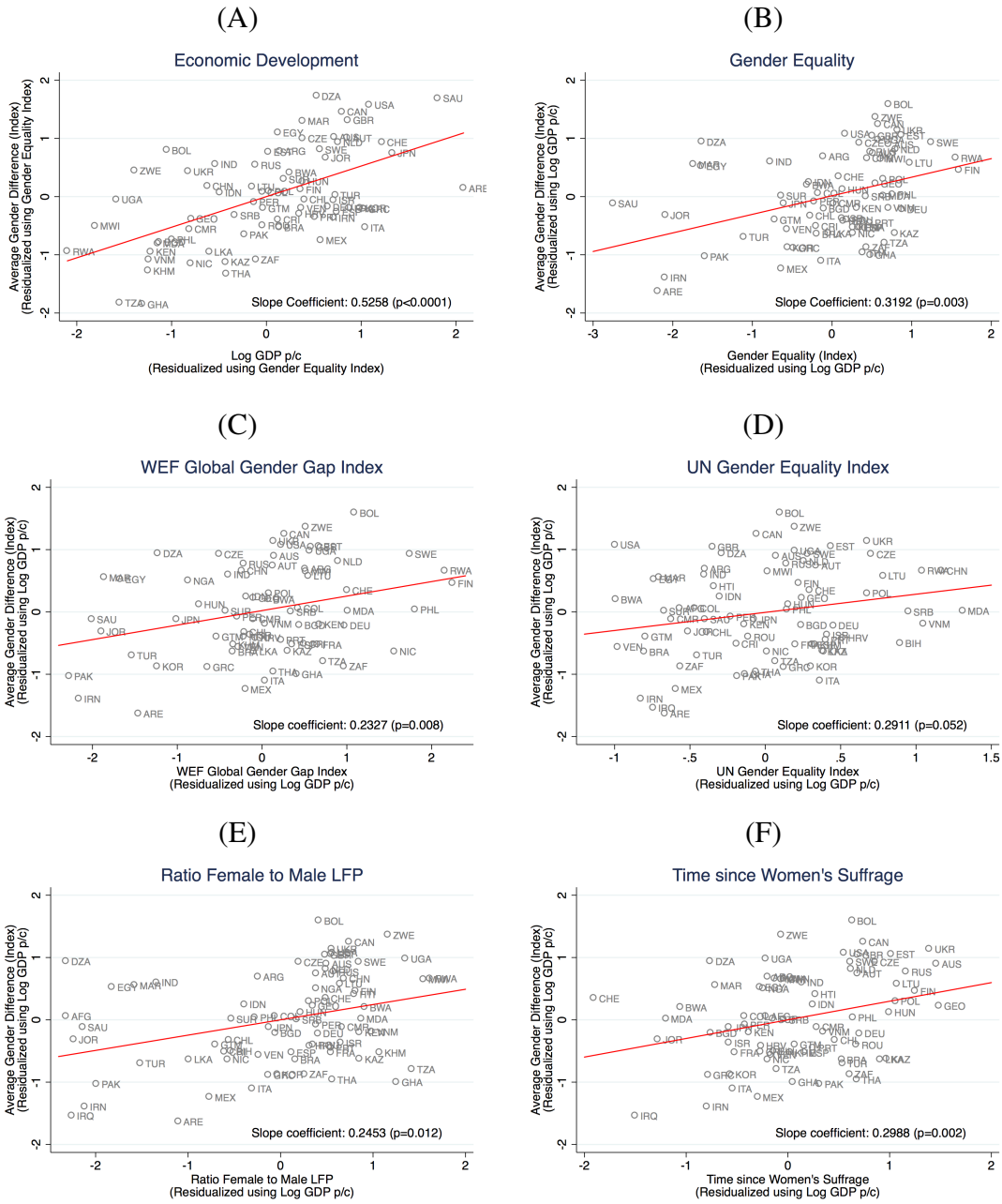
Notes: In Figure 2.4, each panel shows the relationship between country-level gender differences in a particular preference and the Gender Equality Index, including a linear fit. For each preference, the symbols (+)/(-) in the panel titles indicate the direction of the difference. (+) indicates that women exhibited higher levels of the respective preference if the difference was positive. (-) indicates that men exhibited higher levels of the respective preference if the difference was positive. For each preference and country, the gender difference was calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator, controlling for age, age squared, subjective math skills, education level, household income quintile for the particular country sample.

Figure 2.5: Gender Differences and Gender Equality by Equality Index



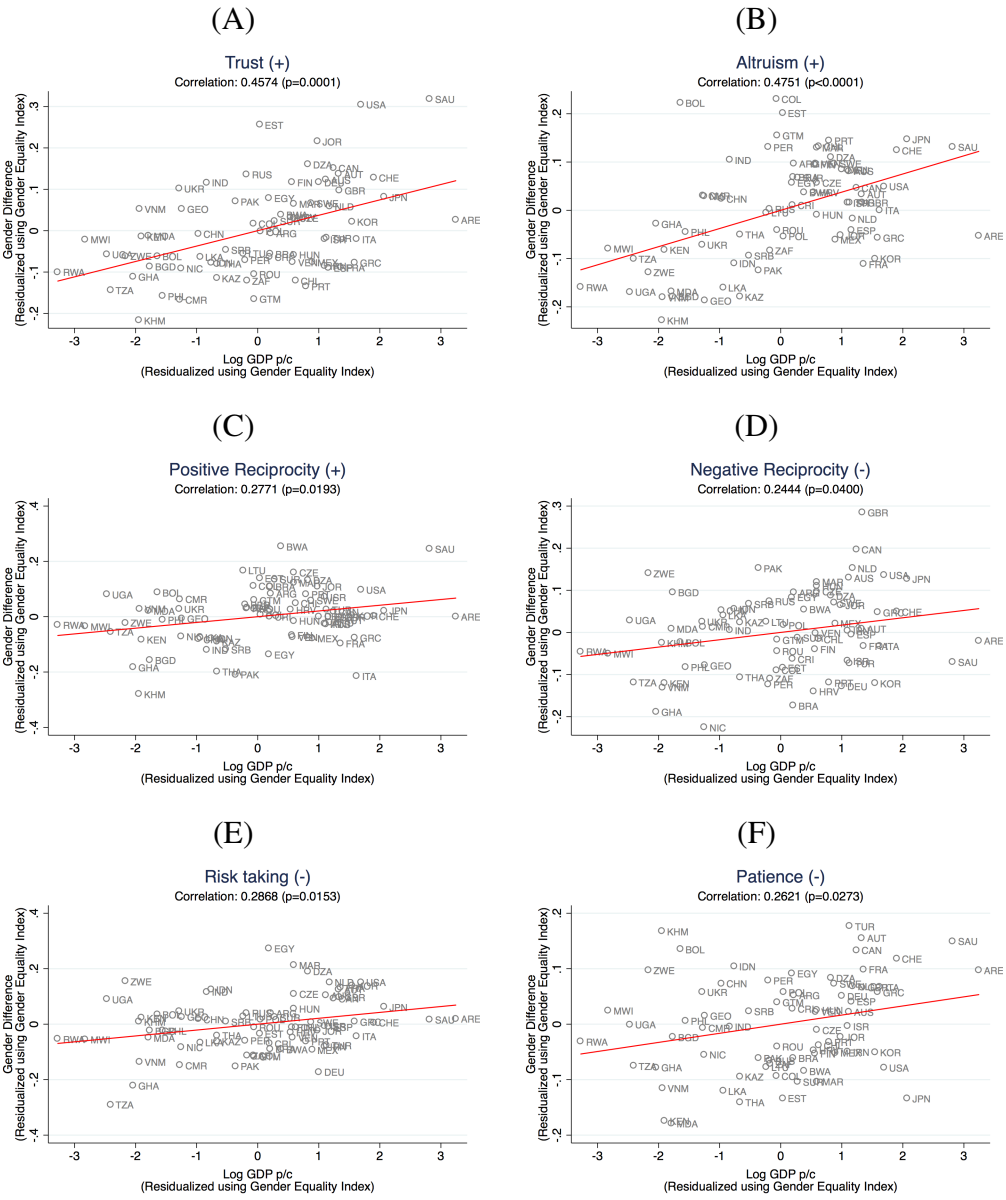
Notes: In Figure 2.5, each panel shows the relationship between the index of gender differences in preferences and an indicator for gender equality, including a linear fit. Panel A uses the Global Gender Gap Index of the World Economic Forum (WEF). Panel B uses the Gender Equality Index of the United Nations (UN). Panel C uses the ratio of female and male labor force participation rates. Panel D uses years since women's suffrage.

Figure 2.6: Gender Differences, Economic Development, and Gender Equality by Preference and Country



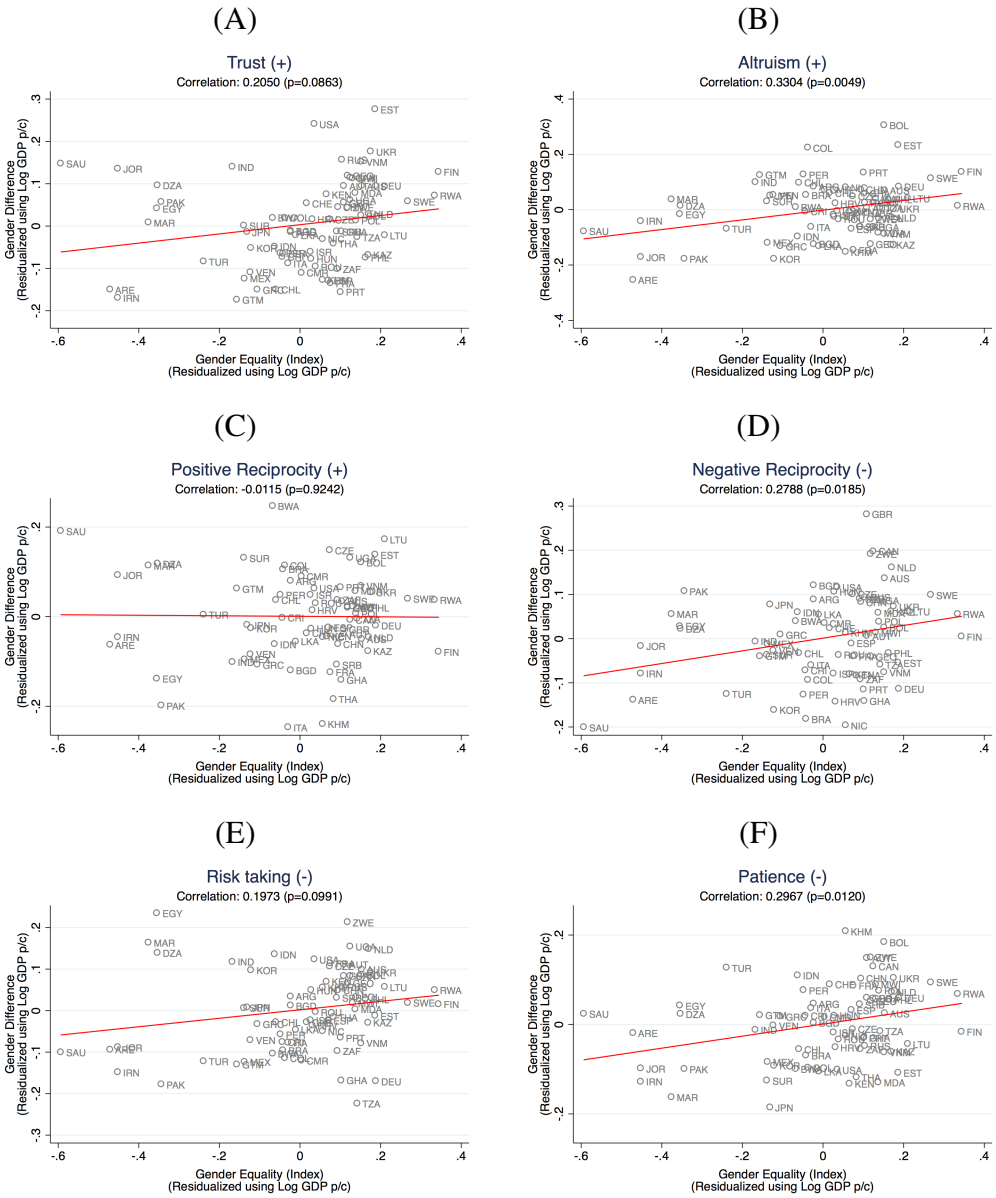
Notes: In Figure 2.6, each panel depicts a partial regression plot. Panel A shows the relationship between the aggregate index of gender differences in preferences and log GDP per capita after residualizing both variables with respect to the Gender Equality Index. Panels B to F show the relationship between the aggregate index of gender differences in preferences and five indices of gender equality after residualizing all variables with respect to log GDP per capita. Indices of gender equality are the Gender Equality Index (Panel B), WEF Global Gender Gap Index (Panel C), UN Gender Equality Index (Panel D), ratio of female to male labor force participation (Panel E), years since women's suffrage (Panel F). For corresponding regression evidence see Table 2.4.

