The inequality of equal mating *

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Abstract

Sharing means that couples pool their incomes, contributing to lower inequality. Flocking means that persons with high earnings marry others with high earnings, contributing to higher inequality. We explore the race between flocking and sharing in the process of unequal leveling in the frmation of couples. To quantify the results we derive tail-sensitive measures of sharing and flocking for analysing data from LIS. We show that i) the sharing effect on average dominates the flocking effect; ii) flocking is significant in the tails of the distribution where high-income flocking is typical for countries with high inequality, while low-income flocking is typical in countries with less extreme inequality; iii) gender differences in income magnify the unequal leveling where inequality among men is associated with higher flocking and lower sharing, while inequality among women is associated with lower flocking and higher sharing.

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1 Introduction

It is widely recognized that equal mating boosts inequality across households since the rich marry other rich, and the poor marry other poor. This flocking effect - the isolated effect of assortative mating - may have lead observers to overlook that household formation also can reduce the inequality in the distribution of individual incomes as marriages pool incomes. Although it might still be true that the marriage is "uniting goods rather than persons" – as de Toqueville famously said – the question is whether it does so on terms that are redistributive, or not?

In this paper we demonstrate how inequality in the distribution of income of couples can be seen as the result of two counteracting effects - a sharing effect, capturing the pooling of two non-negative individual incomes, and a flocking effect, capturing the tendency that people marry within their own income group. We explore the race between sharing and flocking. The impact of sharing and flocking is not the same along the income distribution of couples. Neither is the pattern the same in all countries. Both within and across countries we emphasize a process of what we denote an *unequal income leveling* of the formation of couples.

To emphasize the pure distributional aspects of this process we rely on the simplifying assumption that the supply of labor is unaffected by the formation of couples.[1] We use income data for individuals and couples from the Luxembourg Income Study (LIS), covering 46 countries over the period 1969-2013. To illustrate some aspects we at places focus on twelve countries (the focus countries) Brazil, Czech Republic, Germany, Spain, France, UK, Italy, Norway, Poland, Sweden, US, and South Africa. Using the entire data set, we offer three basic general results.

1. *Pooling*: the process of unequal leveling is inequality reducing. There is a clear net leveling effect in the formation of couples as the sharing effect dominates the flocking

[1] The complications of attempting to incorporate endogenous labor supply would change the focus and make the novelty of the paper less clear. Matching with endogenous labor supply include contributions by Pestel (2017), Kuhn and Ravazini (2017). One interesting strand of the literature explores how higher female labor supply affect inequality, see Mastekaasa and Birkelund (2011), Schwartz (2010), Hrysko et al. (2017).

effect. We demonstrate the claim theoretically and quantify the domminating effect empirically. We show that in all cases where the distribution of income of females and males are not identical, the sharing effect is stronger than the flocking effect, no matter how couples are formed, and stronger in some countries than in others. Accordingly, the formation of households lowers income inequality across individuals. In fact, the inequality across couples tends to be lower than the inequality in the marginal distribution of income for females and males – and obviously also the inequality of the joint distribution of individual incomes. Although a tendency of equal mating reduces the impact of sharing, flocking does not eliminate it.

2. *Polarization*: the overall leveling effect hides a little noticed flocking in the tails of the distribution. In many countries high-income flocking and low-income flocking increase the difference between rich and poor households at the same time as each of the two groups become more homogeneous. The tendency of polarization in the couple distribution might lead to mis-allocation of resources and influence. Flocking in the tails contrasts couple formation in the middle where matches emerges as random. We show how flocking in the tails is associated with differences across countries in the distribution of couples' income. High-income flocking is typical for countries with high inequality, such as Latin-American countries in addition to the US, Spain, and Italy, while low-income flocking is typical in countries with less extreme inequality, such as the North-European countries.

3. *Gender*: differences in the joint income distribution of men and women magnify the unequal leveling, but not in a symmetric manner. Individual inequality among men is associated with higher flocking and lower sharing, while inequality among women is associated with lower flocking and higher sharing. The case of flocking can be explained by a simple non-monotonicity: The impact of inequality in the individual income distributions is hump-shaped - first increasing and then decreasing. The top of the hump is at a lower threshold level of inequality for women than for men. The gender difference in the impact of inequality can then arise as long as the variation in

the level of inequality, that we observe, basically is between these two thresholds.

To capture how systematic matching vary across the income distribution of couples we develop measures of flocking and sharing that can provide detailed information as we move across the income distribution. For instance, to investigate whether equal mating is most prevalent among the rich or the poor, we need flocking and sharing measures that are more disaggregated than conventional measures of inequality. Our measures visualize which quantiles in the income distribution lose and which quantiles gain from the mating game and can be considered as parallells to the Lorenz curve.

To see the pattern of unequal leveling in different countries we aggregate the measures by varying the weights on observations at different parts of the distribution, distinguishing, for instance, between upper tail sensitive measures and lower tail sensitive measures. The approach enables us to classify countries where there have been more flocking and less sharing in either the upper tail or the lower tail of the distribution. We can also characterize the size of 'the neutral middle', where matches are close to what would result if they were random, and hence, the sharing effect is maximal.

Even though we have seen no previous discussion in the literature of unequal leveling of household incomes as a race between sharing and flocking, our paper is clearly building on the literature on assortative mating, going at least back to the work of Becker (1973, 1974) where assortative mating is explained by maximizing returns to marriage. Greenwood et al. (2017) provide an overview of the literature.[2] We connect most directly to the vast empirical part of the literature, documenting the presence of assortative mating on income (Cancian and Reed 1998), education (Mare 1991), and even down to the genetic level (Domingue et al. 2014). See Harkness (2013) for a review. Some emphasis has been on attempting to uncover causal relationships by e.g. looking at newly formed couples (Fiorio and Verzillo 2018) or

[2]More recent theoretical approaches model matching as a search process where each party has an ideal spouse in mind, but due to search frictions typically have to opt for a below ideal spouse (Burdett and Coles 1997, Shimer and Smith 2000, Fernandez et al. 2005, Smith 2006). The distributional impact of this process depends on the gains and losses from marrying someone from a different income group, which again depends on intra-household distribution of resources (Gronau 1973, Manser and Brown 1980, McElroy and Horney 1981, Chiappori 1988) and divorce legislation (Reynoso 2018). Konrad and Lommerud (2010) provide a theoretical analysis of how matching arrangements influence economic inequality, and how this depends on the tax system.

instrumenting educational attainment by genetic predispositions (Barban et al. 2016). It seems that causal effects are fairly close to observed correlations.

The simulated counter factual random matching approach that we employ, was pioneered by Cancian and Reed (1998) and Aslaksen et al. (2005), see e.g. Pasqua (2008) and Greenwood et al. (2014) for subsequent applications of the methodology. While these studies focus on the overall income inequality without differentiating between different parts of the income distribution, we take a more disaggregated view. Some authors combine the counter factual approach with mechanisms for endogenous labor supply (Pestel 2017, Kuhn and Ravazini 2017, Mastekaasa and Birkelund 2011, Schwartz 2010, Hrysko et al. 2017) or predict incomes from individual characteristics (Greenwood et al. 2014, Eika et al. 2017). As highlighted by Harmenberg (2017), this tends to increase the magnitude of assortative mating. A focus on labor supply may lead to a complementary interpretation of some of the patterns that we explore.

Below, we first define sharing and flocking and present the overall inequality-reducing effect of the pooling of incomes (Section 2). Next, we demonstrate step by step our disaggregated measures of sharing and flocking with empirical evidence from the focus countries (Section 3). We demonstrate the foundation for evaluating our measures of unequal leveling relying on the principle of mean preserving correlation-increasing transfers, before we discuss aggregations with varying tail-sensitivity (Section 4). In our descriptive analysis of unequal leveling we focus on differences across countries, exploring the impact of gender inequality and the links between what happens in the bottom and in the top of the income distribution of couples (Section 5). We conclude by a brief summary of our descriptive anaysis (Section 6).

2 Flocking, sharing, and the overall leveling effect

An analysis of flocking and sharing effects calls for measures of the association between women's income and men's income.

2.1 Basics

Let Y_h and Y_w be the incomes (earnings) of husband h and wife w with distribution functions F_h and F_w with means μ_h and μ_w, and let $Y_c = Y_h + Y_w$ be the income of the couple with distribution F_c and mean μ_c. The distribution of the individual (female and male) incomes is denoted F_p. We are considering cases where the total incomes in society is not affected by matching, implying that the mean for the actual distribution of of couple's income equals the mean income of couples with random matching, $\mu_c = \mu_r$ where F_r with mean μ_r denotes the hypothetical distribution of couple incomes with random matching. In addition, the mean income of all persons equals the average of the male and female mean incomes, implying $\mu_p = .5\mu_h + .5\mu_w$.

Since random matching does not produce a systematic pattern of flocking, the hypothetical distribution, where the observed incomes from F_h and F_w are randomly matched, emerges as an appropriate reference distribution for household income. Let L_c, L_p, L_r be the Lorenz-curves associated with F_c, F_p, and F_r. Finally, let C denote a Lorenz-consistent measure of inequality where C_p indicates the inequality between all persons, where C_p, C_h, and C_w are the C-inequality in the distribution F_p, F_h, and F_w.

2.2 Decomposing unequal leveling

We say that there is no flocking together if and only if $L_c(u) = L_r(u)$ for all $u \in \langle 0, 1 \rangle$, which implies that the corresponding inequality measures $C_c = C_r$. A natural measure of the flocking effect, the inequality caused by flocking Δ_F, is thus the difference between the inequality across couples for the actual distribution and the randomly formed distribution: $\Delta_F = C_c - C_r$.[3]

Similarly, a natural measure of the sharing effect is the reduction in inequality that results from random matching of individuals into couples. The isolated result of the pooling of incomes in couples Δ_S, can thus be defined as the difference between the inequality across individuals before and after random matching: $\Delta_S = C_p - C_r$.

[3] Aslaksen et al (2005) used the Gini coefficient version as a measure of flocking together. .

The difference between the sharing and flocking effects is equal to the difference in inequality across individuals and across couples ($C_p - C_c$), what we denote the *actual* leveling of the formation of households:

$$C_p - C_c = \Delta_S - \Delta_F$$

Without flocking, the actual leveling equals the sharing effect. Whenever $C_r < C_c < C_p$ the sharing and flocking effects are both positive. In Appendix B, we show that the actual leveling ($C_p - C_c$) is always non-negative. It can be zero in the special case where the incomes of both husbands and wifes have the same distribution and, in addition, the assortative matching into couples is perfect, implying that the sharing effects equals the flocking effect:

Proposition 1. *Pooling: In all cases where the distribution of income of females and males are not identical, the sharing effect Δ_S is larger than the flocking effect Δ_F– no matter how couples are formed – and hence, the leveling effect $\Delta_S - \Delta_F$ is strictly positive.*

We provide a formal proof of Proposition 1 in Appendix B. Yet, to convince one self about Proposition 1 it may be enough to observe the fact that it is impossible to match individuals into couples of husband and wife such that the inequality in couple-incomes becomes larger than the inequality in individual incomes. Measuring inequality using the Gini coefficient, we show the break down of the inequality difference for our focus countries in Table 1.

Now, the measures ($C_p - C_c$), Δ_S and Δ_F are natural starting points to understand overall inequality, they may be insufficient to describe and understand the unequal leveling and the variation in matching and household inequality along the income distribution and across countries. The overall measures can average out different impacts in different parts of the distribution of couples' income and prevent us from seeing how the association between the incomes of husband and wife may differ in different parts of the income distribution.

There are reasons to believe that sharing and flocking may differ along the income distribution, and that inequality within and across gender matters.

i) A strong flocking effect requires inequality of income within both gender. If there is

Table 1: Decomposition of Gini-inequality reduction (leveling) by sharing and flocking

Country	Year	Sharing Δ_S	Flocking Δ_F	Percentage flocking $100 \times \Delta_F/\Delta_S$	Leveling $\Delta_S - \Delta_F$
Brazil	2013	.15	.049	33	.097
Czech Rep	2010	.15	.037	25	.11
Germany	2010	.17	.016	9	.16
Spain	2013	.16	.043	27	.12
France	2010	.14	.043	30	.1
Italy	2010	.16	.034	21	.13
Norway	2010	.13	.024	19	.1
Poland	2013	.15	.037	24	.12
Sweden	2005	.12	.029	25	.089
UK	2013	.15	.033	22	.12
US	2013	.14	.02	14	.12
South Africa	2012	.13	.044	34	.087

Notes: The table shows the actual leveling effect of coupling on inequality ($C_p - C_r$), decomposed as a sharing effect ($\Delta_S = C_p - C_r$) minus a flocking effect ($\Delta_F = C_c - C_r$).

little inequality in one of the distributions, the flocking effect must be low, while the sharing effect may be strong as the incomes with high inequality are pooled with incomes from a distribution with small or no income differences.

ii) Flocking in the upper tail can be strong and may have a clear effect. Rich men may be wealthy in part because they love money and power more than persons, and they may thus fancy a spouse who matches their own income. Aternatively, rich men may care less about the income of their spouses as the marginal value of more income may be low. The search for a suitable spouse according to other characteristics may nevertheless produce equal mating among top-income earners, if these other characteristics – like status, culture, class, and political beliefs – are positively correlated with income. All this may imply that flocking outweight sharing in the upper tail.

iii) Flocking in the middle may have little impact, while sharing has. Males and females who are middle income earners within their own gender, may have different incomes, implying that marrying within the same quantile of each distribution implies a high sharing effect. Hence, a tendency of equal mating among individuals with middle incomes can have a high sharing effect, while the increasing inequality flocking effect may be low inthe sense that F_c

is similar to the random F_r in central parts of the distributions.

iv) In the lower tail of the income distribution equal mating may sometimes be infeasible financially. A couple with two low incomes may not make ends meet. If so, we should see less registered equal mating among low income earners – accept, perhaps, in countries with a more generous welfare spending and with higher incomes at the bottom of the income distribution.

All this motivates us to explore sharing and flocking in different parts of the income distribution.

3 All along the income distribution

To see where in the distribution of household incomes equal mating is most prevalent and has the greatest effect we need some additional measures. Each of them addresses specific questions.

3.1 Sharing and flocking curves: Which quantiles lose or gain?

To identify where in the income distribution we find winners and losers of the unequal leveling we first consider the sharing effect, capturing a movement from the individual income distribution to the hypothetical distribtion of random matchtes. Doing that we compare the incomes for each quantile u in the two distributions. A couple that occupies the u-quantile with random matching gets a per capita income equal to $F_r^{-1}(u)$, which should be compared to twice of the u-quantile in the personal distribution, i.e. $2F_p^{-1}(u)$. Since, $\mu = \mu_c = 2\mu_p$ we define the sharing curve

$$\Lambda_S(u) = \frac{F_r^{-1}(u)}{\mu_c} - \frac{F_p^{-1}(u)}{\mu_p} = \frac{F_r^{-1}(u) - 2F_p^{-1}(u)}{\mu} \quad \text{for} \quad 0 \leq u \leq 1, \tag{1}$$

showing how much individuals in the u-quantile would lose or gain from random matching relative to μ, the mean of the couples' incomes (twice the mean of the individuals' incomes).

In Figure 1a we illustrate the sharing curves for our focus countries. In all countries the gains from sharing are positive and large at the bottom of the distribution, and negative and large at the top of the distribtion. Yet, the magnitudes vary.

Next, we consider flocking, the movement from the hypothetical random distribution to the actual couple distribution. A couple that occupies the u-quantile with random matching gets an income equal to $F_r^{-1}(u)$, while a couple that occupies the u-quantile in the actual distribution gets $F^{-1}(u)$. We define the flocking curve

$$\Lambda_F(u) = \frac{F_c^{-1}(u) - F_r^{-1}(u)}{\mu} \quad \text{for} \quad 0 \leq u \leq 1, \tag{2}$$

showing how much the u-quantile of the household distribution lose or gain on the assortative mating - relative to the mean μ of the household distribution.

With a tendency of equal mating for all parts of the income distribution $\Lambda_F(u)$ takes negative values for small u (lower tail of the distribution) and positive values for large u (upper tail of the distribution).

In Figure 1b we show the flocking curves for our 12 focus countries. As seen, the flocking is highest at the ends of the distribution for all countries accept South Africa and Brazil. In these two countries the observations in the bottom of the earnings distribution may not be fully representative since informal employment is difficult to measure properly.

The graphs in Figure 1 show that it is in the tails of the distribution that we find the basic contributions to the unequal leveling. By contrast, the leveling dominates in the middle.

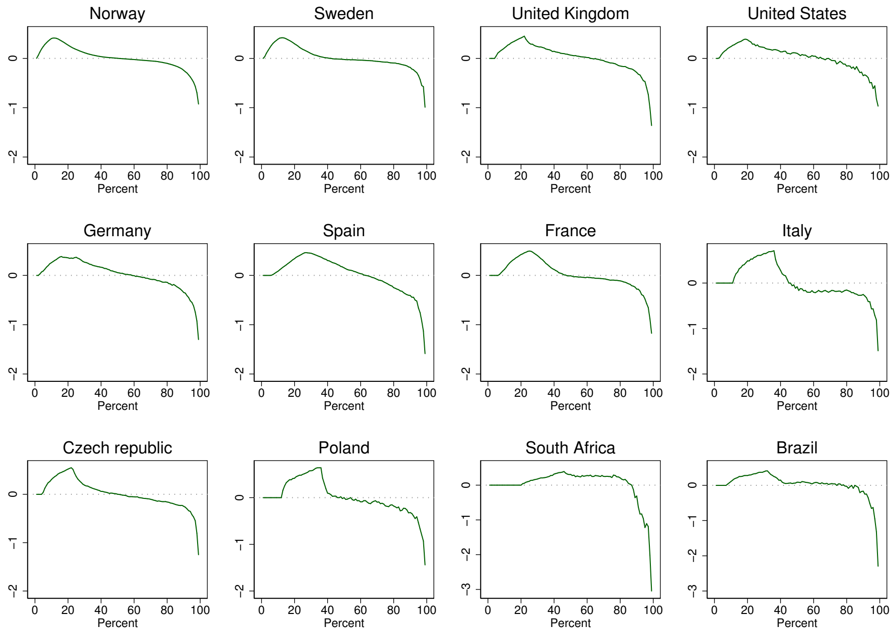
3.2 The neutral middle: Where is the matching almost random?

We are concerned with the size of the 'neutral middle', defined as the fraction of couples where the economic outcomes are as if the couples were formed by random matching. In the neutral middle the actual leveling is equal the sharing effect of pooling two incomes that stem from the middle of the two individual distributions, which may have different mean values.