Figure 2.7: Gender Differences and Economic Development Conditional on Gender Equality by Preference and Country



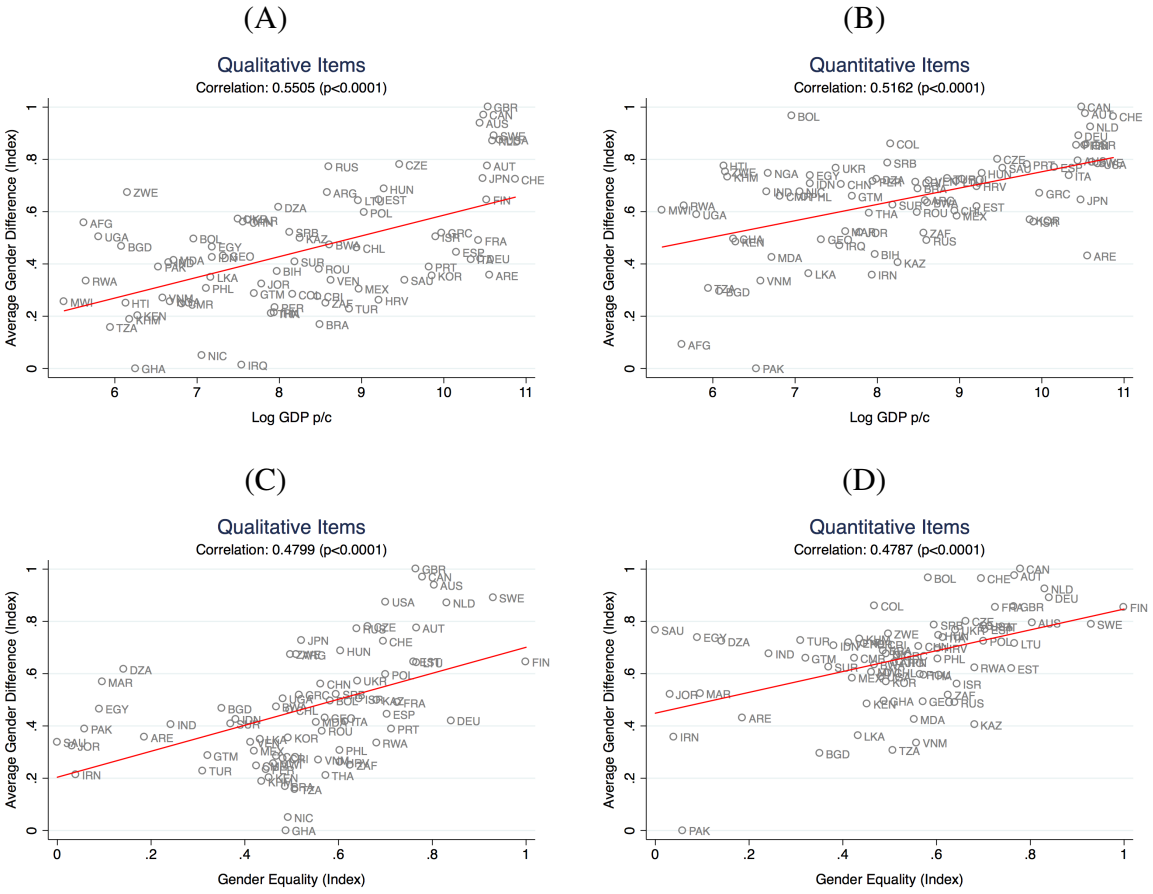
Notes: In Figure 2.7, each panel shows the relationship between country-level gender differences in a particular preference and economic development measured by log GDP p/c, including a linear fit. Gender differences in preferences and log GDP p/c were residualized with respect to the Gender Equality Index. For each preference, the symbols (+)/(-) in the panel titles indicate the general direction of the difference. (+) indicates that women generally exhibited higher levels of the respective preference. (-) indicates that men generally exhibited higher levels of the respective preference. For each preference and country, the gender difference was calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator, controlling for age, age squared, subjective math skills, education level, household income quintile for the particular country sample.

Figure 2.8: Gender Differences and Gender Equality Conditional on Economic Development by Preference and Country



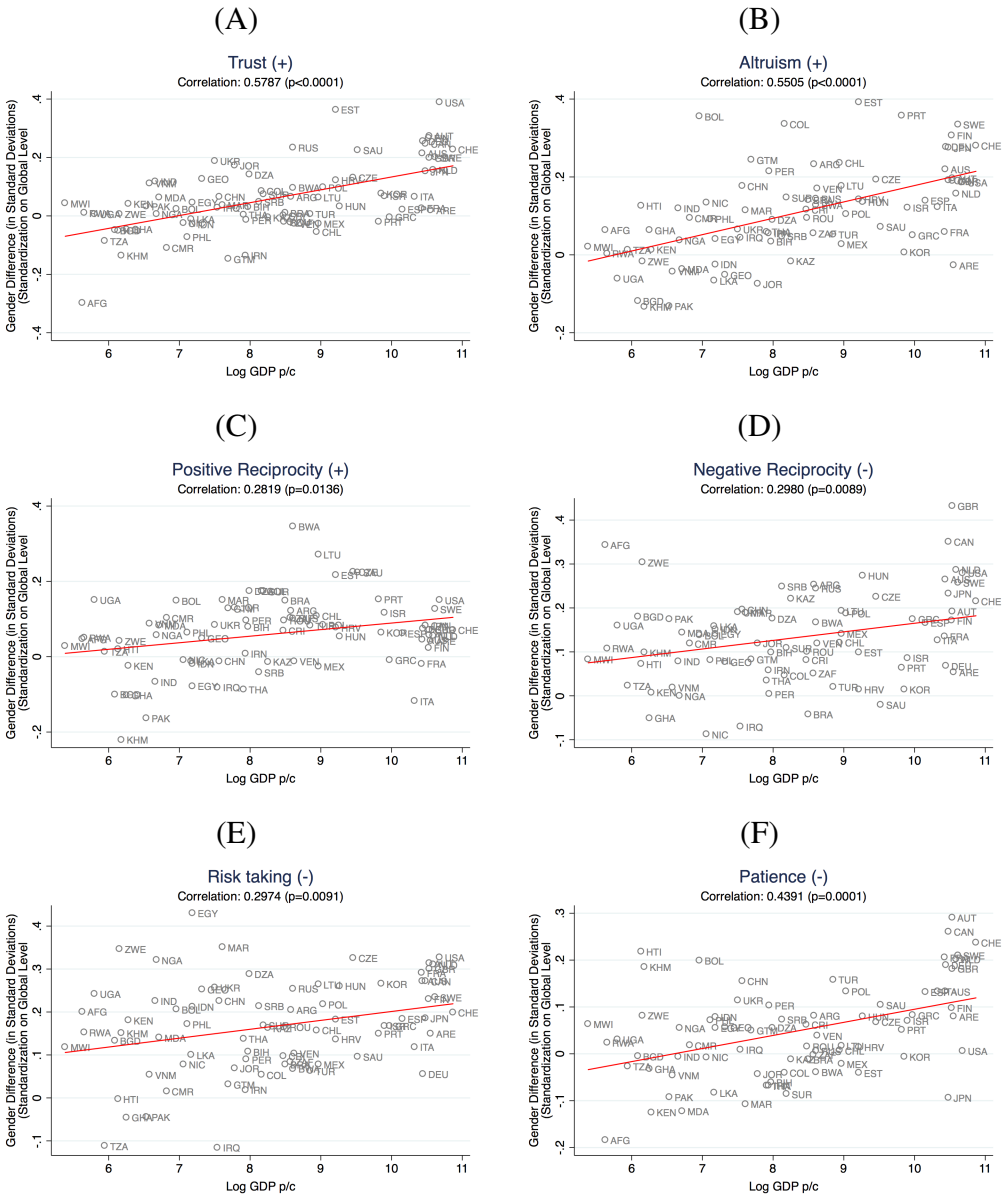
Notes: In Figure 2.8, each panel shows the relationship between country-level gender differences in a particular preference and the Gender Equality Index, including a linear fit. Gender differences in preferences and the Gender Equality Index were residualized with respect to log GDP p/c. For each preference, the symbols (+)/(-) in the panel titles indicate the general direction of the difference. (+) indicates that women generally exhibited higher levels of the respective preference. (-) indicates that men generally exhibited higher levels of the respective preference. For each preference and country, the gender difference was calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator, controlling for age, age squared, subjective math skills, education level, household income quintile for the particular country sample.

Figure 2.9: Gender Differences in Responses to Qualitative and Quantitative Items in Relation to Economic Development and Gender Equality by Country



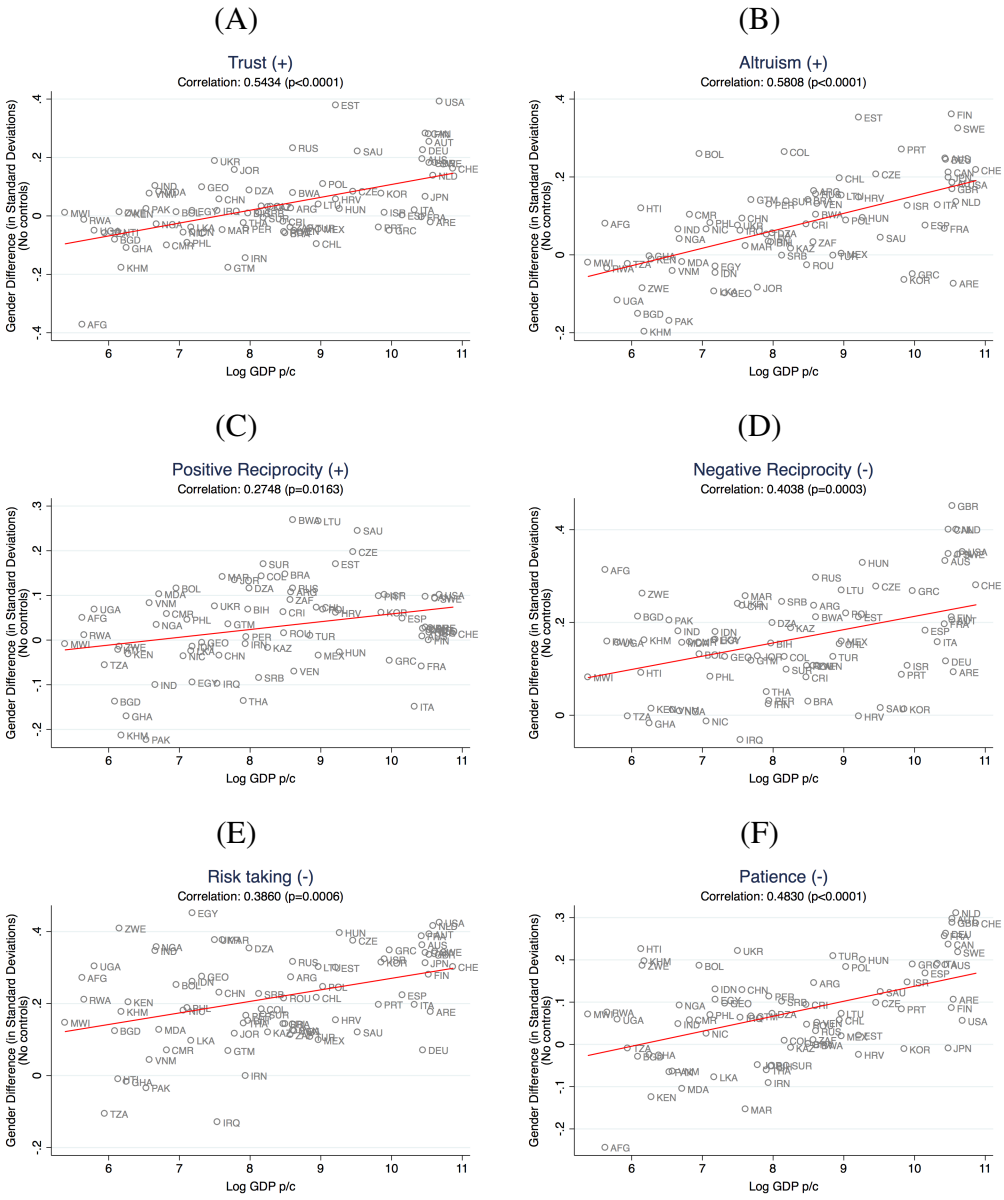
Notes: In Figure 2.9, Panels A and B show the relationship between indices of gender differences in responses to quantitative and qualitative items and economic development, measured by log GDP p/c, including a linear fit. Panels C and D show the relationship between indices of gender differences in responses to quantitative and qualitative items and the Gender Equality Index including a linear fit. The indices of gender differences in quantitative and qualitative items were obtained as the predicted first main component from a principal component analysis of the country-level gender differences in the respective survey items.

Figure 2.10: Gender Differences and Economic Development by Preference and Country using Preferences Standardized at the Global Level



Notes: In Figure 2.10, each panel shows the relationship between country-level gender differences in a particular preference and the level of economic development measured by log GDP p/c, including a linear fit. For each preference, the symbols (+)/(-) in the panel titles indicate the direction of the difference. (+) indicates that women exhibited higher levels of the respective preference if the difference was positive. (-) indicates that men exhibited higher levels of the respective preference if the difference was positive. Preference measures were standardized at the global instead of the country level. For each preference and country, the gender difference was then calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator, controlling for age, age squared, subjective math skills, education level, household income quintile for the particular country sample.

Figure 2.11: Gender Differences and Economic Development by Preference and Country without Controls



Notes: In Figure 2.11, each panel shows the relationship between country-level gender differences in a particular preference and the level of economic development measured by log GDP p/c, including a linear fit. For each preference, the symbols (+)/(-) in the panel titles indicate the direction of the difference. (+) indicates that women exhibited higher levels of the respective preference if the difference was positive. (-) indicates that men exhibited higher levels of the respective preference if the difference was positive. For each preference and country, the gender difference was calculated as the coefficient on a gender indicator with male as the reference category in an OLS regression of the respective preference on the gender indicator without controls for the particular country sample.