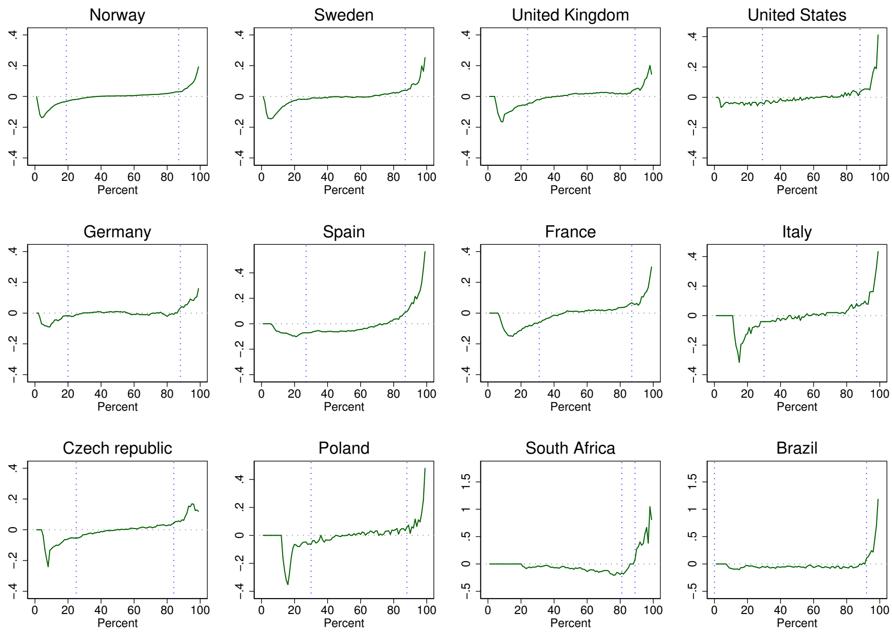
With an underlying tendency of positive assortative matching the lower and upper bounds of the neutral middle can be defined by the quantiles u_L and u_H that satisfy

Figure 1: Sharing and flocking curves in the focus countries

(a) Sharing curves Λ_S



(b) Flocking curves Λ_F



Notes: The graph shows sharing curves Λ_S, the difference between the distributions of individual and the hypothetical random distribution, and flocking curves Λ_F, the difference between the actual and the hypothetical distributions.
Income is pre tax wage incomes, excluding couples where both have 0 income and post tax incomes, including taxes and transfers. Incomes are normalized to have mean 1.

$$\Lambda_F(u) \begin{cases} < 0 \text{ for } u \leq u_L \\ \approx 0 \text{ for } u \in [u_L, u_H] \\ > 0 \text{ for } u \geq u_H \end{cases} \tag{3}$$

Thus u_L is the fraction of losers, $(1 - u_H)$ is the fraction of winners, and $(u_H - u_L)$ is the fraction of couples belonging to the neutral middle. To compute u_L and u_H numerically, we perform a rather simple smoothing exercise.[4] For our focus countries the results are shown in Table 2. As seen, in all of them (except Brazil) the fraction of looser is higher than the fraction of winners. Yet, the most distinct feature is the size of the neutral middle constituting way above half of all couples (except in South Africa). In other words, more than half of the couples have a distribution of incomes that cannot be distinguished from the distribution that would result if matches were random, and where there is only sharing effects from the formation of couples. Again, the contribution to unequal leveling can be found in the tails of the distribution.

3.3 Normalized Lorenz curves: What is the effect on inequality?

We can find the contribution to unequal leveling by comparing the deviations from complete equality at each quantile u. Complete equality means that each household gets identical shares μ of total income at each quantile u. The deviations from complete equality depend on the Lorenz curves $L_c(u)$ and $L_r(u)$. With the actual matching the difference to the

[4]In cases where Λ_F is monotonic, we first smooth the Λ_F, approximating it with a second order local polynomial and take the absolute value A of the smoothed curve. Then we define u_L and u_H such that

$$\Lambda_F(u) \begin{cases} < -A \text{ for } u \leq u_L \\ \in [-A, D] \text{ for } u \in [u_L, u_H] \\ > A \text{ for } u \geq u_H \end{cases}$$

In cases where Λ_F is non-monotonic, we use the first crossing, i.e. $u_L = \min\{u| - A \leq \Lambda_F(u) \leq A\}$ and $u_H = \max\{u| - A \leq \Lambda_F(u) \leq A\}$. Defining the neural middle as the area below mean absolute deviation, we find the boundaries given in Table 2.

Table 2: % winners and looser of equal mating

Country	loosers u_L	winners $1 - u_H$	neutral middle $u_H - u_L$
Sweden	18	13	69
Norway	19	13	68
Germany	20	12	68
United Kingdom	24	11	65
Spain	27	13	60
United States	29	12	59
Czech republic	25	16	59
Poland	30	12	58
France	31	13	56
Italy	30	14	56
Brazil	0	8	92
South Africa	81	11	8

equality benchmark is given by

$$\frac{u\mu - E[Y \mid Y \leq F_c^{-1}(u)]}{u\mu_c} = 1 - \frac{L_c(u)}{u} = N_r(u) - N_c(u), \tag{4}$$

where the *normalized Lorenz curve*, $N_c(u) = L_c(u)/u$, provides a convenient alternative interpretation of the information content of the Lorenz curve and has several additional attractive properties. firstly, for a fixed u, $L(u)/u$ is the ratio between the mean income of the poorest $100u$ per cent of the population and the overall mean. Secondly, the family of normalized Lorenz curves is bounded by the unit square and therefore, visually, there is a sharper distinction between two different normalized Lorenz curves than between the two corresponding Lorenz curves. Thirdly, the normalized Lorenz curve of a uniform $(0, a)$ distribution proves to be the diagonal line joining the points $(0, 0)$ and $(1, 1)$ and thus represents a useful reference line. The egalitarian line, coincides with the horizontal line joining the points $(0, 1)$ and $(1, 1)$. At the other extreme, when one person holds all income, the normalized Lorenz curve coincides with the horizontal axis except for $u = 1$ where it becomes equal to 1.

Figure 2 shows the normalized Lorenz curves for the actual income distributions and the hypothetical distributions with random matching for the focus countries. In addition the shaded areas in the Figure show the span between the lowest level of inequality that can be obtained via arranged matchings to the maximum inequality – i.e. the span ranging from perfect negative to perfect positive assortative mating. The 45 degree line represents the case with a uniform distribution of the household incomes.[5]

As seen from Figure 2, all our focus countries have more inequality at every quantile in the actual household distribution than in the hypothetical distribution with random matching. However, the location of the two curves differ across countries,. In Norway and Sweden, for instance, both the actual and the random distributions are associated with less inequality than the uniform distribution. This holds for every quantile of the distributions. United Kingdom, the United States, Germany, Czech republic have lower inequality than the uniform distribution for lower quantiles, but higher inequality than the uniform distribution for higher quantiles. Finally, Spain, France, Italy Poland, South Africa and Brazil all exhibit larger inequality then the uniform distribution for every quantile.

The individual distributions of income have a clear impact on the level of equality that can in fact be obtained in the marriage market under the most favorable circumstances. Norway and Sweden have the greatest potential for an egalitarian redistribution as indicated by the top end of the shaded area in Figure 2. While the median couple in Norway and Sweden could obtain 80 percent of the mean income by a suitable rearrangement of marriages, the median couple actually obtains 50 per cent of the mean income. In contrast, the high level of inequality in South Africa implies that maximal redistribution via the marriage market and the actual matching both result in similar low levels of incomes relative to the mean: The median couple in South Africa could at the maximum obtain 20 percent of the mean by a suitable rearrangement of marriages, while the median couple actually obtains about 15 percent of the mean. Most of the countries, however, resemble more the Scandinavian than the South African case. In fact, almost all couples can obtain around 70 per cent of the mean income by a suitable rearrangement of marriages. The main exception is Brazil where the median obtains less than 25 percent and could at the maximum obtain 50 percent.

[5]For further discussion of the properties of the normalized Lorenz curve see Aaberge (2007).

As indicated, the potential of unequal leveling (the grey area in in Figure 2) vary across countries. Again, in all countries the individual income distribution (the blue stipulated curve) exhibits normalized Lorenz curves with higher inequality than the actual distribution across households (the green solid curve).

3.4 Inequality associated curves: How much of the inequality?

To better describe the process of unequal leveling we need to bee pricise about how much each quantile contributes to inequality. First, we compare the deviations from complete equality in the case with random matching and in the case with the actual matching. The deviation, called *the inequality associated flocking curve*, is given by

$$[1 - \frac{L_c(u)}{u}] - [1 - \frac{L_r(u)}{u}] = \frac{1}{u}[L_r(u) - L_c(u)]$$

Formally, it can also be defined by the integral of the flocking curve in (2) between u and 1:

$$\mathit{\Gamma}_F(u) = \frac{1}{u}\int_u^1 \Lambda_F(t)dt = \frac{1}{u}[L_r(u) - L_c(u)] \quad \text{for} \quad 0 \leq u \leq 1, \tag{5}$$

Next, we compare the deviations from complete equality in the case with random matching and in the case with the individual distributions. The inequality associated sharing curve is defined by

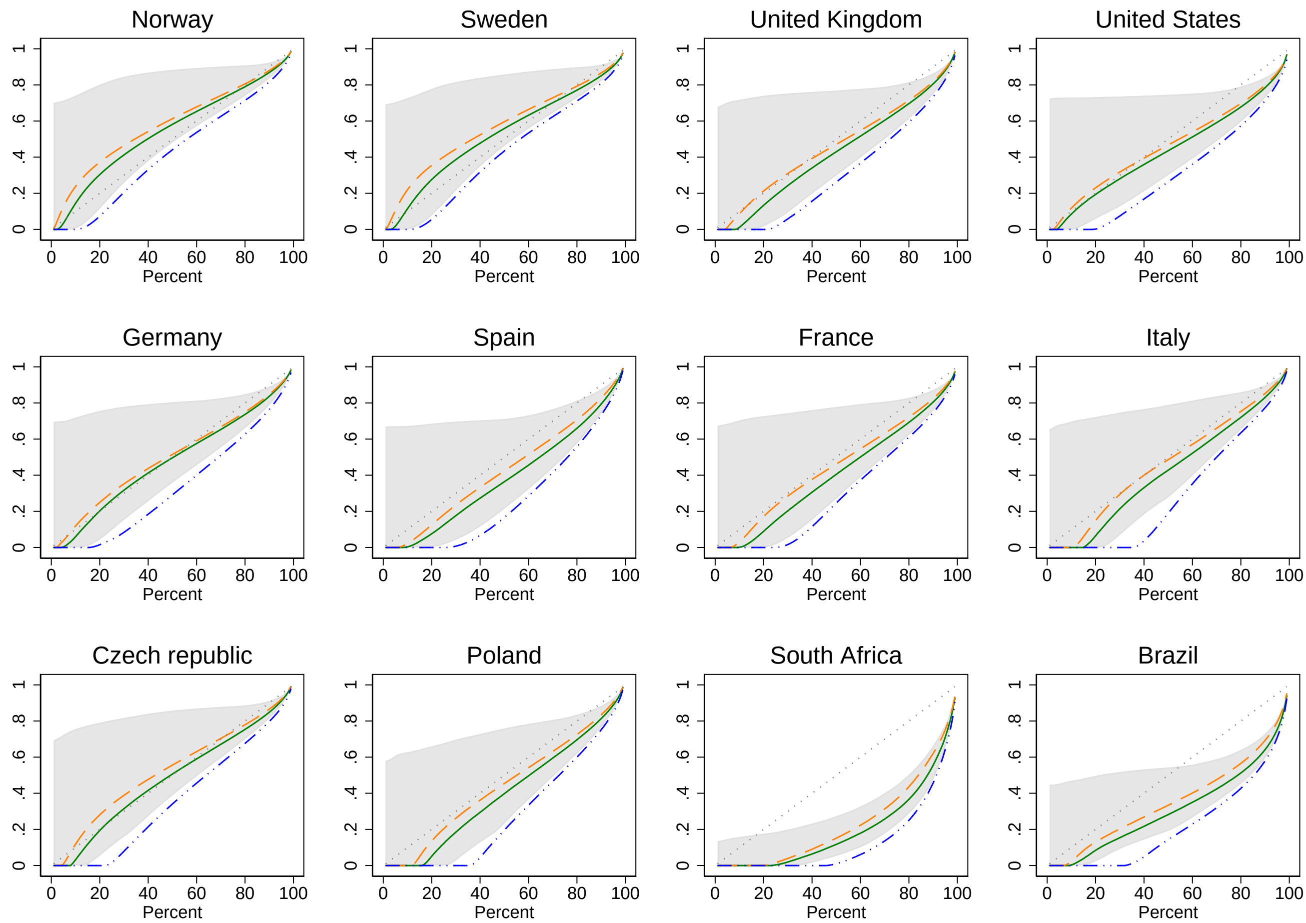
$$\mathit{\Gamma}_S(u) = \frac{1}{u}\int_u^1 \Lambda_S(t)dt = \frac{1}{u}[L_r(u) - L_p(u)] \quad \text{for} \quad 0 \leq u \leq 1, \tag{6}$$

Figure 3 shows $\mathit{\Gamma}_F(u)$ and $\mathit{\Gamma}_S(u)$ for our selected countries. As seen from Panel (a), the inequality generated by equal mating is clearly most distinct for the lower tail of the distribution in 8 of the 12 countries. In South Africa, however, the inequality is highest in the upper tail of the distribution. In the United States, Spain, and Brazil the generated inequality is almost the same for all quantiles.

As seen from Panel (b) of Figure 3, the equalizing sharing effect is also strongest toward

Figure 2: Normalized Lorenz curves $L(u)/u$ for selected countries

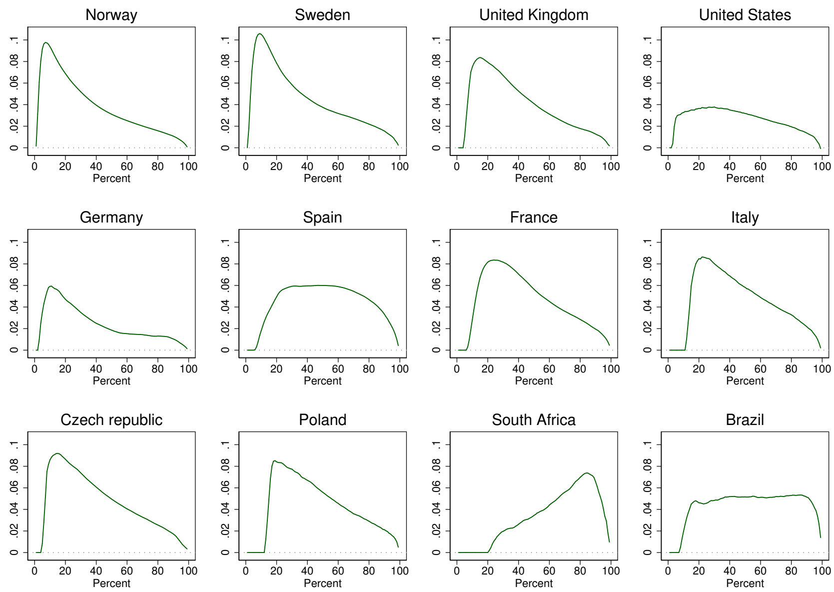
(a) Earnings distributions



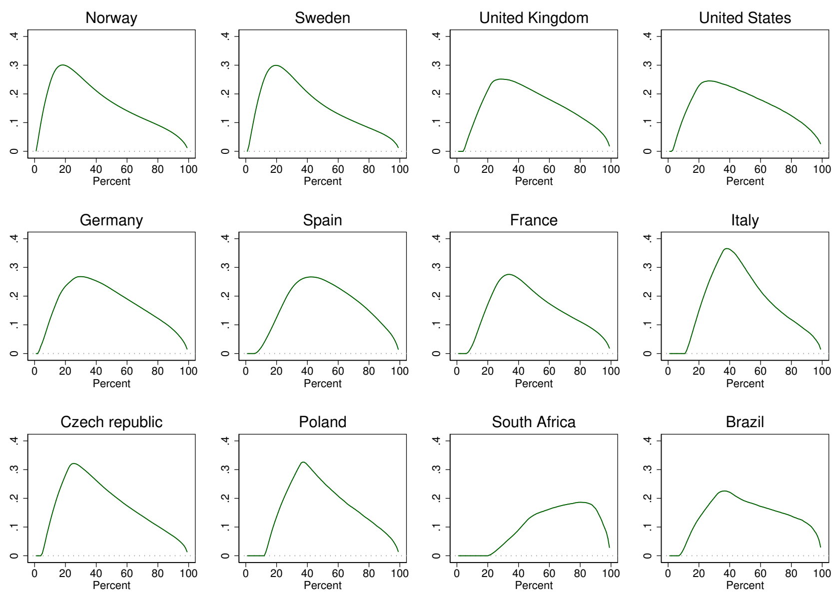
Notes: Solid green curves are actual income distributions, dashed orange curves from the hypothetical income distributions, and dot-dashed blue curves are individual levels. The shaded area shows the span of distributions ranging from perfect positive to perfect negative assortative mating.

Figure 3: The inequality associated flocking and sharing curves

(a) Flocking



(b) Sharing



Notes: The Figure shows the flocking curve $\Gamma_F(u)$ *and sharing curve* $\Gamma_S(u)$ *for the focus countries.*

the bottom in all countries except South Africa and partially Brazil. However, this effect is stronger around the 25th percentile than at the very bottom of the distribution.

This completes our disaggregated discription of unequal leveling. We now combine the measures in a way that allows us to emphasize where the unequal leveling is most unequal.

4 Tail-sensitive measures of sharing and flocking

As shown in Section 3, the flocking and sharing in the tails of the distribution are the most evident features of unequal leveling. We therefor need measures that are particular sensitive to what happens in the tails, but nevertheless portrait the traditional Gini measure as a special case. We introduce two sets of weights, one that is more lower-tail senistive than the Gini-coefficient, and another that is more upper-tail sensitive than the Gini-coefficient.

To do that we use a parameter k, indicating the inequality aversion profile for our class of inequality measures

$$C_k = 1 - \frac{1}{\mu}\int_0^1 q_k(u)F^{-1}(u)\ du, \text{ for } k = 1, 2, 3 \tag{7}$$

where

$$q_k(u) = \begin{cases} -\log u, & \text{for } k = 1 \\ \frac{k}{k-1}(1 - u^{k-1}), & \text{for } k = 2, 3 \end{cases} \tag{8}$$

Clearly, $k = 2$ gives us the traditional Gini-coefficient C_2 with $q_2(u) = 2(1 - u)$, while C_1 measures inequality by increasing the weights on the quantiles in the lower tail for distribtion, and C_3 measures inequality by increasing the weights on the quantiles in the upper tail of the distribution. The value of $q_k(u)$ can be interpreted as the ratio between the weight put on the actual social welfare attained under the observed distribution, and the social welfare attained under complete equality.