Table 2.1: Global Gender Differences in Preferences Conditional on Controls and Unconditional

	Trust	Altruism	Positive Reciprocity	Negative Reciprocity	Risk Taking	Patience
	(1)	(2)	(3)	(4)	(5)	(6)
Conditional	0.064***	0.106***	0.055***	-0.129***	-0.168***	-0.050***
	(0.015)	(0.013)	(0.011)	(0.012)	(0.013)	(0.012)
Unconditional	0.030*	0.066***	0.042***	-0.170***	-0.227***	-0.077***
	(0.017)	(0.015)	(0.013)	(0.013)	(0.016)	(0.017)

Notes: Table 2.1 presents gender differences in preferences on the global level. Positive values indicate that women exhibited higher levels of the respective preference, negative values indicate that women exhibited lower levels of the respective preference. Gender differences were calculated as coefficients on a gender indicator with male as the reference category in an OLS regression of the respective preference on the worldwide sample. Conditional gender differences were calculated using as controls age, age squared, subjective math skills, education level, household income quintile, and country fixed effects. Unconditional gender differences were calculated without controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.2: Gender Differences in Preferences and Economic Development

	Average Gender Difference (Index)				
	(1)	(2)	(3)	(4)	(5)
Log GDP p/c	0.668***	0.620***	0.567***	0.704***	0.703***
	(0.091)	(0.125)	(0.154)	(0.124)	(0.187)
Geographic Ctrls.	No	Yes	No	No	Yes
Demographic and Cultural Ctrls.	No	No	Yes	No	Yes
Historical Ctrls.	No	No	No	Yes	Yes
Observations	76	74	73	75	72
R^2	0.447	0.713	0.518	0.449	0.759

Notes: Table 2.2 presents country-level regressions of the index of gender differences in preferences on log GDP p/c and different sets of controls. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. Column (1) used no controls. Column (2) used geographic controls containing longitude, absolute latitude, log area, mean elevation, % living in (sub-)tropical zones, % arable land, land suitability for agriculture, mean precipitation, mean temperature, % at risk of malaria, predicted genetic diversity and its square, and continent fixed effects. Column (3) used demographic and cultural controls containing average age, ethnic fractionalization, linguistic fractionalization, religious fractionalization, and share of atheists. Column (4) used historical controls containing years of civil conflict 1800-2007, years of interstate conflict 1800-2007, and an indicator variable for colonization, with 1 indicating that the country was under colonial rule. Column (5) used all three sets of controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.3: Gender Differences in Preferences and Gender-Specific Levels of Economic Development

	Gender Difference in					
	Altruism	Trust	Positive Reciprocity	Negative Reciprocity	Risk Taking	Patience
	(1)	(2)	(3)	(4)	(5)	(6)
Female GNI p/c	0.123***	0.072**	0.021	0.088***	0.064**	0.040**
	(0.021)	(0.030)	(0.030)	(0.022)	(0.025)	(0.017)
Male GNI p/c	-0.055**	0.015	0.008	-0.042*	-0.016	0.004
	(0.021)	(0.031)	(0.033)	(0.024)	(0.024)	(0.016)
Observations	76	76	76	76	76	76
R^2	0.403	0.461	0.077	0.241	0.193	0.187

Notes: Table 2.3 presents country-level regressions of gender differences in preferences on standardized values of male and female Gross National Income p/c (by preference). As dependent variable, column (1) used the gender difference in altruism, column (2) used the gender difference in trust, column (3) used the gender difference in positive reciprocity, column (4) used the gender difference in negative reciprocity, column (5) used the gender difference in risk taking, column (6) used the gender difference in patience. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.4: Gender Differences in Preferences, Gender Equality, and Economic Development

	Average Gender Difference (Index)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log GDP p/c	0.668***						0.526***	0.596***	0.432**	0.661***	0.552***
	(0.091)						(0.101)	(0.095)	(0.165)	(0.085)	(0.093)
Gender Equality (Index)		0.556***					0.319***				
		(0.115)					(0.105)				
WEF Global Gender Gap Index			0.405***					0.233***			
			(0.104)					(0.086)			
UN Gender Equality Index				0.652***					0.291*		
				(0.085)					(0.147)		
Ratio Female to Male LFP					0.266**					0.245**	
					(0.121)					(0.096)	
Time since Women's Suffrage						0.514***					0.299***
						(0.135)					(0.095)
Observations	76	71	72	75	76	76	71	72	75	76	76
R^2	0.447	0.311	0.168	0.420	0.071	0.264	0.528	0.494	0.475	0.507	0.523

Notes: Table 2.4 presents country-level regressions of the index of gender differences in preferences on measures of gender equality and log GDP p/c. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. As independent variable, column (1) used log GDP p/c, column (2) used the Gender Equality Index, column (3) used the WEF Global Gender Gap Index, column (4) used the UN Gender Equality Index, column (5) used the ratio of female to male labor force participation rates, column (6) used the time since women's suffrage. Columns (7) to (11) were analogous to columns (2) to (6) but additionally used log GDP p/c as an independent variable. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.5: Gender Differences in Preferences and Economic Development Excluding Trust

	Average Gender Difference (Index without Trust)				
	(1)	(2)	(3)	(4)	(5)
Log GDP p/c	0.613***	0.573***	0.534***	0.648***	0.749***
	(0.097)	(0.152)	(0.160)	(0.130)	(0.205)
Geographic Ctrls.	No	Yes	No	No	Yes
Demographic and Cultural Ctrls.	No	No	Yes	No	Yes
Historical Ctrls.	No	No	No	Yes	Yes
Observations	76	74	73	75	72
R^2	0.376	0.642	0.430	0.383	0.710

Notes: Table 2.5 presents country-level regressions of an alternative index of gender differences in preferences excluding trust on log GDP p/c and different sets of controls. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. Column (1) used no controls. Column (2) used geographic controls containing longitude, absolute latitude, log area, mean elevation, % living in (sub-)tropical zones, % arable land, land suitability for agriculture, mean precipitation, mean temperature, % at risk of malaria, predicted genetic diversity and its square, and continent fixed effects. Column (3) used demographic and cultural controls containing average age, ethnic fractionalization, linguistic fractionalization, religious fractionalization, and share of atheists. Column (4) used historical controls containing years of civil conflict 1800-2007, years of interstate conflict 1800-2007, and an indicator variable for colonization, with 1 indicating that the country was under colonial rule. Column (5) used all three sets of controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.6: Gender Differences in Preferences, Gender Equality, and Economic Development Excluding Trust

	Average Gender Difference (Index without Trust)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log GDP p/c	0.613***						0.481***	0.554***	0.409**	0.605***	0.485***
	(0.097)						(0.104)	(0.101)	(0.169)	(0.093)	(0.095)
Gender Equality (Index)		0.552***					0.336***				
		(0.106)					(0.102)				
WEF Global Gender Gap Index			0.405***					0.244**			
			(0.104)					(0.093)			
UN Gender Equality Index				0.596***					0.254		
				(0.095)					(0.156)		
Ratio Female to Male LFP					0.272**					0.253**	
					(0.125)					(0.110)	
Time since Women's Suffrage						0.518***					0.329***
						(0.117)					(0.082)
Observations	76	71	72	75	76	76	71	72	75	76	76
R^2	0.376	0.310	0.168	0.350	0.074	0.268	0.491	0.452	0.399	0.440	0.468

Notes: Table 2.6 presents country-level regressions of an alternative index of gender differences in preferences excluding trust on measures of gender equality and log GDP p/c. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. As independent variable, column (1) used log GDP p/c, column (2) used the Gender Equality Index, column (3) used the WEF Global Gender Gap Index, column (4) used the UN Gender Equality Index, column (5) used the ratio of female to male labor force participation rates, column (6) used the time since women's suffrage. Columns (7) to (11) were analogous to columns (2) to (6) but additionally used log GDP p/c as an independent variable. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.7: Gender Differences in Preferences and Economic Development Using Preferences Standardized at the Global Level

	Average Gender Difference (Index Using Preferences Standardized at Global Level)				
	(1)	(2)	(3)	(4)	(5)
Log GDP p/c	0.642***	0.547***	0.521***	0.682***	0.648***
	(0.091)	(0.129)	(0.152)	(0.124)	(0.194)
Geographic Ctrls.	No	Yes	No	No	Yes
Demographic and Cultural Ctrls.	No	No	Yes	No	Yes
Historical Ctrls.	No	No	No	Yes	Yes
Observations	76	74	73	75	72
R^2	0.413	0.688	0.490	0.418	0.741

Notes: Table 2.7 presents country-level regressions of an alternative index of gender differences in preferences on log GDP p/c and different sets of controls. The index was constructed in a parallel way to the main index but used preferences standardized at the global (instead of country) level. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. Column (1) used no controls. Column (2) used geographic controls containing longitude, absolute latitude, log area, mean elevation, % living in (sub-)tropical zones, % arable land, land suitability for agriculture, mean precipitation, mean temperature, % at risk of malaria, predicted genetic diversity and its square, and continent fixed effects. Column (3) used demographic and cultural controls containing average age, ethnic fractionalization, linguistic fractionalization, religious fractionalization, and share of atheists. Column (4) used historical controls containing years of civil conflict 1800-2007, years of interstate conflict 1800-2007, and an indicator variable for colonization, with 1 indicating that the country was under colonial rule. Column (5) used all three sets of controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.8: Gender Differences in Preferences, Economic Development and Gender Equality Using Preferences Standardized at the Global Level

	Average Gender Difference (Index Using Preferences Standardized at Global Level)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log GDP p/c	0.642***						0.503***	0.574***	0.393**	0.635***	0.526***
	(0.091)						(0.102)	(0.096)	(0.166)	(0.086)	(0.094)
Gender Equality (Index)		0.540***					0.314***				
		(0.115)					(0.107)				
WEF Global Gender Gap Index			0.392***					0.226**			
			(0.107)					(0.091)			
UN Gender Equality Index				0.634***					0.305**		
				(0.087)					(0.152)		
Ratio Female to Male LFP					0.253**					0.233**	
					(0.122)					(0.101)	
Time since Women's Suffrage						0.503***					0.298***
						(0.128)					(0.091)
Observations	76	71	72	75	76	76	71	72	75	76	76
R^2	0.413	0.293	0.156	0.397	0.064	0.253	0.491	0.458	0.443	0.467	0.488

Notes: Table 2.8 presents country-level regressions of an alternative index of gender differences in preferences on log GDP p/c and measures of gender equality. The index was constructed in a parallel way to the main index but used preferences standardized at the global (instead of country) level. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. As independent variable, column (1) used log GDP p/c, column (2) used the Gender Equality Index, column (3) used the WEF Global Gender Gap Index, column (4) used the UN Gender Equality Index, column (5) used the ratio of female to male labor force participation rates, column (6) used the time since women's suffrage. Columns (7) to (11) were analogous to columns (2) to (6) but additionally used log GDP p/c as an independent variable. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.9: Gender Differences in Preferences and Economic Development Using Index without Controls

	Average Gender Difference (Index Using no Controls)				
	(1)	(2)	(3)	(4)	(5)
Log GDP p/c	0.669***	0.549***	0.544***	0.698***	0.653***
	(0.087)	(0.124)	(0.159)	(0.122)	(0.187)
Geographic Ctrls.	No	Yes	No	No	Yes
Demographic and Cultural Ctrls.	No	No	Yes	No	Yes
Historical Ctrls.	No	No	No	Yes	Yes
Observations	76	74	73	75	72
R^2	0.447	0.712	0.536	0.451	0.751

Notes: Table 2.9 presents country-level regressions of an alternative index of gender differences in preferences on log GDP p/c and different sets of controls. The index was constructed in a parallel way to the main index but country-level gender differences were calculated without using controls. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. Column (1) used no controls. Column (2) used geographic controls containing longitude, absolute latitude, log area, mean elevation, % living in (sub-)tropical zones, % arable land, land suitability for agriculture, mean precipitation, mean temperature, % at risk of malaria, predicted genetic diversity and its square, and continent fixed effects. Column (3) used demographic and cultural controls containing average age, ethnic fractionalization, linguistic fractionalization, religious fractionalization, and share of atheists. Column (4) used historical controls containing years of civil conflict 1800-2007, years of interstate conflict 1800-2007, and an indicator variable for colonization, with 1 indicating that the country was under colonial rule. Column (5) used all three sets of controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.10: Gender Differences in Preferences, Gender Equality, and Economic Development Using Index without Controls

	Average Gender Difference (Index Using no Controls)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log GDP p/c	0.669***						0.520***	0.597***	0.409**	0.662***	0.545***
	(0.087)						(0.095)	(0.090)	(0.162)	(0.082)	(0.089)
Gender Equality (Index)		0.574***					0.340***				
		(0.111)					(0.102)				
WEF Global Gender Gap Index			0.420***					0.247***			
			(0.099)					(0.082)			
UN Gender Equality Index				0.660***					0.318**		
				(0.084)					(0.149)		
Ratio Female to Male LFP					0.256**					0.235**	
					(0.116)					(0.091)	
Time since Women's Suffrage						0.530***					0.317***
						(0.130)					(0.090)
Observations	76	71	72	75	76	76	71	72	75	76	76
R^2	0.447	0.326	0.177	0.430	0.065	0.281	0.534	0.497	0.480	0.503	0.533

Notes: Table 2.10 presents country-level regressions of an alternative index of gender differences in preferences on log GDP p/c and measures of gender equality. The index was constructed in a parallel way to the main index but country-level gender differences were calculated without using controls. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. As independent variable, column (1) used log GDP p/c, column (2) used the Gender Equality Index, column (3) used the WEF Global Gender Gap Index, column (4) used the UN Gender Equality Index, column (5) used the ratio of female to male labor force participation rates, column (6) used the time since women's suffrage. Columns (7) to (11) were analogous to columns (2) to (6) but additionally used log GDP p/c as an independent variable. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.11: Gender Differences in Preferences and Economic Development Controlling for Linguistic Distance to Germany

	Average Gender Difference (Index)				
	(1)	(2)	(3)	(4)	(5)
Log GDP p/c	0.584***	0.577***	0.472***	0.621***	0.663***
	(0.099)	(0.136)	(0.157)	(0.129)	(0.193)
Geographic Ctrls.	No	Yes	No	No	Yes
Demographic and Cultural Ctrls.	No	No	Yes	No	Yes
Historical Ctrls.	No	No	No	Yes	Yes
Linguistic Distance to German	Yes	Yes	Yes	Yes	Yes
Observations	76	74	73	75	72
R^2	0.489	0.721	0.549	0.496	0.772

Notes: Table 2.11 presents country-level regressions of the index of gender differences in preferences on log GDP p/c and different sets of controls. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. All specifications used controls for linguistic distance to Germany containing the ASJP measure of linguistic distance to Germany as well as an indicator variable for German language, with 1 indicating that the country's major language is German. Column (1) used no additional controls. Column (2) additionally used geographic controls containing longitude, absolute latitude, log area, mean elevation, % living in (sub-)tropical zones, % arable land, land suitability for agriculture, mean precipitation, mean temperature, % at risk of malaria, predicted genetic diversity and its square, and continent fixed effects. Column (3) additionally used demographic and cultural controls containing average age, ethnic fractionalization, linguistic fractionalization, religious fractionalization, and share of atheists. Column (4) additionally used historical controls containing years of civil conflict 1800-2007, years of interstate conflict 1800-2007, and an indicator variable for colonization, with 1 indicating that the country was under colonial rule. Column (5) additionally used all three sets of further controls. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.12: Gender Differences in Preferences, Gender Equality, and Economic Development Controlling for Linguistic Distance to Germany

	Average Gender Difference (Index)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Log GDP p/c	0.584***						0.484***	0.547***	0.315*	0.597***	0.490***
	(0.099)						(0.111)	(0.102)	(0.165)	(0.094)	(0.096)
Gender Equality (Index)		0.443***					0.285***				
		(0.121)					(0.107)				
WEF Global Gender Gap Index			0.289**					0.197**			
			(0.113)					(0.088)			
UN Gender Equality Index				0.571***					0.323**		
				(0.092)					(0.144)		
Ratio Female to Male LFP					0.179					0.211**	
					(0.119)					(0.097)	
Time since Women's Suffrage						0.424***					0.271***
						(0.130)					(0.093)
Linguistic Distance to German	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	76	71	72	75	76	76	71	72	75	76	76
R^2	0.489	0.380	0.277	0.492	0.238	0.372	0.544	0.517	0.519	0.532	0.550