To ease the interpretation of the inequality aversion profiles exhibited by (7), Table 3 displays ratios of the weights as defined by (7) given to the median individual and the 5 per cent poorest, the 30 per cent poorest and the 5 per cent richest income earners. The weights in Table 3 demonstrate that the weight of an additional Euro to a person located at the 5 per cent decile is 4.3 times the weight for the median income earner when C_1 is used as a measure of inequality, whereas it is only 1.3 times the weight for the median earner when C_3 is used

Table 3: Distributional weight profiles

Weight ratios relative to the median	C_1	C_2	C_3
$p(.05)$	4.32	1.90	1.33
$p(.30)$	1.74	1.40	1.21
$p(.70)$	0.51	0.60	0.68
$p(.95)$	0.07	0.10	0.13

Notes: The Table shows the weight associated with selected income ranks relative to the median...

as a measure of inequality. This means that C_1 is particularly sensitive to changes that take place in the lower part of the income distribution, whereas C_3 pays particular attention to changes that take place in the upper part of the income distribution. Considered together these three measures provide a good summary of the inequality information exhibited by the normalized Lorenz curve (as emphasized by Aaberge, 2007).

We can use these measures in the defintions of flocking and sharing:

$$\varDelta_k^F = k \int_0^1 u^{k-1} \varGamma_F(u)du = C_{ck} - C_{rk} \text{ for } k = 1, 2, 3, \tag{9}$$

$$\varDelta_k^S = k \int_0^1 u^{k-1} \varGamma_S(u)du = C_{pk} - C_{rk} \text{ for } k = 1, 2, 3, \tag{10}$$

where C_{pk}, C_{ck} and C_{rk} for $k = 1, 2, 3$ are inequality associated with L_p, L_c and L_r with different tail sensitivity.

4.1 Correlation-increasing transfers

In (9) and (10) the randomly matched benchmark distributions are constructed under the assumption that the individual distributions remain fixed. Therefore we cannot claim that the lower of two non-intersecting flocking curves, or sharing curves, exhibits less inequality by relying on the conventional Pigou-Dalton's principle of transfers. Instead, we can use distribution-preserving transfers that increase the correlation between husbands' and wives' income (see Appendic X for a precise definition). Using this we can prove the following proposition

Proposition 2. *Let Γ_{L1} and Γ_{L2} be members of the family of inequality associated flocking curves, defined by (3). Then the following statements are equivalent,*

(i) $\Gamma_{L1}(u)$ first-degree dominates $\Gamma_{L2}(u)$, meaning $\Gamma_{L1}(u) \leq \Gamma_{L2}(u)$ for all $u \in [0, 1]$

(ii) $\Gamma_{L2}(u)$ can be obtained from $\Gamma_{L1}(u)$ by a sequence of correlation-increasing transfers

(iii) $\Delta_p(L1)) < \Delta_p(L2)$ for all positive non-increasing p

Proof. See appendix □

5 Unequal leveling in the aggregates

We now use these measure to assess empirically the extent of unequal leveling and its correlates across countries.

5.1 Gender

To what extent are gender differences associated with the process of unequal leveling? One should expect a rather complicated picture. First, the sharing effect is basically associated with the pooling of two unequal incomes. If the basic inequality were across gender and not within, we should expect a strong sharing effect and a weak flocking effect. In any case we should expect a low level of sharing to be associated with high female/male income-ratio the gender gaps in income.

Second, the impact of higher inequality in the distribution of the income of one gender, keeping the inequality in the distribution of the other constant, is likely be be hump-shaped. To see this, fix the inequality among women, and let inequality among men vary from zero to one. When there is no inequality, flocking (the difference $C_{ck} - C_{rk}$) must be zero since matching have no impact when all men have the same income (and $C_{ck} = C_{rk}$). At a somewhat higher level of inequality the flocking must be clearly higher as long as we have a tendency of equal mating. When there is maximal inequality, however, systematic and random matching can only produce a cosmetic differences in the distribution of couples' income, if any at all. The difference $C_{ck} - C_{rk}$, does then in essence only depend on the income of the women who become the wife of the man who has all the income. All other matches involve men with zero income. The maximal impact of flocking must therefore be for a level of inequality among men between the two extremes. Hence, the hump.

zzzTable 4 reports results from regressing C_2 based measures of flocking and sharing on inequality, as well as country income levels and the female/male income ratio.[6]

We now explore whether we can find these associations for the whole data set. The results are reported in Table 4. Note first that in richer countries, we find more sharing (and perhaps lower flocking) — and that these effects are weaker in the bottom of the income distribution than in the top.Keeping this in mind we concentrate on disparities in income and gender. Based on the regressions we can make a case for a asymmetric role of gender differences for the process of unequal leveling.

In Panel A of Table 4, the relationship between flocking, on the one hand, and inequality among men and among women, on the other, seem to be non-linear, no matter how we measure inequality. The impacts are hump-shaped: first increasing and then decreasing. At the bottom of the panel we report the threshold level of inequality that gives us the peak of the hump. To make sense of the asymmetry, observe that threshold levels where the the hump peaks are much lower for women than man – for instance 0.28 for women and 0.889 for men with the inequality measure C_1. The relevant intervals of variations in the inequality measures, we have an overall negative effect of inequality in the women's distribution and positive effect of inequality in the men's distribution. In other words, most of the variation in inequality is to the right of the peak for women, while it is to the left of the peak for men. Hence, for the most reasonable ranges of inequality levels. there seems to be an *positive* concave effect of male inequality on flocking and a similar *negative* concave effect of female inequality on flocking. Individual inequality among men is therefore associated higher flocking, while inequality among women is associated with lower flocking.

[6]Regressions for using all three C_i measures can be found in Appendix Tables A-2 and A-3. Results are qualitatively comparable.

Table 4: Flocking and sharing versus inequality levels

	Flocking			Sharing		
	(1)	(2)	(3)	(4)	(5)	(6)
Inequality, men	0.137***	0.450***	0.207**	-0.280***	-0.268*	-0.331**
	(7.42)	(3.94)	(2.10)	(-10.73)	(-1.87)	(-2.28)
Inequality, women	-0.0704***	0.00554	0.104***	0.230***	0.582***	0.598***
	(-6.29)	(0.09)	(2.79)	(13.92)	(6.11)	(6.66)
Inequality men, squared		-0.312**	-0.171*		-0.00500	0.0948
		(-2.67)	(-1.97)		(-0.04)	(0.68)
Inequality women, squared		-0.0560	-0.0381		-0.276***	-0.300***
		(-1.07)	(-1.17)		(-3.39)	(-3.51)
Log GDP			-0.000463			0.00513***
			(-0.30)			(2.73)
Female/male income ratio			0.103***			-0.0179
			(7.02)			(-0.87)
Turning pt., men		0.720	0.604		-26.77	1.747
Turning pt., women		0.0495	1.370		1.054	0.999
Obs.	253	253	242	253	253	242
R2	0.416	0.477	0.669	0.786	0.826	0.839

Notes: The Table reports measures of flocking and sharing by the C_2 (Gini) measure using (pre-tax) wage earnings. "Inequality" refers to the corresponding C_2 measure on individual income inequality among men and women. "Turning pt." indicates the estimated turning point for the quadratic relationship.
*t-values based on standard errors clustered at the country level reported in parentheses, and *, **, and *** denotes significance at the 10, 5, and 1 percent level.*

Why is the threshold that gives us the peak, lower for women than for men? The answer to that question is most likely related to the fact that many women have zero earnings. For the sake of the argument, keep the fractions of zero income women constant. Mean preserving increases in inequality is then affecting a smaller number of women than man, implying that the impact of higher inequality peaks at a lower level for women than for men.

The variation that we find across countries, strengthens this interpretation. High inequality among women is associated with a high fraction of zero-income women. Thus in cases where more women have an income, the inequality among women tends to be lower. A higher female labor participation also means that more women meet more men in similar income breaks. So female labor participation is likely to be associated with lower inequality among women and we presume a higher tendency of equal mating, contributing to how more flocking can go together with low inequality among women.

In Panel B of Table 4, the relationship between sharing, on the one hand, and inequality among men and among women, on the other, also seem to be non-linear, no matter how we measure inequality. The signs of the estimated coefficients, however, differ from the case with flocking. Inequality among men is associated with lower levels of sharing, while inequality among women is associted with higher levels of sharing, but in a concave relationship. The turning points indicating the top of the peaks, reported at the bottom of the Panel, are not close to the relevant intervals of variation in inequality measures. To understand the opposite effects of inequality among men and of inequality among women, recall that on average women earn less than men. Hence, in the measures of sharing, $C_{pk} - C_{rk}$, the inequality in male incomes dominates in the hypothetical random distribution. Every entity in this distribution is a sum of a male and a female incomes that are randomly matched. Every draw of a male income is taken from a distribution with a higher mean compared to the draw of the female income. In the distribution of individual incomes, in contrast, the males are just half of the population where all income differences counts. Hence, a higher inequality in the men's income distribution raises C_{rk} relatively more than it raises C_{pk}, while the opposite is true for the inequality in the women's distribution. A higher inequality in the women's distribution raises C_{pk} relatively more than C_{rk}.