Notes: Table 2.12 presents country-level regressions of the index of gender differences in preferences on measures of gender equality and log GDP p/c. The dependent and independent variables were standardized to exhibit a mean of zero and a standard deviation of one. As independent variable, column (1) used log GDP p/c, column (2) used the Gender Equality Index, column (3) used the WEF Global Gender Gap Index, column (4) used the UN Gender Equality Index, column (5) used the ratio of female to male labor force participation rates, column (6) used the time since women's suffrage. Columns (7) to (11) were analogous to columns (2) to (6) but additionally used log GDP p/c as an independent variable. All specifications used additional controls for linguistic distance to Germany containing the ASJP measure of linguistic distance to Germany as well as an indicator variable for German language, with 1 indicating that the country's major language is German. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.13: Gender Differences in Preferences and Respondent-Level Income

	Trust	Altruism	Positive Reciprocity	Negative Reciprocity	Risk Taking	Patience
	(1)	(2)	(3)	(4)	(5)	(6)
1 if female	0.072***	0.110***	0.056***	-0.137***	-0.179***	-0.049***
	(0.014)	(0.012)	(0.012)	(0.012)	(0.013)	(0.011)
1 if female X Log [Household income p/c]	0.069***	0.060***	0.017*	-0.024**	-0.028**	-0.040***
	(0.012)	(0.010)	(0.009)	(0.011)	(0.012)	(0.011)
Log [Household income p/c]	-0.051***	0.021*	0.033***	0.038**	0.097***	0.068***
	(0.013)	(0.012)	(0.012)	(0.017)	(0.012)	(0.012)
Age	0.453**	-0.110	1.022***	-0.309*	-0.144	0.522***
	(0.218)	(0.147)	(0.191)	(0.186)	(0.200)	(0.168)
Age^2	-0.076	0.177	-1.132***	-0.529***	-1.138***	-1.207***
	(0.221)	(0.156)	(0.208)	(0.185)	(0.207)	(0.183)
Subj. math skills	0.062***	0.041***	0.036***	0.042***	0.042***	0.025***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.004)	(0.002)
Education level	-0.048***	0.076***	0.079***	-0.004	0.082***	0.091***
	(0.014)	(0.013)	(0.011)	(0.010)	(0.011)	(0.014)
Observations	77072	77855	78086	76761	77673	77726
R^2	0.030	0.022	0.018	0.040	0.081	0.027

Notes: Table 2.13 presents individual-level regressions of preferences, standardized at the country-level, on a gender indicator with male as the reference category, log household income per capita, and their interaction controlling for age, age squared, subjective math skills, education level, and country-fixed effects. Log household income per capita was standardized to exhibit a mean of zero and standard deviation of one. As dependent variable, column (1) used trust, column (2) used altruism, column (3) used positive reciprocity, column (4) used negative reciprocity, column (5) used risk taking, column (6) used patience. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2.14: Gender Differences in Preferences, Non-Linear Effects of Economic Development and Gender Equality

	Average Gender Difference (Index)			
	(1)	(2)	(3)	(4)
Log [GDP p/c PPP]	0.429***	-0.803	0.337***	-0.134
	(0.059)	(0.561)	(0.064)	(0.611)
Log [GDP p/c PPP] squared		0.074**		0.029
		(0.034)		(0.037)
Gender Equality (Index)			1.482***	1.374**
			(0.487)	(0.535)
F-statistic and p-value for F-test of zero impact of Log [GDP p/c PPP]	53.57 (p<0.0001)	29.56 (p<0.0001)	27.33 (p<0.0001)	13.31 (*p*<0.0001)
Observations	76	76	71	71
R^2	0.447	0.475	0.528	0.531

Notes: Table 2.14 presents country-level regressions of the index of gender differences in preferences on log GDP p/c, log GDP p/c squared and the Gender Equality Index. As independent variables, column (1) used log GDP p/c, column (2) used log GDP p/c and log GDP p/c squared, column (3) used log GDP p/c and the Gender Equality Index, column (4) used log GDP p/c, log GDP p/c squared and the Gender Equality Index. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Chapter 3

Longevity and Patience

3.1 Introduction

Patience constitutes a fundamental determinant of any inter-temporal choice and is viewed as a key primitive in both macroeconomic and microeconomic models. Empirical work has presented evidence that variation in patience accounts for a considerable part of the observed heterogeneity in education, savings and per-capita income across individuals, regions as well as across countries (Borghans et al., 2008; Sutter et al., 2013; Dohmen et al., 2018). However, little is known about the determinants of patience.

This study provides direct evidence for the most prominent hypothesis proposed in the literature, namely that greater longevity leads to greater patience and more future-oriented behavior (Becker and Mulligan, 1997).

Testing this hypothesis requires data on patience that fulfill two key requirements. First, the measure of patience needs to be reliable and predictive of real-world behavior. Second, to identify an effect of longevity on patience, the data sample must exhibit plausibly exogenous variation in longevity. We employ a global dataset of individual patience endowments that fulfills these requirements (Falk et al., 2018). Our measure of patience is elicited by two survey items involving (i) a choice between immediate and delayed monetary rewards and (ii) a self-assessment of the willingness to delay rewards to the future. Both survey items were selected through a rigorous ex-ante experimental selection and validation procedure, thereby ensuring that the survey items are predictive of incentivized economic behavior. The patience measures are elicited for a total of 80,000 individuals in 76 representative country samples that cover all continents and a broad range of economic development providing large variation in longevity levels.

Our identification strategy makes use of objective and exogenous variation in individual life expectancy by combining the individual patience data with granular data from period life tables provided by the *Population Division of the United Nations*. These life tables contain information about the expected remaining years of life for a given gender-age cell in a particular country. To establish a plausibly causal relationship between longevity and patience we apply an identification strategy that relates variation in longevity across gender-age-country cells from period life tables

to variation in patience. Importantly, this identification strategy isolates the estimated effect from any systematic differences across countries, age groups and gender groups by applying the logic of a differences-in-difference design.

To illustrate our identification strategy, consider two individuals aged 20 and 50 from the US and two individuals of the same ages from South Africa. We calculate the difference in patience between the 20- and 50-year old in the US in comparison to the difference between the 20- and 50-year old in South Africa. We then relate the resulting difference-in-differences to the corresponding differences in expected remaining years of life to obtain an estimate of the effect of longevity on patience.

Two aspects of our identification strategy are particularly noteworthy. First, our approach isolates the effect of longevity from other country-specific confounding factors shared by individuals from the same country. Potential candidate confounds that may influence patience but are isolated by this strategy include variation in institutional quality or economic development. Following a similar logic, our approach separates the effect of longevity from all age-specific confounding factors shared by individuals of the same age. For instance, patience may follow age patterns that are predetermined by biological or evolutionary factors. Second, the measures of expected remaining years of life from period life tables reflect the life expectancy for an individual of a particular age if they experienced the (age-specific) mortality rates of the given period throughout the remaining life. This implies that expected remaining life years are based on mortality patterns of older cohorts and hence plausibly exogenous to the actions of the individuals of the respective age group. This rules out any reverse causality from patience to longevity, which would be a concern when using subjective beliefs about health and longevity.

Our main result provides evidence for a significant positive effect of longevity on patience. In quantitative terms, a ten-year increase in life expectancy leads to a 5-percentage point increase in the discount factor, constructed from the quantitative patience measure. This effect is robust to the inclusion of an extensive set of control variables. In particular, our point estimates are unaffected when accounting for variation in religion, language and potentially endogenous variables such as proxies for cognitive ability and education.

We provide several additional pieces of evidence that shed light on the robustness, underlying mechanisms, and consequences of this effect. First, the positive association of patience with longevity holds for all geographic regions of the world and is present for both women and men. Second, there is no significant association between variation in longevity and other preference measures such as risk attitudes, altruism, trust or negative reciprocity with longevity. Only for positive reciprocity a similar, albeit smaller, effect emerges. This finding is consistent with the intuition that longevity favors repeated interactions, creating incentives for engaging in positively reciprocal behavior. Third, our point estimates are virtually unaffected when using alternative data or measures of longevity. Fourth, to further mitigate concerns about simultaneity, we instrument current remaining years of life with values based on earlier cohorts, yielding similar results. Fifth, we test for robustness against lifetime experience effects on patience arising from experienced economic development, institutional quality, or political violence throughout an individual's life course. While our results indicate that such experiences may have an effect on patience, the association of patience with longevity remains unaffected. Sixth, we document an effect of subjectively-

perceived health on patience. However, this effect appears to be independent as the impact of objective remaining years of life remains virtually unaffected by including the control for subjective health status. Finally, we provide a theoretical model that highlights the consequences of this finding for the emergence of poverty traps through a vicious cycle of high mortality, low patience, and low human capital investments.

In documenting a sizable and significant positive effect of individual life expectancy on patience, this study contributes to the understanding of the determinants of time preferences. Time preferences are an important determinant for economic outcomes, see Mischel et al. (1989), Chabris et al. (2008), Sutter et al. (2013), and Figlio et al. (2016) for evidence on the level of the individual; see also Falk et al. (2019), which includes an overview table of papers relating preferences to outcomes. Recent work by Dohmen et al. (2018) has provided evidence for the role of patience for economic development at both the individual and the aggregate level.

Only a few studies have investigated the determinants of patience, providing evidence for the role of geographic factors, including in particular agricultural suitability (Galor and Özak, 2016), historical migration patterns (Becker et al., 2018), and language (Chen, 2013; Falk et al., 2018). This study complements this literature by pointing towards the crucial role of health and longevity for patience. Our results also complement findings regarding the importance of lifetime experiences for (risk) preference formation (Malmendier and Nagel, 2011, 2016) by reporting qualitatively similar results for the domain of time preferences and showing that longevity has a distinct influence on patience.

The remainder of the study is structured as follows. Section 3.2 discusses the data and the empirical strategy. Section 3.3 presents the empirical results. Section 3.4 concludes by discussing the implications of the empirical findings for long-run development.

3.2 Data and Empirical Framework

Patience

Our data stems from the Global Preference Survey (GPS) (Falk et al., 2018). The GPS is a newly-constructed cross-sectional dataset containing measures of fundamental economic preferences for approximately 80,000 individuals in representative samples from 76 countries (see Figure 3.1 for a world map of countries covered in the data). The countries selected for the survey cover all continents and represent a total of 90% of the world's income and population. The elicitation was implemented as part of the Gallup World Poll using the same survey infrastructure.

The GPS contains two measures of patience that are relevant for the purpose of this study, a quantitative revealed preference measure of patience that captures respondents' indifference point between a payment today and a payment with 12 months delay, and a qualitative measure capturing respondents' subjective assessment of their patience. The quantitative item presents the participants with a sequence of five interdependent trade-off questions:

> *"Suppose you were given the choice between receiving a payment today or a payment in 12 months. We will now present to you five situations. The payment today is the same in each of these situations. The payment in 12 months is different in every situation. For each of these situations we would like to know which you would choose. Please assume there is no inflation, i.e, future prices are the same as today's prices. Please consider the following: Would you rather receive 100 Euro today or x Euro in 12 months?"*

By varying the amount x, we obtain the indifference point between a payment on the day of the survey and a payment 12 months later which serves as a quantitative measure of patience. The precise elicitation protocol is shown in Appendix 3.5. The qualitative survey item asks participants:

> *"How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future? Please indicate your answer on a scale from 0 to 10, where 0 means you are 'completely unwilling to do so' and a 10 means you are 'very willing to do so'. You can also use any numbers between 0 and 10 to indicate where you fall on the scale, like 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10."*

These two survey items were selected through a rigorous, ex-ante experimental validation before the implementation in the international survey. In this procedure, subjects responded to survey questions but also participated in incentivized state-of-the-art choice experiments. Out of a large set of survey questions, the two survey items were selected for the international survey as the best joint predictors of incentivized behavior. After the implementation of the worldwide survey in 2012, the final measure for patience was generated according to the following procedure. First, each of the two survey items was standardized using the mean and variance of the entire worldwide sample. Next, the relevant z-scores were averaged using weights developed in the experimental validation. Finally, the combined measure was standardized on the worldwide sample to exhibit a mean of zero and standard deviation of one. For further details on the GPS data, see Falk et al. (2018).

Longevity

We combine the individual-level patience measures with granular period life table data from the *Population Division of the United Nations*.[1] These period life tables provide information about the values of age-specific mortality for gender-age-country cells and can be used to compute the life expectancy in terms of remaining years of life for each gender-age-country cell.

The mortality data by age and gender are obtained from vital registration systems in each country in a given year that are reported to either the United Nations Statistics Division or the World Health Organization (WHO) and combined with data from population censuses to obtain mortality

[1] See `http://www.un.org/en/development/desa/population/publications/database/index.shtml`.

patterns in given years.[2] The use of period life table information implies that the respective remaining years of life for individuals in a particular gender-age-country cell are based on mortality information from older cohorts.

Provided that past mortality patterns are stable, the life table information provides a valid measure of the average longevity expectation for individuals (Smith et al., 2001) and is likely to be more accurate and reliable than subjective beliefs (Hamermesh, 1985; Elder, 2013). For robustness checks, we also make use of alternative life table data provided by the *The Human Mortality Database*.[3]

Descriptive Evidence and Empirical Strategy

Does longevity affect patience? A first and cursory look at the empirical relevance of the conjectured influence can be obtained by considering the patience data at the country-level. Figure 3.2 shows that longevity and patience are indeed strongly and positively correlated across countries.[4] However, this correlation is likely to suffer from reverse causality problems and omitted variable bias. Specifically, forward-looking and more patient individuals and countries may be more likely to undertake investments in their health or implement better, health-promoting, institutions. Furthermore, other potential determinants of patience, such as historical and institutional factors, might be correlated with life expectancy, giving rise to a spurious relationship.

Hence, an empirical analysis relying on plain cross-country variation in levels of longevity is not suited to identify the effect of longevity on patience. To obtain a credible causal estimate of this effect, we propose an identification strategy that exploits differences in the remaining years of life across age cells, conditional on country and age fixed effects. Intuitively, the source of identifying variation is the difference in remaining years of life between young and old individuals in a particular country relative to the differences in remaining years of life between young and old individuals in another country. Gender-specific remaining years of life for a given age-country combination serve as an additional source of variation. We use the variation in expected remaining life years across gender-age-country cells and relate it to the variation in patience across the corresponding cells.

Formally, we regress individual-level patience β_{igac} on the expected remaining years of life π_{igac} of an individual i of gender g and age a in country c, controlling for gender ζ_g, a vector of age fixed effects δ_a, a vector of country fixed effects α_c, and additional potentially relevant individual characteristics X_{igac},

$$\beta_{igac} = \gamma \cdot \pi_{igac} + \zeta_g + \delta_a + \alpha_c + \rho \cdot X_{igac} + \varepsilon_{igac},$$

where ε_{igac} captures an idiosyncratic error term. To facilitate readibility, the patience measure is multiplied by 100. In the baseline analysis, we cluster standard errors at the country level.

[2] See also `http://www.who.int/healthinfo/statistics/LT_method.pdf` for details on the methodology.

[3] See `www.mortality.org`.

[4] For a world map of country-level mean patience see Figure 3.1.

In light of the results in Falk et al. (2018), the vector of individual characteristics X in the baseline specification includes gender, subjective math skills as proxy for cognitive ability, education and the log of household income per capita. Summary statistics of the variables contained in the baseline analysis are displayed in Tables 3.1 and 3.2.

The intuition behind the identification strategy is similar to a difference-in-differences approach, as the model uses variation in life expectancy between different age groups in different countries and relates it to the corresponding variation in patience. Importantly, the measure of remaining years of life is constructed based on mortality rates of past cohorts. This captures the best statistical prediction of the remaining life time of an individual in a particular age-gender-country cell without being prone to potential endogeneity problems at the individual level. Concerns about reverse causality are hence mitigated, as the life expectancy measure cannot be altered by the behavior of a given individual or even a gender-age cohort. For this reason, the use of life-table information has a distinct advantage over using subjective measures or beliefs of life expectancy.

3.3 Empirical Results

Baseline Results

Table 3.3 presents the main results. The baseline specification in Column (1) documents a substantial positive association between the expected length of the remaining lifetime and individual patience. A one-year increase in remaining years of life is associated with a 0.0163 (s.e.=0.004) standard deviation increase in patience. Adding other, potentially endogenous, individual-level controls such as cognitive ability, education, or log household income per capita as in Column (2) yields a virtually unaffected point estimate of 0.0173 (s.e.=0.004). We obtain similar point estimates when controlling for within-country regions instead of country fixed effects in Column (3). In addition, given previous evidence emphasizing the potential role of religion (Becker and Woessmann, 2009) or language (Chen, 2013) for education and future orientation, we control for religion and language in Columns (4) to (6). We obtain virtually identical results when controlling for these factors separately or all factors jointly.

In order to quantify the effect sizes, we repeat the estimation using the discount factor as the dependent variable. More specifically, we replicate the analysis using only the quantitative survey item that elicits a participant's indifference point between a payment of 100 Euros today and a payment of x Euros in one year. Hence, the value of x for which the individual is indifferent directly pins down the yearly discount factor as $D(x) = \frac{100}{x}$.[5] Using the value of $D(x)$ as the dependent variable delivers coefficient estimates that allow for a straightforward quantitative interpretation of the effect of a one-year increase in longevity on the discount factor over a one-year horizon. Given that our elicitation procedure invokes bounds on the discount factor, we estimate Tobit regressions. The results indicate that 10 more years of expected remaining life time are associated with an increase in the discount factor by 5-6 percent (Table 3.4).

[5]The implicit assumption is that utility is approximately linear for the stakes involved in this trade-off.

The findings remain robust in various alternative specifications. In particular, the findings are unaffected when conducting inference based on alternative assumptions about cross-sectional dependencies and applying two-way clustering on country and age (Table 3.5). Moreover, the effect of longevity robustly emerges across various geographic sub-samples and for women and men separately (Table 3.6).[6]

Are other preferences similarly affected by longevity? The GPS data also contain measures of other preferences related to risk taking, altruism, trust, and positive and negative reciprocity, which were elicited in comparable ways to patience by using a combination of qualitative and quantitative survey items (see Falk et al., 2018). While these preferences might also be influenced by longevity, it is conceptually much less obvious to formulate clear empirical hypotheses. We replicate the analysis for other preference measures to explore whether the effect of life expectancy is unique to time preferences or whether it also applies to other preferences. The results document no significant effect of expected remaining life years on any other preference measure, with the exception of positive reciprocity (Table 3.7). The positive effect on positive reciprocity appears plausible in light of the intrinsic relation between reciprocity and future-oriented behavior, whereby individuals who are willing to reciprocate invest resources today to reap potential social benefits in the future (Kreps et al., 1982).

Alternative Measures of Longevity and Instrumental Variables

The results are unchanged when using alternative measures of life expectancy. To demonstrate this, we use alternative life table data from the *Human Mortality Database* to compute the remaining years of life for each country-age-gender cell. The results are also robust when longevity is conceptualized as the inverse of the probability of dying within the next year, which captures a more immediate or short-term measure of mortality rather than focusing on the entire remaining life span (Table 3.8).

Complementarily, we also applied an instrumental variable approach that uses the life expectancy of particular age-gender cells in a given country for earlier periods to instrument life expectancy for the period of observation. In our main specification, reverse causality is unlikely as a consequence of the construction of the measures of longevity: as expected remaining years of life is based on the mortality rates of past cohorts, it cannot be directly affected by the patience endowment of an individual in the particular age group. Nevertheless, one might be worried about simultaneity bias. To investigate the robustness of the results and address potential measurement error, we use life table information for 2000, 1990, 1980, and 1970, respectively, to instrument the measure of remaining years of life computed from the period life table for 2010 that has been used in the baseline analysis. The variation used for identification thus pertains to age-specific mortality of cohorts even further in the past. The second-stage results reveal that the coefficient on remaining

[6]The effect is in fact largely comparable in size across geographic world regions, but somewhat smaller in less developed countries, in particular in African countries and the Middle East. Moreover, the effect of remaining lifetime on patience is positive and significant for both women and men, but larger for women than for men.

years of life is statistically significant in all specifications and quantitatively almost identical to the baseline estimates (Table 3.8).[7]

Alternative Explanations and Mechanisms

Lifetime Experiences: Development and Institutions

Life expectancy in terms of remaining years of life for an individual in a given age-gender-country cell appears to be a strong predictor of individual patience conditional on country- and age-specific effects. A potential concern regarding this finding involves other factors that vary by age-gender-country cells conditional on country- and age-specific effects. Most importantly, certain lifetime experiences that are crucial for the formation of patience might vary at this level. For instance, the differences in institutional quality over the life course experienced by a 50-year old in the United States and a 50-year old in South Africa might be fundamentally distinct from the corresponding differences experienced by two 20-year olds.

Generally, experience effects – for instance, of economic hardship in times of a depression – have been shown in the context of willingness to take risks (Malmendier and Nagel, 2011, 2016). Other studies find that income, socio-economic background and living conditions in general affect preferences (Tanaka et al., 2010; Fehr and Haushofer, 2014; Falk et al., 2019; Kosse et al., 2019). Likewise, institutional quality has been argued to influence cultural norms, which might include future orientation (Lowes et al., 2017). Moreover, violent conflict has been identified as a source of variation in the willingness to take risks (Callen et al., 2014) and individual exposure to an institutional environment has been shown to affect preferences for democracy (Fuchs-Schündeln and Schündeln, 2015). Finally, the subjective perception of institutional quality or the risk of expropriation and violence might influence individual patience. Consequently, the perception of a very unsafe environment may prevent individuals from undertaking investments with future rewards, for instance in education (Acemoglu et al., 2014).

In order to test whether such experience effects might explain our results, for each cohort in each country we construct average lifetime values for experienced log GDP per capita using data from the *Maddison Project*, institutional quality using the Polity IV index from the *Polity IV Project*, democracy using data from *Freedom House*, and political violence using information from the *Peace Research Institute Oslo*. These variables also exhibit variation across age-country cells and thus allow for a conceptually similar identification as the measure for remaining years of life.[8]

In addition, we also use a measure of subjectively-perceived institutional quality as reported by respondents to the Gallup World Poll. For individual decision-making, subjective perceptions about institutional quality are potentially more important than the objectively experienced institutional environment. However, in contrast to the other institutional background variables, which exhibit plausibly exogenous variation in the present context, subjective perceptions might consti-

[7] We present the first-stage estimates in Table 3.9. The first-stage results of this exercise reveal that remaining years of life computed from life tables in the past are strong predictors of remaining years of life in the present, with F-statistics exceeding 10 in all specifications.

[8] The only difference is that the measures of experiences exhibit no variation across gender groups.

tute a bad control (in the sense of Angrist and Pischke, 2006, p. 64.). We nevertheless include this variable in some of the analysis to explore the implications for the coefficient of interest.

Table 3.10 shows empirical results from the estimation of an extended specification that includes remaining years of life as well as measures of lifetime experiences, separately as well as jointly. The findings reveal no systematic association between patience and experienced log GDP per capita, a marginally significant association with experienced institutional quality, and negative associations with experienced political violence. The results also show a positive and significant relationship between patience and subjective institutional quality. In sum, this evidence suggests that certain life time experiences – particularly in terms of the institutional environment – indeed matter for the formation of patience.

The regressions also show, however, that the effect of remaining years of life on patience is essentially unaffected by the effects of these lifetime experiences. Additional robustness checks focusing on income, institutional quality or democracy and violence at birth or the age of 15 instead of aggregating over the life cycle provide very similar conclusions (Tables 3.11 and 3.12). In sum, these results support the conjecture that the impact of longevity on patience is largely unaffected by potential experience effects or subjective perceptions of institutional quality.

Subjective Health Status and the Formation of Patience

The results so far are strongly suggestive of an important role of longevity for patience. Importantly, the identification has been based on longevity measured by the expected remaining years of life from period life tables, i.e., based on period mortality, which refers to previous cohorts in the respective age-gender-country cells. This captures unbiased and objective information about the remaining life time for an individual in a given gender-age-country cell. Recent evidence has pointed to the influence of health perceptions for individual subjective life expectancy, which itself is a predictor of individual mortality (van Solinge and Henkens, 2018).

In order to explore the role of subjective health conditions for patience and assess the robustness of the results obtained with objective longevity information from life tables, we repeat the analysis controlling for subjective health perceptions.[9] When interpreting these results, however, it is necessary to keep in mind, that similar to subjective perceptions about institutional quality, subjectively-perceived health status might be prone to endogeneity or simultaneity problems.

Table 3.13 presents the corresponding estimation results, which indeed show that individuals with a better subjective perception of their health status also exhibit greater patience, conditional on age and other control variables. Nevertheless, the effect of the objective measure of average remaining years of life based on life table statistics remains significant and quantitatively virtually unchanged compared to the baseline results.

Finally, we investigate whether expected longevity forms patience early in life or whether patience is predominantly determined by contemporaneous life expectancy. To do so, we add to our

[9]Individual health perceptions are measured in terms of a personal health index that is constructed from combining individual responses to six questions about self-reported personal health assessments. These include satisfaction with personal health, health problems leading to behavioral limitations, and perception of stress, physical pain, worries, or sadness.

baseline specification as an additional independent variable the expected length of an individual at their birth.[10]

The results in Table 3.14 affirm the robust effects of contemporaneous life expectancy with coefficients similar to the baseline specifications in Table 3.3. In contrast, there is no robust effect of life expectancy at birth. These results underscore that an individual's patience endowment is not fixed but rather a function of the contemporaneous life expectancy, consistent with the conjecture by Becker and Mulligan (1997).

3.4 Discussion

Patience constitutes a fundamental determinant of inter-temporal choices and economic outcomes in canonical models of economic behavior. This study contributes to the small body of literature on the determinants of patience by providing evidence for the impact of a widely-hypothesized factor: longevity. Using globally representative data on patience in combination with plausibly exogenous variation in country-specific and cohort-specific longevity, we establish a quantitatively substantial and robust empirical link between patience and expected life time. In more detail, greater longevity is associated with higher patience: a 10-year increase in remaining years of life implies a 5-percentage point increase in the discount factor.

This finding emerges robustly for various sub-samples and different proxies for longevity, as well as when applying instrumental variable estimations. We also show that potential experience effects arising from experienced economic development, institutional quality, or violence over the life course might affect patience but do not affect the main result for longevity.

The significant positive effect of longevity on patience can have far-reaching implications for the emergence of poverty traps. Recent work on poverty traps has isolated various factors that can lead to detrimental feedback loops, including bio-physical and psychological factors, low levels or loss of human capital, bad health conditions, or financial market imperfections (see the introductory discussion by Barrett et al. (2019) and the contributions in their collected volume). Past research has argued that improvements in life expectancy are crucial for countries' transition from quasi-stagnation to sustained growth due to their effects on human capital investment (Cervellati and Sunde, 2005; Castello-Climent and Domenech, 2008; Cervellati and Sunde, 2015).

As patience is also a crucial determinant of health and human capital investments (Jayachandran and Lleras-Muney, 2009; Fortson, 2011; Oster et al., 2013), our evidence provides scope for a negative feedback effect that amplifies the consequences of bad health and low life expectancy for long-run development. Such a longevity-patience development trap arises through a vicious cycle of high mortality, low patience, and low investments into human capital and health. Vice versa, the results suggest that improvements in longevity, for instance as a consequence of health interventions, imply greater patience and thereby propel long-term investments and ultimately boost a county's economic development.

[10]Information on life expectancy at birth is taken from past period life tables provided by the *Population Division of the United Nations*. As these data are only available back to 1950, we conduct a linear extrapolation to impute life expectancy at birth for older cohorts.

In Appendix 3.5, we formalize these intuitions in a simple overlapping generations model that captures the interdependencies between patience and longevity and that highlights the potential for a longevity-patience poverty trap. This mechanism complements standard mechanisms leading to poverty traps, which are usually related to either external frictions or non-homothetic preferences (Ghatak, 2015). At the same time, the link between health and patience extends previous work on endogenous time preferences (Becker and Mulligan, 1997; Strulik, 2012).

In sum, the evidence presented in this study points towards an important feedback loop between bio-physical and psychological factors that can have important consequences for development. In terms of policy implications, our findings suggest that health interventions that improve longevity might have positive externalities: besides increasing individual productivity and well-being, higher longevity shifts greater weight to future outcomes, thereby fostering future-oriented decision-making such as investment in human or physical capital.

3.5 Appendix III

Longevity, Patience, and Poverty Traps

This section presents a simple model that highlights the interdependencies between patience, longevity, and economic development and illustrates how these interdependencies can lead to a longevity-patience poverty trap.