5.2 Polarizaton

To explore sharing and flocking in the top and in the bottom of the income distribtion , we regress the differences $\Delta_3^j - \Delta_1^j$ for $j \in \{F, S\}$ against a number of outcomes. The results are given in Table 5. There is some evidence (in Panel A) that flocking is more at the bottom of the income distribution in richer countries, but the strongest result is that more inegalitarian countries have more flocking at the top of the income distribution. In addition, it seems that some combination of high female labor force participation, having a well developed welfare state, and being a Nordic country lead to stronger flocking at the bottom of the income distribution, but we are not able to distinguish well between the three factors.

From Panel B of Table 5, we see that also sharing seems to be more present at the top of the income distribution in more inegalitarian countries. The effect of income levels is not perfectly clear, but when we control for inequality, more prosperous countries tend to have most of their sharing effect at the top of the income distribution. Finally, higher female labor force participation seems to correlate with more sharing in the bottom of the income distribution.

What is most evident from table (5) is the clear association between the general inequality in society and the merging of high incomes in the fomation of couples among top earners. High-income flocking in high-inequality countries widens the difference between rich and poor households. Flocking in the tails can also contribute to polarization in the income distribution. This is particularly true when high-income flocking is combined with low-income flocking, implying that both rich and poor groups become more homogeneous at the same time as the difference between them increases. It seems typical for countries with high inequality, such as Latin-American countries. So far we have only considered the impact of the general inequality in the personal distribution of income. Inequality across and within gender is also important.

Table 5: Sharing and flocking at the top and at the bottom

A. Flocking The difference $\Delta_3^F - \Delta_1^F$ regressed against affluence and inequality

	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP	-0.790***		-0.210	-0.222*	-0.419	-0.198
	(-6.41)		(-1.55)	(-1.69)	(-1.08)	(-1.46)
C2 Inequality		8.021***	7.401***	7.033***	3.848**	6.862***
		(6.71)	(4.65)	(4.35)	(2.19)	(4.13)
Female lab part				-0.0112	-0.0251***	-0.00758
				(-1.12)	(-4.12)	(-0.73)
Welfare state generosity					-0.0256	
					(-1.49)	
Nordic country						-0.305
						(-1.18)
N	242	253	242	242	134	242
r2	0.396	0.470	0.601	0.612	0.500	0.619

B. Sharing The difference $\Delta_3^S - \Delta_1^S$ regressed against affluence and inequality

	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP	-0.0118***		0.00733***	0.00669***	-0.00695	0.00633***
	(-3.93)		(3.39)	(3.31)	(-1.09)	(3.06)
C2 Inequality		0.208***	0.245***	0.226***	0.285***	0.228***
		(10.52)	(11.35)	(11.11)	(19.37)	(11.01)
Female lab part				-0.000583***	-0.000223	-0.000638***
				(-5.52)	(-1.45)	(-5.41)
Welfare state generosity					0.000196	
					(0.87)	
Nordic country						0.00454
						(1.50)
N	242	253	242	242	134	242
r2	0.185	0.608	0.649	0.712	0.765	0.716

*Notes: t-values based on standard errors clustered at the country level reported in parentheses, and *, **, and *** denotes significance at the 10, 5, and 1 percent level.*

5.3 Observed and potential levels of inequity

We conclude this section by some observations concerning how much, or little, redistribution there are in the marriage market - in the light of the net leveling effect compared to the sharing effect and to the potential for redistribution when all matches can be alterted. We emphasize again the focus countries.

Consider first Table 1.[7] As long as random matches is the natural comparison, we observe that net leveling is about the same percentage of the sharing effect no matter which of the inequality measures that we use. As seen there are variations across countries, but not so much across how tail sensitive the inequality measures are. Net leveling is between 65 to 86 percent of the sharing effect. Surprisingly perhaps, the US has the highest percentage of the twelve countries 0f 85 to 86 percent.

The picture change somewhat when we consier net leveling as a fraction of the maximal leveling with as illustrated in Figure 4. Here we show the leveling effect of couple formation using the three measures C_1, C_2, and C_3 for our focus countries in relation to the potential leveling. In the figure individual inequality is shown as blue diamonds and observed inequality between couples are shown as red dots. Moreover, the green lines shows the range of couple inequality that is obtainable by differing degree of assortative matching (i.e. the interval $[C_{\min,i}, C_{\max,i}]$), with the case of random matching C_{ri} shown as a cross.

Again, we should notice that couple formation is inequality reducing in all countries, driven by the sharing effect. This is, however, dampened by a reverse flocking effect in all countries. For the C_1-measure, the reversal is strong in Northern Europe, whereas flocking is stronger along the C_3-measure in the poorer countries in the sample.

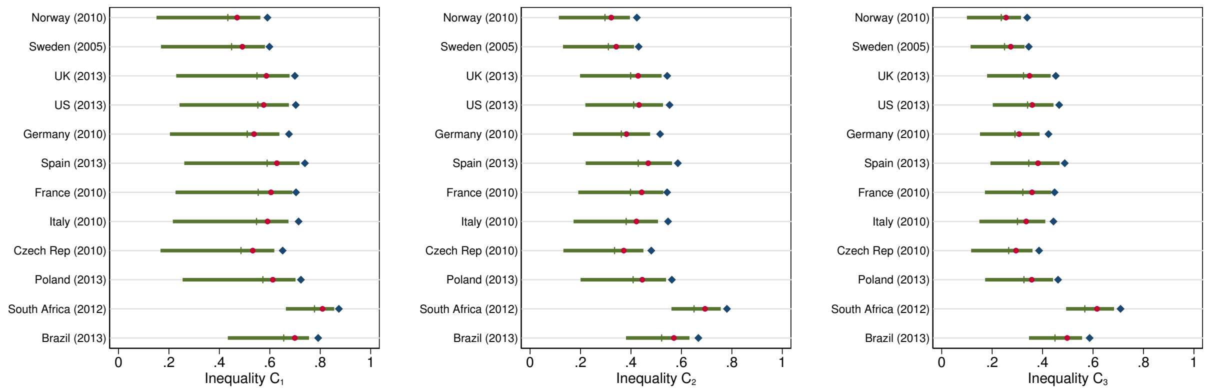
Expressing the net leveling effect as a fraction of the potential for leveling, the inequality in the individual distributions minus the the lowest inequality that can be obtained by matching individuals into coupls – that is the left-han end of the green line in Figure 4), we obtain

In Table 1 we showed the numbers behind the difference between individual and household

[7] Similar results for the C_1 and C_3 measures can be found in Appendix Table A-1.

Figure 4: Observed and feasible levels of inequality

(a) C_1 inequality (b) C_2 inequality (c) C_3 inequality



Notes: The graph shows for each of the inequality measures C_1, C_2, and C_3 the individual inequality as blue diamonds, the inequality between couples as red dots. The green line depict the range from the inequality with perfect inverse assortative mating to perfect positive assortative mating with random matching indicated as a cross.

inequality, and break the difference into the contributions from sharing and flocking for the three inequality measures C_1 to C_3 in our focus countries.

5.4 High-income and low-income flocking and sharing

To visualize the pattern across countries we explore how differences in ranks and scores of flocking and sharing depend on the tail-sensitivity of the inequality measure we apply. Although flocking and sharing patterns have some of the same characteristics for all measures of inequality, we can use the tail-sensitive measures C_1 and C_3 to highlight clear differences between the countries. We are particularly interested in flocking and sharing at the bottom of the income distribution verus at the top of the distribution.

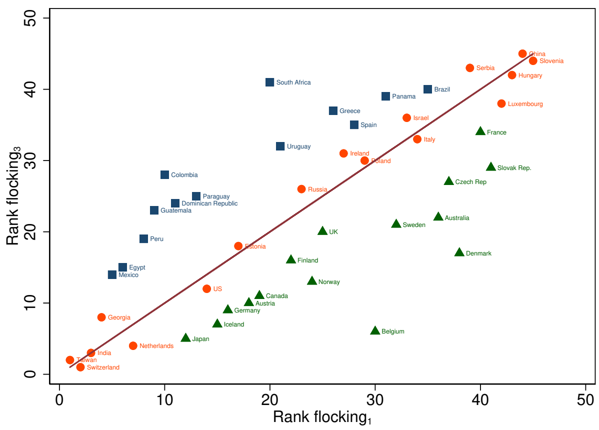
To distinguish countries where the tendency of equal mating is strongest among the rich and countries where it is strongest among the poor, we compare our measure of flocking Δ_k^F and our measure of sharing Δ_k^S measured with $k = 1$ to the measures with $k = 3$. To make the differences as clear as possible we show the plot using each country's rank on the Δ_k^F and Δ_k^S measures.[8]

Figure 5 illustrates interesting features. Inspecting Panel (a), we see that flocking is

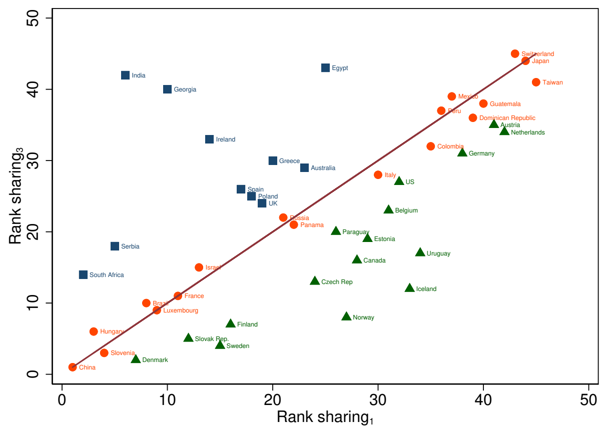
[8] Observed values can be found in Appendix Figure XX.