Consider an overlapping generations economy. Each generation t has a unit mass of individuals that live for two periods. Individuals are endowed with one unit of time during each period, and exhibit heterogeneity with respect to their innate ability. Ability is distributed uniformly, $a_i \sim U[0,1]$. At the beginning of the first period of life, individuals can decide to either work as unskilled workers throughout their life or to spend a share of their time $\bar{e} > 0$ on acquiring education in order to work as skilled workers during the second period of life. Individuals with higher ability acquire more productive knowledge during their education, with productivity as skilled workers being given by a_i. This specification assumes that time spent in education and individual ability are complements in the education process. Unskilled individuals earn a wage w_t^L, while skilled workers receive a wage w_t^H. For simplicity, we assume a linear production function, which implies a skill premium of $\sigma_t > 0$ (such that $w^L/w^H = 1/(1+\sigma)$).[11] Individuals discount the future with their time preference $0 < \beta < 1$ as well as with their expected survival probability until the second period of life, π_t. Then, with logarithmic preferences, the individual chooses education time $e_i = \{0, \bar{e}\}$ optimally to maximize lifetime utility. An individual prefers becoming skilled depending on

$$\begin{aligned} U(e_i = \bar{e}) &\gtrless U(e_i = 0) \\ \Leftrightarrow \ln w_t^L(1-\bar{e}) + \beta\pi_t \ln w_t^H a_i &\gtrless \ln w_t^L + \beta\pi_t \ln w_t^L \end{aligned}$$

This delivers an ability threshold at which an individual of generation t is indifferent between becoming skilled and remaining unskilled

$$a_t^* = \left(\frac{1}{1+\sigma_t}\right)\left(\frac{1}{1-\bar{e}}\right)^{\frac{1}{\beta\pi_t}}. \tag{3.1}$$

For a given β, the ability threshold is decreasing and convex in π, and vice versa.

Without loss of generality, consider as a benchmark a scenario in which all individuals are endowed with a time preference $1 > \underline{\beta} > 0$ and let the survival probability be given by $0 < \underline{\pi} < 1$. Moreover, assume that the time cost for education is sufficiently high compared to the skill premium such that $\bar{e} > 1 - \frac{1}{(1+\sigma)^{\underline{\beta}\underline{\pi}}}$. This implies with $\underline{\beta}$ given that for a survival probability of $\underline{\pi}$ or less, the ability threshold is above 1. In other words, no individual, not even the most able, is willing to become skilled. However, given $\underline{\beta}$ an increase in life expectancy, reflected by $\pi_t > \underline{\pi}$ would induce some individuals of generation t to invest in education.

[11] This allows us to make the main point while endogenizing the wage in a general equilibrium OLG framework with $Y = L + (1+\sigma)H$. Using a neoclassical production function would not deliver substantially different insights but would ensure interior equilibria throughout.

In the following, we consider a dynamic version of this benchmark scenario that shows the consequences of endogenizing the survival probability as a function of the education composition of the population. This will allow us, in a next step, to illustrate the broader implications of the empirical finding of individual life expectancy (i.e., the survival probability) affecting patience. In particular, assume an inter-temporal externality at the aggregate level (along the lines of Cervellati and Sunde, 2005), where life expectancy, reflected by the survival probability π, is positively affected by the share of skilled individuals in the previous generation. For simplicity, consider a linear relationship between π_t and a^*_{t-1} such as

$$\pi_t = \pi(a^*_{t-1}) = \bar{\pi} - \zeta \cdot a^*_{t-1} \tag{3.2}$$

where ζ is assumed to be sufficiently large in absolute terms to ensure that $\pi(1) < \underline{\pi}$. Hence, even with this externality the steady state remains to be characterized by no individual being willing to become skilled, as characterized by $a^*(\pi(1)) = 1, \pi(1))$.

This situation is depicted in Figure 3.3, where the ability threshold $a^*(\pi, \underline{\beta})$ described by (3.1) implies no education acquired by any individual if the survival probability is at or below $\underline{\pi}$. Whatever the survival probability to start with is, the steady state equilibrium of this economy is one of no education (i.e. an ability threshold of $a^* = 1$ and a low survival probability $\pi(1)$ that is consistent with no education). In other words, in this setting the model exhibits a development trap due to a lack of forward-looking behavior, since for any π the equilibrium share of skilled individuals is smaller (the ability threshold is higher) than what is required to establish an equilibrium with a higher survival probability than π.

Now consider the consequences of individual life expectancy in terms of π affecting patience as suggested by the empirical results shown before. In particular, consider the following generalization with

$$\beta_t = \underline{\beta} + \rho(\bar{\beta} - \underline{\beta})\pi_t \,, \tag{3.3}$$

where $\rho \in [0,1]$ and $1 > \bar{\beta} > \underline{\beta}$, which relaxes the implicit assumption of $\rho = 0$ considered so far. Since the condition for the ability threshold (3.1) implies that an increase in β shifts the ability threshold down for any π, thereby increasing the tendency to acquire education.[12] Hence, for any π the ability threshold is lower, i.e. $a^*(\pi, \beta) < a^*(\pi, \underline{\beta})$. Obviously, a sufficiently pronounced shift (a sufficiently high choice of $\bar{\beta}$) implies the emergence of two interior steady states, a stable steady state that features a strictly positive share of the population acquiring education (in terms of $a^*(\tilde{\pi}, \beta(\tilde{\pi})) < 1$), and a corresponding survival probability $\tilde{\pi} > \underline{\pi}$, as well as an unstable steady state. Figure 3.4 depicts this situation with the unstable steady state being characterized by the intersection of the two curves between $\pi(1)$ and $\underline{\pi}$. For any survival probability above the level of this intersection of the unstable steady state, the economy will converge to the interior steady state $\{a^*(\tilde{\pi}, \beta(\tilde{\pi})), \tilde{\pi}\}$, whereas for any survival probability below that the economy will remain in the steady state with $\{a^*(\pi(1)) = 1, \pi(1)\}$.

Obviously, with a stronger effect of longevity on patience (a larger ρ), the positive feedback loop can even lead to the disappearance of the development trap altogether, as depicted in Figure 3.5.

[12] Taking cross derivatives, it becomes clear that the shift of a^* is more pronounced for smaller π.

Taken together, these considerations suggest that the empirical finding that life expectancy influences patience can generate feedback mechanisms that can lead to poverty traps. Through its effect on individual patience, this feedback amplifies the effects of low life expectancy for future-oriented decisions long-run development, as suggested by Cervellati and Sunde (2005, 2015).

Data

Staircase procedure

The sequence of survey questions that form the basis for the quantitative patience measure is given by the "tree" logic depicted in Figure 3.6 for the benchmark of the German questionnaire. Each respondent faced five interdependent choices between receiving 100 euros today or varying amounts of money in 12 months. The values in the tree denote the amounts of money to be received in 12 months. The rightmost level of the tree (5th decision) contains 16 distinct monetary amounts, so that responses can be classified into 32 categories which are ordered in the sense that the (visually) lowest path / endpoint indicates the highest level of patience. As in the experimental validation procedure in Falk et al. (2015), we assign values 1-32 to these endpoints, with 32 denoting the highest level of patience.

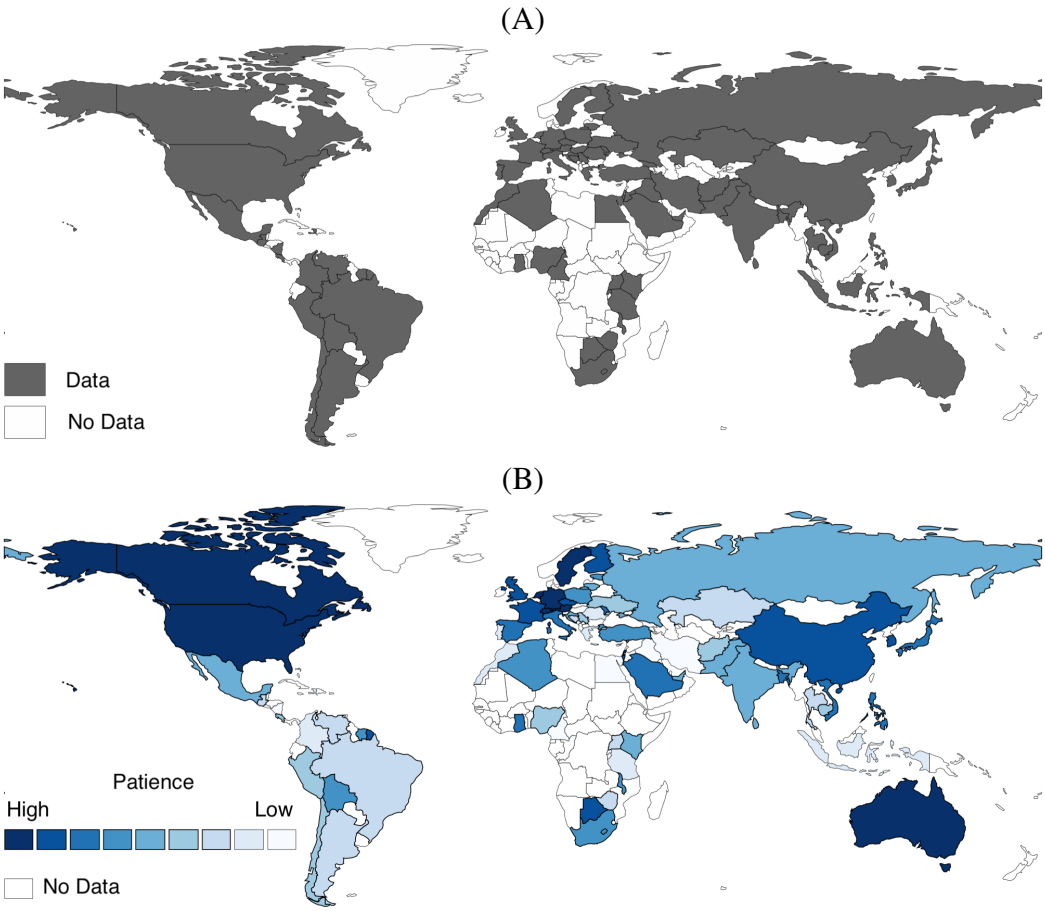
Computation of Preference Indices at Individual Level

The individual-level index of patience is computed by (i) computing the z-scores of each survey item at the individual level and (ii) weighing these z-scores using the weights resulting from the experimental validation procedure of Falk et al. (2015). Formally, these weights are given by the coefficients of an OLS regression of observed behavior on responses to the respective survey items, such that the coefficients sum to one. These weights are given by (see above for the precise survey items):

$$\text{Patience} = 0.7115185 \times \text{ Quantitative measure} + 0.2884815 \times \text{ Qualitative item}$$

3.6 Figures and Tables

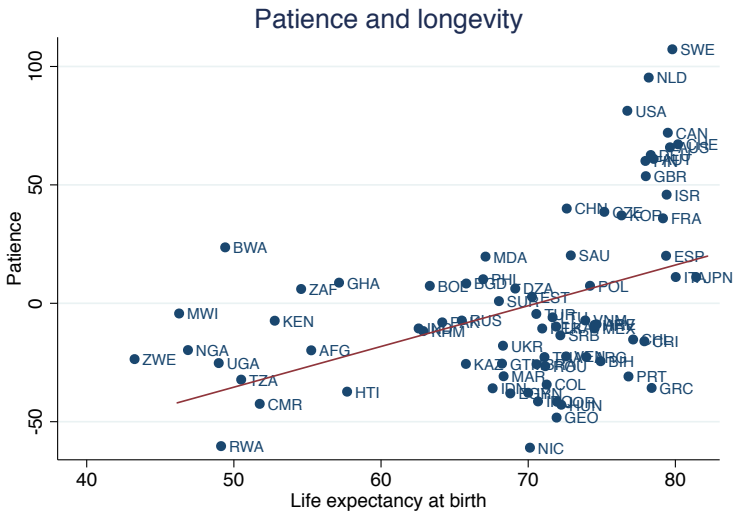
Figure 3.1: World Maps



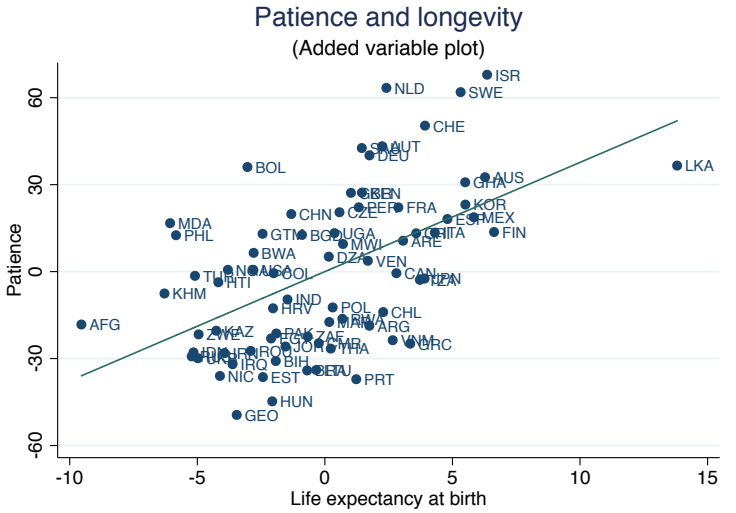
Notes: Figure 3.1, Panel A provides a world map of countries covered in the data. Figure 3.1, Panel B visualizes mean country-level patience across countries.