Figure 5: Countries with flocking and sharing in top and in the bottom of the income distribution

(a) Flocking



(b) Sharing



Notes: The graphs show the most recent estimate of flocking Δ_k^F *and sharing* Δ_k^S *for each country and* $k = 1, 3$*, showing the country's rank on the relevant measure. Countries with* Δ_1^j *rank 4 levels or above the* Δ_3^j *rank* ($j \in \{F, S\}$) *are shown with green triangles, countries with* Δ_3^j *ranks 4 levels of more above the* Δ_1^j *levels with blue squares, and the remaining countries with orange dots.*

mostly present in the top of the income distribution in many highly unequal Latin American countries. In contrast, there is more flocking in the bottom in most European countries – the group of countries that are located close to the 45 degree line have similar flocking in both tails of the distribution.

In Panel (b) of Figure 5 we see how sharing occurs in the top and the bottom of the income distribution. The group of countries with strongest sharing effects at the bottom of the income distribution again seem to be richer countries with a heavy European presence. The group with sharing at the top of the income distribution is a more diverse group.

6 Conclusion

The aim of our discussion is to give an analytical description of unequal leveling. We are far from making causal inference. Yet, we claim that analytical descriptions of the leveling as the net result of sharing and flocking effects are important for understanding the distribution of income in different countries. All countries have a sharing effect, a potential reduction in the individual income inequality obtained by a pairwise random pooling of incomes, capturing how income inequality declines as couples are formed with no systematic matching. The sharing effect contributes to income leveling as long as the two individuals in a couple have different incomes. The flocking effect is the increase in inequality associated with the tendency of equal mating. As birds of a feather flock together, the actual reduction in inequality through the creation of couples becomes lower than the sharing effect, but net leveling is far from zero.

The actual leveling of incomes in the marriage market is highly unequal in countries with either equal mating at the top or at the bottom of the income distribution, and in countries with either *higher inequality* among men, *lower inequality* among women, or both. We also find that that unequal leveling is associated with polarization of the income distribution across households. Countries with a high level of inequality of individual incomes tend to have more flocking in the tails - in particular in the upper tail – implying an increasing distance between rich and poor households and more homogeneity within the groups of rich and poor households.

In the midlle of the income distribution, in contrast, random and equal mating can lead to the same composition of couples for the middle class – what we denote 'the neutral middle'. A neutral middle can in this way be interpreted as a result of the tyranny of equal economic conditions for a double yes in the marriage market. Alternatively, it can be interpreted as an indication of the unimportance of economic factors all together, where instead it is "only similarity of taste and ideas that brings man and an woman together", as Tocqueville said.

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Appendix A Data

The main data used in this paper are taken from the Luxembourg Income Study (LIS).[9] In total, we use 257 surveys from 46 countries spanning the time interval 1967 to 2013. In parts of the study we focus on the most recent data and a selection of 12 focus countries: two middle income developing countries: Brazil and South Africa ; two central European countries: France and Germany; two Eastern European countries Czech republic and Poland; two Scandinavian countries: Norway and Sweden; two South European countries Italy and Spain; two Anglo Saxon countries: UK and US. The LIS variables we use are:

LIS variable name	Definition
`dhi`	Disposable household income
`hxit`	Household income taxes and social security contributions
`pi`	Individual total income
`pil`	Individual labor income
`pxit`	Individual income taxes and social security contributions
`pic`	Individual capital income
`sex`	Sex
`age`	Age in years
`prelation`	Individual relation to household head

The population we consider is the population of couples where both are aged between 25 and 61 at the time of surveying. Other family members are disregarded. To avoid some households with unrealistically low incomes, we only include households with a total disposable income of at least 10 % of the median household disposable income. In most cases, this excludes less than 1 % of the sampled households.

Most of the results reported are based on pre-tax wage income. For robustness we also use disposable income. Individual disposable income is computed as individual total income

[9]See `http://www.lisdatacenter.org/` for details.

minus individual income taxes and social security contributions. For some countries, typically those with joint taxation of couples, we don't have data on couples. In those cases, we have imputed individual taxes as a share of total household taxes, weighted by income shares.

In addition to the LIS data, we also include GDP per capita (`rgdpe`) from the Penn World Tables v8.1, female labor force participation from the World Development Indicators (`SL.TLF.CACT.FE.ZS`), and welfare state generosity coded by Scruggs et al. (2014).

Appendix B Inequality dominance

Let F be an income distribution with mean μ and let the family of rank-dependent measures of inequality be defined by

$$I_P(F) = 1 - \frac{\int P' F^{-1}(t)\ dt}{\mu} = \frac{\int [P(F(x)) - F(x)]\ dx}{\mu} \tag{11}$$

where P is a non-decreasing function with decreasing derivative P', $P(0) = 0$ and $P(1) = 1$ that represents the preferences of the social planner.

Proposition 3. *F_c and F_p denote the distributions of income for couples and spouses and let $I_P(F_p)$ and $I_P(F_c)$ be the associated rank-dependent measure of inequality for any given preference function P. Then we have that*

$$I_P(F_c) \leq I_P(F_p)$$

for all non-decreasing concave P such that $P(0) = 0$ and $P(1) = 1$.

Proof. Let F_h and F_w be the income distributions of husbands and wives.
Since the distribution of spouses incomes are composed of the distributions of husbands and wives income we have that

$$F_p(x) = \frac{F_h(x) + F_w(x)}{2}. \tag{12}$$

Next, inserting for (12) in the numerator of the latter term of equation (11) we get

$$\begin{aligned}&\int \left[P\left(F_p(x)\right) - F_p(x)\right]\ dx = \\ &\frac{1}{2}\sum_{i=h,w}\int \left[P\left(F_i(x)\right) - F_i(x)\right]\ dx + \int \left[P\left(\frac{1}{2}\sum_{i=h,w}F_i(x)\right) - \frac{1}{2}\sum_{i=h,w}P(F_i(x))\right]\ dx\end{aligned} \tag{13}$$

The first term of the right side of expression (13) is non-negative, which follows from the fact that P is a non-decreasing concave function on $[0,1]$. The concavity of P means that

$$P\left(\frac{s+t}{2}\right) > \frac{P(s)+P(t)}{2} \tag{14}$$

From (14) it follows that the latter term of Expression (13) is positive, which implies that

$$\int \left[P(F_p(x)) - F_p(x)\right]\ dx > \frac{1}{2}\sum_{i=h,w}\int \left[P(F_i(x)) - F_i(x)\right]\ dx. \tag{15}$$

By inserting (15) in (11) we get

$$\begin{aligned} I_P(F_p) &> \frac{1}{2\mu_P}\sum_{i=h,w}\int \left[P(F_i(x)) - F_i(x)\right]\ dx \\ &= \frac{\mu_h}{2\mu_p} I_P(F_h) + \frac{\mu_w}{2\mu_p} I_P(F_w), \end{aligned} \tag{16}$$

where μ_h and μ_w are the mean incomes of husbands and wives, and $\mu_h + \mu_w = 2\mu_p$. Next, decomposing inequality in the distribution of income for couples by spouses' incomes yields

$$I_P(F_c) = \frac{\mu_h}{\mu_c}\gamma_h + \frac{\mu_w}{\mu_c}\gamma_w, \tag{17}$$

where μ_c are the mean income of couples, $\mu_c = \mu_h + \mu_w = 2\mu_p$, γ_h and γ_w are the concentration coefficients of husbands and wives (see Rao, 1967). Since $\gamma_h \le I_P(F_h)$ and $\gamma_w \le I_P(F_w)$, where $I_P(F_h)$ and $I_P(F_w)$ are inequality in the distributions of husbands' and wives' incomes, we get from (17) that

$$
\begin{aligned}
I_P(F_c) &= \frac{\mu_h}{\mu_c}\gamma_h + \frac{\mu_w}{\mu_c}\gamma_w \\
&\leq \frac{\mu_h}{\mu_c} I_P(F_h) + \frac{\mu_w}{\mu_c} I_P(F_w) = \frac{\mu_h}{2\mu_p} I_P(F_h) + \frac{\mu_w}{2\mu_p} I_P(F_w)
\end{aligned} \tag{18}
$$

By inserting for (16) in (18) we have $I_P(F_c) < I_P(F_p)$. □

Appendix C Additional estimation results

Table A-1: Decomposition of C_1 and C_3 inequality reduction (leveling) by sharing and flocking

Country	Year	Sharing Δ_S	Flocking Δ_F	Percentage flocking $100 \times \Delta_F/\Delta_S$	Leveling $\Delta_S - \Delta_F$
A. C_1 inequality					
Brazil	2013	.14	.044	32	.093
Czech Rep	2010	.17	.047	29	.12
Germany	2010	.18	.019	10	.16
Spain	2013	.15	.04	27	.11
France	2010	.15	.05	34	.099
Italy	2010	.16	.037	23	.12
Norway	2010	.16	.036	23	.12
Poland	2013	.15	.039	26	.11
Sweden	2005	.15	.039	27	.11
UK	2013	.16	.043	27	.11
US	2013	.15	.023	15	.13
South Africa	2012	.097	.032	33	.065
B. C_3 inequality					
Brazil	2013	.14	.048	35	.089
Czech Rep	2010	.12	.029	24	.091
Germany	2010	.15	.014	9	.14
Spain	2013	.15	.04	28	.11
France	2010	.12	.034	28	.089
Italy	2010	.14	.028	21	.11
Norway	2010	.1	.018	18	.084
Poland	2013	.14	.032	23	.1
Sweden	2005	.095	.024	25	.072
UK	2013	.13	.026	20	.1
US	2013	.12	.017	14	.11
South Africa	2012	.14	.049	35	.093

Notes: The table shows the actual leveling effect of coupling on inequality ($C_p - C_r$), decomposed as a sharing effect ($\Delta_S = C_p - C_r$) minus a flocking effect ($\Delta_F = C_c - C_r$).