Figure 3.2: Patience and Life Expectancy

(A)

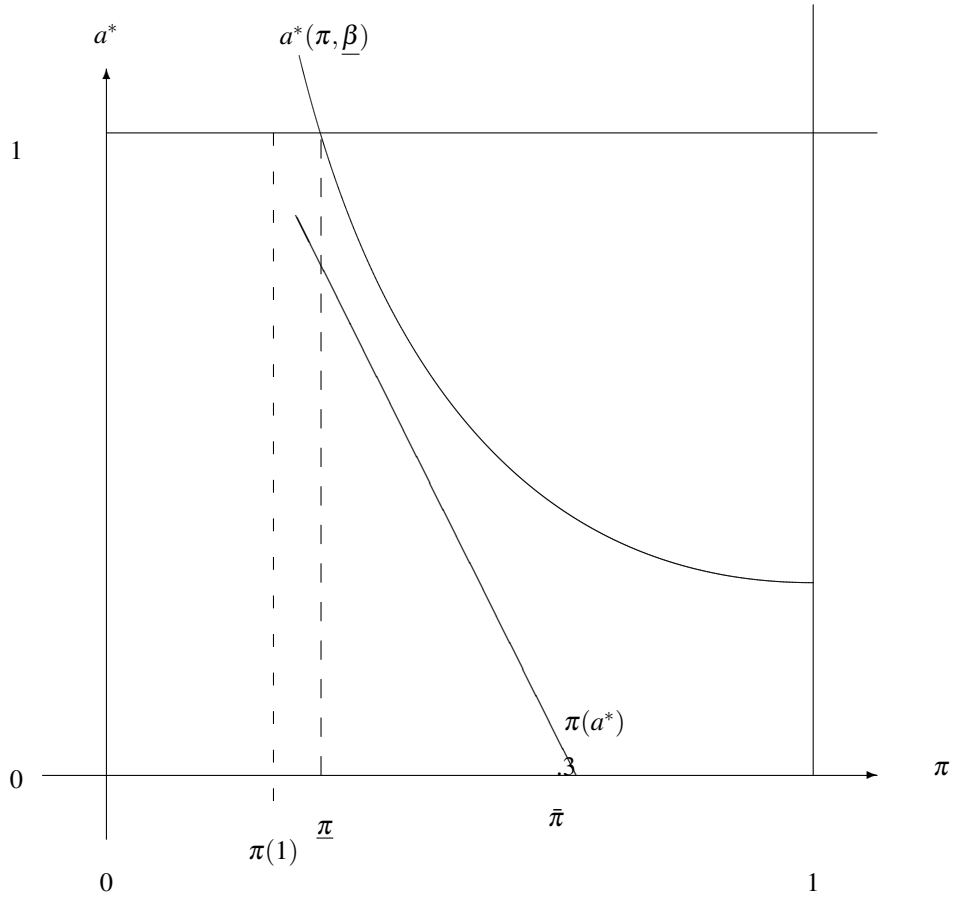


(B)



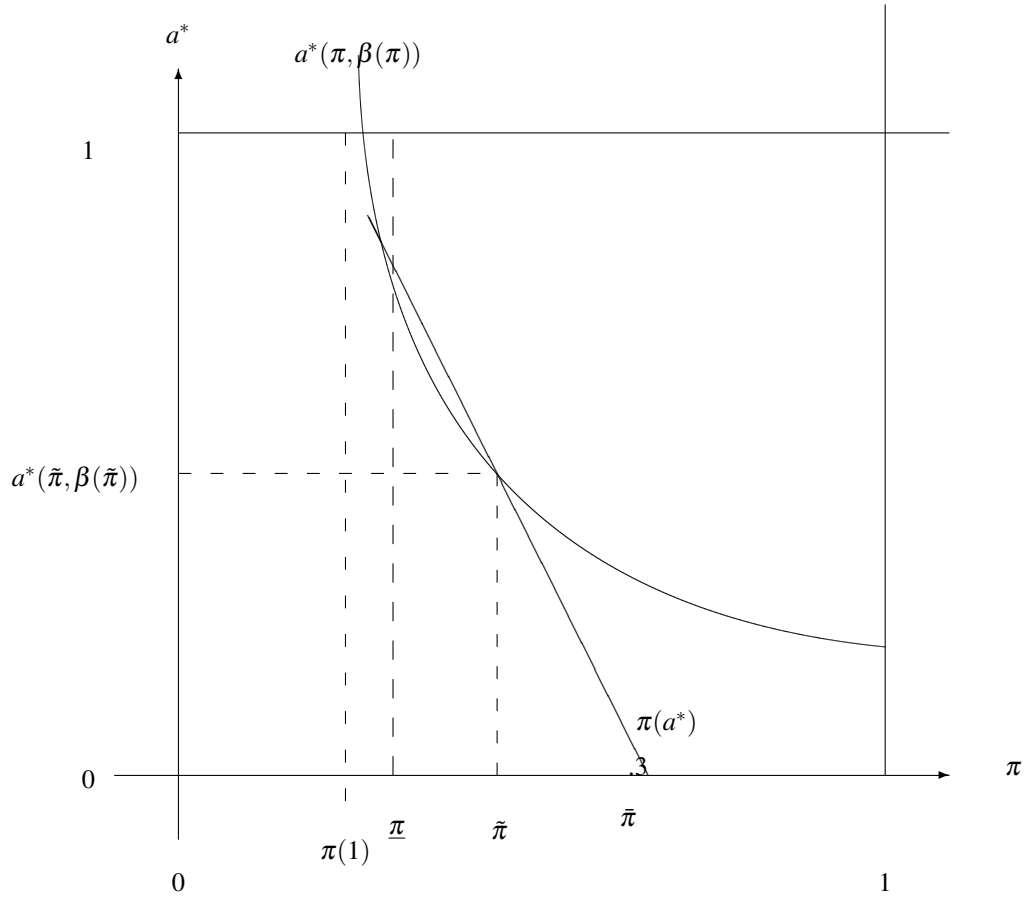
Notes: Figure 3.2, Panel A illustrates the association of country-level patience with life expectancy at birth at the country level unconditionally and Figure 3.2, Panel B shows the same association conditional on control variables. Controls include indicators for geographic region, absolute latitude, land suitability for agriculture, avg. temperature, avg. precipitation, timing of neolithic revolution, percentage living in (sub-)tropical zones.

Figure 3.3: A Longevity-Patience Development Trap



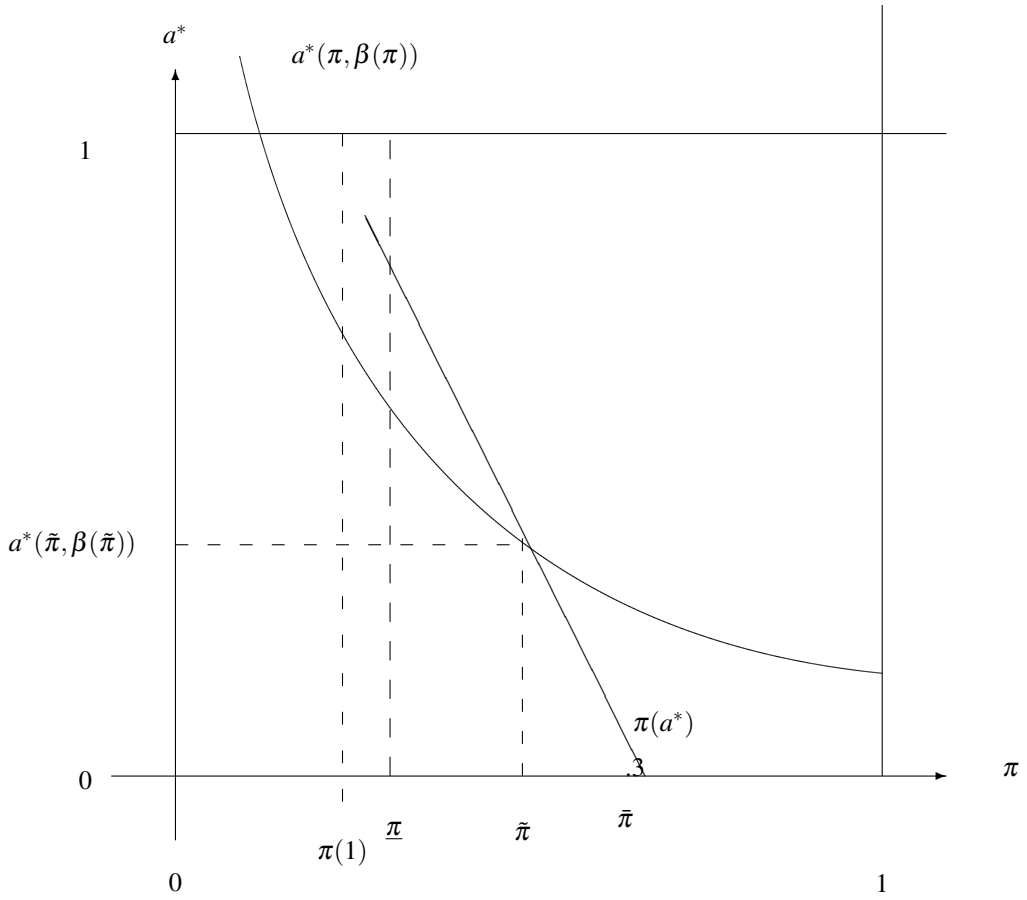
Notes: Figure 3.3 visualizes a longevity-patience development trap in the model presented in Appendix 3.5.

Figure 3.4: Longevity and Patience: Multiple Development Equilibria and Development Traps



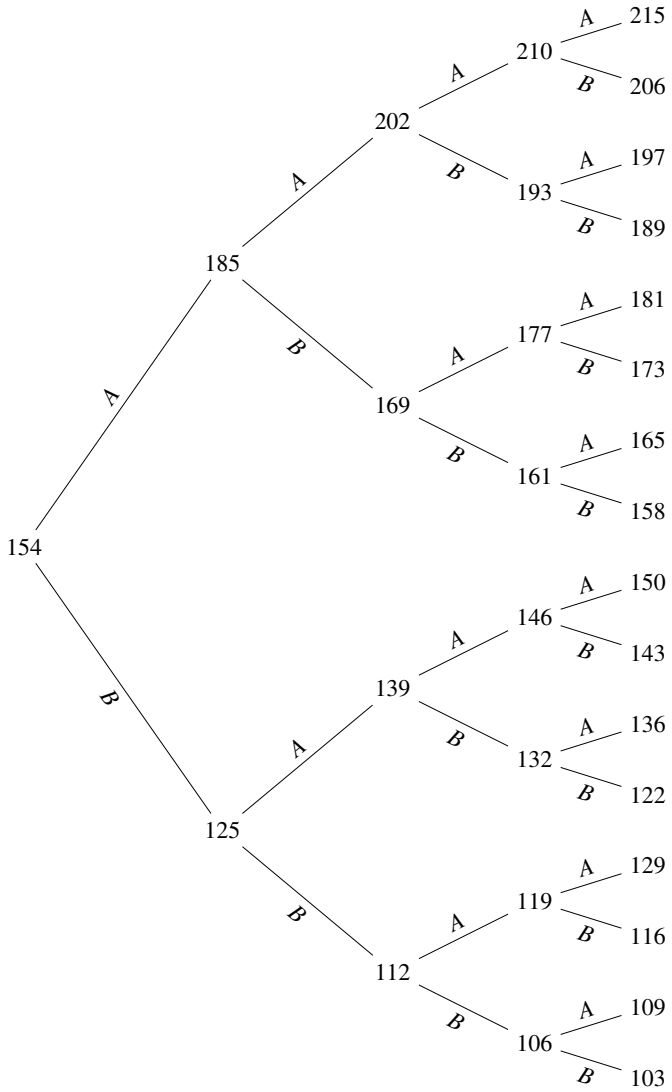
Notes: Figure 3.4 visualizes multiple development equilibria in the model presented in Appendix 3.5.

Figure 3.5: Eliminating the Longevity-Patience Development Trap



Notes: Figure 3.5 visualizes how development traps can get eliminated due to a stronger longevity-patience link in the model presented in Appendix 3.5.

Figure 3.6: Decision Tree for the Staircase Time Task, Stakes for Germany



Notes: Numbers correspond to payment in 12 months, A = choice of "100 euros today", B = choice of "x euros in 12 months". The staircase procedure worked as follows. First, each respondent was asked whether they would prefer to receive 100 euros today or 154 euros 12 months from now (leftmost decision node). In case the respondent opted for the payment today ("A"), in the second question the payment in 12 months was adjusted upwards to 185 euros. On the other hand, if the respondent chose the payment in 12 months, the corresponding payment was adjusted down to 125 euros. Working further through the tree follows the same logic.

Table 3.1: Summary Statistics: Main Variables

Baseline Specification					
	Mean	Std. Dev.	Min	Max	N
Patience	0.00	100.00	-131	276	79,730
Remaining years of life	36.21	14.43	2	72	80,021
1 if female	0.55	0.50	0	1	80,337
Age	41.82	17.49	15	99	80,061
Subj. math skills	5.18	2.82	0	10	79,211
Education level	1.86	0.66	1	3	79,945
Log [Household income p/c]	7.92	1.52	-4	15	79,848

Notes: Table 3.1 shows summary statistics of the main variables used in the analysis.

Table 3.2: Summary Statistics: Additional Variables

Additional Variables					
	Mean	Std. Dev.	Min	Max	N
Discount Factor	0.56	0.16	0	1	74,124
Remaining years of life (mortality.org)	33.20	15.45	2	72	25,419
1/(Probablity of Dying)	616.40	839.76	4	7,933	79,498
Avg. log GDP p/c lifetime	8.26	1.16	0	10	80,061
Avg. institutional quality lifetime	2.03	5.97	-10	10	80,061
Avg. democracy lifetime	0.53	0.41	0	1	80,061
Subjective institutional quality	49.08	35.47	0	100	60,096
Avg. societal political violence lifetime	0.97	1.54	0	8	80,061
Avg. interstate political violence lifetime	0.21	0.49	0	4	80,061
Will. to take risks	-0.00	100.00	-187	247	79,703
Altruism	-0.00	100.00	-261	233	79,903
Trust	0.00	100.00	-197	168	78,774
Positive reciprocity	0.00	100.00	-384	133	80,189
Negative reciprocity	0.00	100.00	-159	233	78,536

Notes: Table 3.2 shows summary statistics of additional variables used in the analysis.

Table 3.3: Longevity and Patience at the Individual Level

	Dependent variable: Patience					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	1.63***	1.73***	1.67***	1.68***	1.75***	1.59***
	(0.359)	(0.376)	(0.375)	(0.381)	(0.413)	(0.423)
1 if female	-13.5***	-11.5***	-11.6***	-10.8***	-12.4***	-11.2***
	(2.246)	(2.207)	(2.209)	(2.294)	(2.295)	(2.422)
Subj. math skills		2.24***	2.05***	2.22***	2.22***	2.05***
		(0.208)	(0.191)	(0.218)	(0.209)	(0.195)
Education level		8.58***	8.63***	9.32***	8.73***	9.71***
		(1.381)	(1.303)	(1.356)	(1.457)	(1.416)
Log [Household income p/c]		3.28***	3.04***	3.47***	3.31***	3.49***
		(0.562)	(0.553)	(0.581)	(0.607)	(0.627)
Country FE	Yes	Yes	No	Yes	Yes	No
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Religion FE	No	No	No	Yes	No	Yes
Language FE	No	No	No	No	Yes	Yes
Observations	79433	77693	76793	69245	71987	62691
R^2	0.161	0.172	0.218	0.176	0.184	0.232

Notes: Table 3.3 presents OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects and different sets of control variables. In the specifications using within-country region fixed effects, no country fixed effects are included as they are collinear. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.4: Life Expectancy and Patience: Quantitative Effects

	Dependent variable: Discount factor					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	0.0055***	0.0060***	0.0057***	0.0057***	0.0058***	0.0050***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
1 if female	-0.039***	-0.034***	-0.035***	-0.031***	-0.036***	-0.032***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.000)	(0.000)
Subj. math skills		0.0049***	0.0042***	0.0047***	0.0047***	0.0039***
		(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Education level		0.029***	0.029***	0.030***	0.030***	0.033***
		(0.005)	(0.005)	(0.005)	(0.000)	(0.000)
Log [Household income p/c]		0.014***	0.012***	0.014***	0.014***	0.013***
		(0.002)	(0.002)	(0.003)	(0.000)	(0.000)
Country FE	Yes	Yes	No	Yes	Yes	No
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Religion FE	No	No	No	Yes	No	Yes
Language FE	No	No	No	No	Yes	Yes
Observations	73887	72454	71732	64872	67075	58814

Notes: Table 3.4 presents Tobit estimates of a regression of the discount factor on remaining years of life controlling for gender, country fixed effects, age fixed effects and different sets of control variables. In the specifications using within-country region fixed effects, no country fixed effects are included as they are collinear. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.5: Life Expectancy and Patience: Inference with two-way clustered S.E.

	Dependent variable: Patience					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	1.63***	1.73***	1.67***	1.68***	1.75***	1.59***
	(0.368)	(0.391)	(0.380)	(0.394)	(0.437)	(0.438)
1 if female	-13.5***	-11.5***	-11.6***	-10.8***	-12.4***	-11.2***
	(2.331)	(2.291)	(2.265)	(2.386)	(2.437)	(2.561)
Subj. math skills		2.24***	2.05***	2.22***	2.22***	2.05***
		(0.200)	(0.184)	(0.212)	(0.198)	(0.189)
Education level		8.58***	8.63***	9.32***	8.73***	9.71***
		(1.379)	(1.303)	(1.366)	(1.463)	(1.435)
Log [Household income p/c]		3.28***	3.04***	3.47***	3.31***	3.49***
		(0.576)	(0.559)	(0.610)	(0.621)	(0.638)
Country FE	Yes	Yes	No	Yes	Yes	No
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Religion FE	No	No	No	Yes	No	Yes
Language FE	No	No	No	No	Yes	Yes
Observations	79433	77693	76793	69245	71987	62691
R^2	0.161	0.172	0.218	0.176	0.184	0.232

Notes: Table 3.5 presents OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects and different sets of control variables. In the specifications using within-country region fixed effects, no country fixed effects are included as they are collinear. Patience is standardized to exhibit a standard deviation of 100. Standard errors two-way clustered at country and age level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.6: Life Expectancy and Patience: Results for Different Sub-Samples

	Dependent variable: Patience in ...							
	Europe & CA	Americas	Africa & ME	SE Asia & Pacific	OECD	Non-OECD	Men	Women
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Remaining years of life	2.34***	1.60*	1.14***	3.52***	3.67**	1.14***	1.59***	3.84***
	(0.745)	(0.784)	(0.364)	(1.025)	(1.524)	(0.401)	(0.557)	(0.665)
1 if female	-22.3***	-11.5**	-3.21*	-14.1**	-28.3***	-5.96***		
	(4.504)	(4.700)	(1.753)	(6.018)	(6.346)	(2.149)		
Subj. math skills	2.53***	1.92**	1.85***	2.63***	2.78***	2.12***	2.82***	1.76***
	(0.343)	(0.686)	(0.293)	(0.366)	(0.519)	(0.206)	(0.274)	(0.216)
Education level	14.1***	14.8***	2.09	3.72	21.1***	4.11***	9.64***	7.99***
	(2.271)	(3.085)	(1.392)	(2.909)	(2.341)	(1.123)	(1.682)	(1.507)
Log [Household income p/c]	7.86***	2.39**	0.63	3.84***	8.07***	1.95***	2.91***	3.60***
	(1.102)	(0.933)	(0.889)	(1.100)	(1.138)	(0.544)	(0.736)	(0.712)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26312	13525	21235	16621	21332	56361	35364	42329
R^2	0.219	0.203	0.107	0.099	0.207	0.088	0.196	0.156

Notes: Table 3.6 presents for different sub-samples OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects and additional controls that include subjective math skills, education level, and log household income per capita. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.7: Longevity and Other Preferences

	Alternative Outcome				
Dep. Var.:	Risk Taking	Altruism	Trust	Pos. Recip.	Neg. Recip.
	(1)	(2)	(3)	(4)	(5)
Remaining years of life	0.69	-0.050	-0.57	0.92***	0.56
	(0.596)	(0.381)	(0.437)	(0.343)	(0.431)
1 if female	-19.5***	10.7***	8.65***	1.93	-15.0***
	(2.687)	(2.066)	(2.240)	(1.805)	(1.820)
Subj. math skills	4.01***	3.80***	5.88***	3.32***	3.94***
	(0.345)	(0.308)	(0.271)	(0.264)	(0.418)
Education level	7.27***	7.66***	-4.39***	7.68***	-0.28
	(1.029)	(1.211)	(1.309)	(1.112)	(1.002)
Log [Household income p/c]	5.26***	3.20***	-0.97	2.82***	1.56*
	(0.680)	(0.615)	(0.661)	(0.720)	(0.904)
Country FE	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes
Observations	77641	77822	77040	78053	76728
R^2	0.174	0.139	0.113	0.131	0.113

Notes: Table 3.7 presents OLS estimates of a regression of different preferences on remaining years of life controlling for gender, country fixed effects, age fixed effects and additional controls that include subjective math skills, education level, and log household income per capita. All preferences are standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.8: Longevity and Patience: Alternative Measures of Mortality and IV

	Dependent variable: Patience					
	Alternative Measures		Instrument: Remaining years of life in...			
			2000	1990	1980	1970
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life (mortality.org)	1.78***					
	(0.621)					
1/(Probablity of Dying)		0.0056***				
		(0.001)				
Remaining years of life (instrumented)			1.72***	1.44***	1.66***	2.02***
			(0.373)	(0.399)	(0.465)	(0.424)
1 if female	-19.9***	-7.21***	-11.5***	-10.4***	-11.3***	-12.6***
	(3.741)	(1.308)	(2.107)	(2.178)	(2.320)	(2.242)
Subj. math skills	2.79***	2.24***	2.24***	2.24***	2.24***	2.25***
	(0.378)	(0.206)	(0.206)	(0.206)	(0.207)	(0.207)
Education level	20.2***	8.85***	8.58***	8.59***	8.58***	8.56***
	(2.242)	(1.408)	(1.373)	(1.370)	(1.375)	(1.376)
Log [Household income p/c]	9.37***	3.29***	3.28***	3.26***	3.28***	3.31***
	(1.201)	(0.571)	(0.557)	(0.552)	(0.552)	(0.557)
Gender	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24716	77235	77693	77693	77693	77693
R^2	0.218	0.172	0.172	0.172	0.172	0.172

Notes: Columns (1) and (2) of Table 3.8 present OLS estimates of a regression of patience on two measures of longevity controlling for gender, country fixed effects, age fixed effects, development and additional controls that include subjective math skills, education level, and log household income per capita. Columns (3) to (6) present IV estimates of a regression of patience on remaining years of life controlling for the same control variables. Instruments employed are the remaining years of life for a given gender-age-country cell in previous decades (for the first stage see Table 3.9). Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.9: Life Expectancy and Patience: IV Estimates (First Stage)

Dep. Variable:	First Stage Remaining years of life (2010)			
	(3)	(4)	(5)	(6)
Remaining years of life 2000	0.63***			
	(0.049)			
Remaining years of life 1990		0.78***		
		(0.068)		
Remaining years of life 1980			0.63***	
			(0.167)	
Remaining years of life 1970				0.75***
				(0.074)
Gender	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes
Observations	77693	77693	77693	77693
F	162.66	131.98	14.27	102.76

Notes: Table 3.9 presents the first-stage estimates of the IV regressions in Columns (3) to (6) of Table 3.8. Additional controls include subjective math skills, education level, and log household income per capita.

Table 3.10: Life Expectancy and Patience: The Role of Life Experiences of Development and Institutions

	Dependent variable: Patience							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Remaining years of life	1.62***	1.73***	1.72***	1.62***	1.68***	1.66***	1.50***	1.38***
	(0.394)	(0.379)	(0.377)	(0.397)	(0.380)	(0.387)	(0.424)	(0.448)
Avg. log GDP p/c	5.14						7.20	8.03
	(5.235)						(5.251)	(8.638)
Avg. institutional quality		0.89*					1.49**	1.53**
		(0.455)					(0.575)	(0.622)
Avg. democracy			6.49				-10.0	-11.4
			(6.494)				(7.411)	(8.152)
Avg. societal political violence				-2.46**			-1.92**	-2.13
				(1.137)			(0.866)	(1.325)
Avg. interstate political violence					-6.71		-4.94	-5.20
					(4.385)		(4.127)	(4.878)
Subjective institutional quality						0.15***		0.15***
						(0.025)		(0.024)
Gender	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77693	77693	77693	77693	58062	77693	77693	58062
R^2	0.172	0.172	0.172	0.172	0.167	0.172	0.172	0.167

Notes: Table 3.10 presents OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects, experienced development and institutional quality. Additional controls include subjective math skills, education level, and log household income per capita. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.11: Life Expectancy and Patience: Experience Effects (Robustness 1: At Birth)

	Dependent variable: Patience					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	1.45***	1.52***	1.52***	1.62***	1.64***	1.31***
	(0.403)	(0.378)	(0.373)	(0.374)	(0.371)	(0.399)
Log GDP p/c at birth	3.33*					2.10
	(1.832)					(1.588)
Inst. quality at birth		0.037				0.062
		(0.139)				(0.174)
Democracy at birth			-0.11			-1.55
			(1.728)			(2.050)
Societal pol. violence at birth				-0.47		-0.45
				(0.364)		(0.359)
Interstate pol. violence at birth					0.27	0.32
					(0.694)	(0.554)
Gender	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77693	77693	77693	77693	77693	77693
R^2	0.172	0.172	0.172	0.172	0.172	0.172

Notes: Table 3.11 presents OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects, development and institutional quality experienced at birth. Additional controls include subjective math skills, education level, and log household income per capita. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.12: Life Expectancy and Patience: Experience Effects (Robustness 2: At Age 15)

	Dependent variable: Patience					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	1.71***	1.66***	1.68***	1.53***	1.56***	1.54***
	(0.382)	(0.371)	(0.370)	(0.371)	(0.372)	(0.376)
Log GDP p/c at age 15	-0.40					-0.92
	(1.360)					(1.350)
Inst. quality at age 15		0.18				0.12
		(0.135)				(0.189)
Democracy at age 15			2.01			0.33
			(1.652)			(2.184)
Societal pol. violence at age 15				-0.70***		-0.69**
				(0.265)		(0.268)
Interstate pol. violence at age 15					-0.33	-0.27
					(0.514)	(0.528)
Gender	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	77693	77693	77693	77693	77693	77693
R^2	0.172	0.172	0.172	0.172	0.172	0.172

Notes: Table 3.12 presents OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects, development and institutional quality experienced at age 15. Additional controls include subjective math skills, education level, and log household income per capita. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.13: Life Expectancy and Patience: The Role of Subjective Health Perceptions

	Dependent variable: Patience					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	1.72***	1.78***	1.72***	1.74***	1.82***	1.66***
	(0.369)	(0.382)	(0.383)	(0.389)	(0.420)	(0.432)
Subjective health perceptions	0.13***	0.083***	0.086***	0.10***	0.086***	0.11***
	(0.021)	(0.019)	(0.019)	(0.017)	(0.020)	(0.018)
Country FE	Yes	Yes	No	Yes	Yes	No
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Gender	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	Yes	Yes	Yes	Yes	Yes
Religion FE	No	No	No	Yes	No	Yes
Language FE	No	No	No	No	Yes	Yes
Observations	77411	75707	74807	67353	70001	60799
R^2	0.151	0.161	0.208	0.164	0.173	0.221

Notes: Table 3.13 presents OLS estimates of a regression of patience on remaining years of life controlling for gender, country fixed effects, age fixed effects, subjective health perceptions and different sets of control variables. Additional controls include subjective math skills, education level, and log household income per capita In the specifications using within-country region fixed effects, no country fixed effects are included as they are collinear. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3.14: Life Expectancy at Birth and Patience

	Dependent variable: Patience					
	(1)	(2)	(3)	(4)	(5)	(6)
Remaining years of life	1.66***	1.87***	1.80***	1.79***	1.88***	1.68***
	(0.385)	(0.405)	(0.405)	(0.407)	(0.439)	(0.445)
Life expectancy at birth	-0.078	-0.29*	-0.26*	-0.26*	-0.30*	-0.26
	(0.139)	(0.153)	(0.150)	(0.157)	(0.165)	(0.172)
1 if female	-13.3***	-10.7***	-10.9***	-9.94***	-11.5***	-10.3***
	(2.147)	(2.074)	(2.068)	(2.086)	(2.126)	(2.144)
Subj. math skills		2.25***	2.05***	2.22***	2.22***	2.05***
		(0.208)	(0.191)	(0.218)	(0.209)	(0.195)
Education level		8.79***	8.83***	9.52***	8.95***	9.91***
		(1.429)	(1.352)	(1.398)	(1.511)	(1.466)
Log [Household income p/c]		3.30***	3.05***	3.47***	3.33***	3.50***
		(0.564)	(0.556)	(0.583)	(0.611)	(0.630)
Country FE	Yes	Yes	No	Yes	Yes	No
Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	Yes	No	No	Yes
Religion FE	No	No	No	Yes	No	Yes
Language FE	No	No	No	No	Yes	Yes
Observations	79433	77693	76793	69245	71987	62691
R^2	0.161	0.172	0.218	0.176	0.184	0.232

Notes: Table 3.14 presents OLS estimates of a regression of patience on remaining years of life as well as life expectancy at birth controlling for gender, country fixed effects, age fixed effects, and additional controls that include subjective math skills, education level, and log household income per capita. Patience is standardized to exhibit a standard deviation of 100. Standard errors clustered at the country level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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