Table A-2: Flocking for different measures of inequality

	C_1			C_2			C_3		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. Household inequality									
Inequality, hh	0.0161	0.574***	0.318***	0.0606**	0.437***	0.324***	0.0808***	0.364***	0.292***
	(0.55)	(2.94)	(4.08)	(2.43)	(3.13)	(5.97)	(3.63)	(2.97)	(5.12)
Inequality hh, squared		-0.457***	-0.211***		-0.397***	-0.241***		-0.355**	-0.229***
		(-2.99)	(-3.27)		(-2.74)	(-4.45)		(-2.28)	(-3.26)
Log GDP			0.00212			0.000674			-0.000228
			(1.36)			(0.43)			(-0.15)
Female/male income ratio			0.0907***			0.0782***			0.0651***
			(14.97)			(18.33)			(17.86)
Turning pt.		0.628	0.755		0.549	0.672		0.513	0.637
Obs.	253	253	242	253	253	242	253	253	242
R2	0.00656	0.0761	0.698	0.124	0.203	0.709	0.243	0.307	0.719
B. Inequality by gender									
Inequality, men	0.138***	0.701***	0.411***	0.137***	0.450***	0.207**	0.135***	0.344***	0.129
	(6.15)	(4.28)	(3.00)	(7.42)	(3.94)	(2.10)	(7.95)	(3.26)	(1.47)
Inequality, women	-0.137***	0.0408	-0.00445	-0.0704***	0.00554	0.104***	-0.0457***	0.000552	0.126***
	(-8.74)	(0.27)	(-0.04)	(-6.29)	(0.09)	(2.79)	(-4.86)	(0.01)	(4.33)
Inequality men, squared		-0.436***	-0.295***		-0.312**	-0.171*		-0.249*	-0.106
		(-3.45)	(-3.05)		(-2.67)	(-1.97)		(-1.90)	(-1.10)
Inequality women, squared		-0.115	0.0167		-0.0560	-0.0381		-0.0373	-0.0581**
		(-1.15)	(0.20)		(-1.07)	(-1.17)		(-0.99)	(-2.56)
Log GDP			0.000739			-0.000463			-0.00116
			(0.46)			(-0.30)			(-0.79)
Female/male income ratio			0.0936***			0.103***			0.0958***
			(6.75)			(7.02)			(6.85)
Turning pt., men		0.805	0.697		0.720	0.604		0.691	0.610
Turning pt., women		0.178	0.133		0.0495	1.370		0.00740	1.085
Obs.	253	253	242	253	253	242	253	253	242
R2	0.486	0.551	0.669	0.416	0.477	0.669	0.417	0.459	0.688

Notes: The Table reports measures of flocking by the C_i measures using (pre-tax) wage earnings. "Inequality" refers to the corresponding C_i measure on household and individual income inequality among men and women respectively. "Turning pt." indicates the estimated turning point for the quadratic relationship.
*t-values based on standard errors clustered at the country level reported in parentheses, and *, **, and *** denotes significance at the 10, 5, and 1 percent level.*

Table A-3: Sharing for different measures of inequality

	C_1			C_2			C_3		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A. Household inequality									
Inequality, hh	-0.208***	0.381	0.681***	-0.0224	0.375	0.594***	0.0748*	0.324	0.483***
	(-5.96)	(1.23)	(3.22)	(-0.53)	(1.23)	(3.57)	(1.73)	(1.08)	(3.25)
Inequality hh, squared		-0.482**	-0.767***		-0.420	-0.731***		-0.312	-0.625***
		(-2.09)	(-4.57)		(-1.47)	(-4.28)		(-0.93)	(-3.46)
Log GDP			-0.000826			-0.000909			-0.00158
			(-0.48)			(-0.31)			(-0.49)
Female/male income ratio			-0.116***			-0.169***			-0.175***
			(-7.09)			(-7.53)			(-8.25)
Turning pt.		0.395	0.444		0.446	0.406		0.519	0.386
Obs.	253	253	242	253	253	242	253	253	242
R2	0.403	0.432	0.799	0.00475	0.0296	0.709	0.0459	0.0568	0.724
B. Inequality by gender									
Inequality, men	-0.404***	-0.515**	-0.588**	-0.280***	-0.268*	-0.331**	-0.208***	-0.172	-0.199*
	(-16.01)	(-2.52)	(-2.53)	(-10.73)	(-1.87)	(-2.28)	(-9.09)	(-1.39)	(-1.68)
Inequality, women	0.174***	0.954***	0.987***	0.230***	0.582***	0.598***	0.232***	0.439***	0.438***
	(9.54)	(6.14)	(5.98)	(13.92)	(6.11)	(6.66)	(17.40)	(6.86)	(7.30)
Inequality men, squared		0.0883	0.164		-0.00500	0.0948		-0.0342	0.0489
		(0.57)	(0.95)		(-0.04)	(0.68)		(-0.24)	(0.37)
Inequality women, squared		-0.516***	-0.544***		-0.276***	-0.300***		-0.183***	-0.200***
		(-4.80)	(-4.40)		(-3.39)	(-3.51)		(-2.97)	(-3.22)
Log GDP			0.00315**			0.00513***			0.00479**
			(2.26)			(2.73)			(2.45)
Female/male income ratio			-0.0119			-0.0179			-0.0236
			(-0.76)			(-0.87)			(-1.30)
Turning pt., men		2.918	1.798		-26.77	1.747		-2.519	2.037
Turning pt., women		0.925	0.906		1.054	0.999		1.202	1.097
Obs.	253	253	242	253	253	242	253	253	242
R2	0.845	0.890	0.890	0.786	0.826	0.839	0.811	0.836	0.850

Notes: The Table reports measures of sharing by the C_i measures using (pre-tax) wage earnings. "Inequality" refers to the corresponding C_i measure on household and individual income inequality among men and women respectively. "Turning pt." indicates the estimated turning point for the quadratic relationship.
*t-values based on standard errors clustered at the country level reported in parentheses, and *, **, and *** denotes significance at the 10, 5, and 1 percent level.*

Appendix D Appendix on ...

Aggregating the measures that we have considered, we vary the weights on observations at different parts of the distribution, distinguishing between upper tail sensitive measures and lower tail sensitive measures. With these measures we are able to classify countries with more flocking and less sharing in either the upper tail or the lower tail of the distribution. First, however, we must clarify what we mean by higher inequality in the couples' distribution in situations where we do not alter the individual distributions of men and women.

Appendix D.1 Correlation-increasing transfers and flocking curve dominance

In our assessment of unequal leveling we cannot claim that the lower of two non-intersecting flocking curves (or sharing curves) exhibits less inequality by relying on the conventional Pigou-Dalton's principle of transfers. The randomly matched benchmark distributions are constructed under the assumption that the individual distributions remain fixed – hence, we need to incorporate a more restrictive transfer principle that fits our case.

Obviously, bivariate distributions with fixed marginal distributions can solely be altered by interventions that affect the association between the two variables in question. This kind of distribution-preserving transfers that increase the correlation between husbands' and wives' income, fits nicely to normatively assess flocking-together-inequality (and sharing).

Since flocking curves might intersect we must introduce weaker dominance criteria than first-degree dominance. For this purpose we employ the "dual approach" by Yaari (1987, 1988). Let $p(u)$ be a weight function which is non-negative and non-increasing, and has $p(1) = 0$. Consider then $\int_0^1 p(u)F^{-1}(u)du$ that can be interpreted as a social welfare function. It takes its maximum value μ when incomes are equally distributed. By this measure the cost of inequality (relative to full equality) is $J_p = [\mu - \int_0^1 p(u)F^{-1}(u)du]/\mu$. Using the definition of the normalized Lorenz curve $L(u)/u$ in this expression, we can, by partial integration

Table A-4: Inequality by individual (marginal) inequality

	C_p			C_r			C_c		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
C_1 inequality									
Inequality, men	0.357***	-0.0708	-0.0211	0.761***	0.445***	0.567***	0.900***	1.146***	0.978***
	(28.70)	(-0.64)	(-0.21)	(38.01)	(3.20)	(3.71)	(30.46)	(6.17)	(4.53)
Inequality, women	0.558***	0.689***	0.831***	0.384***	-0.265*	-0.156	0.247***	-0.224	-0.160
	(60.90)	(7.61)	(12.11)	(24.78)	(-1.96)	(-1.26)	(12.02)	(-1.33)	(-0.93)
Inequality men, squared		0.332***	0.342***		0.244**	0.178		-0.192	-0.117
		(4.09)	(4.57)		(2.26)	(1.52)		(-1.32)	(-0.74)
Inequality women, squared		-0.0885	-0.248***		0.427***	0.296***		0.313***	0.313**
		(-1.54)	(-5.06)		(4.51)	(3.13)		(2.69)	(2.37)
Log GDP			-0.000366			-0.00351***			-0.00277
			(-0.50)			(-3.52)			(-1.44)
Female/male income ratio			-0.0638***			-0.0518***			0.0418**
			(-6.62)			(-5.03)			(2.40)
Turning pt., men		0.107	0.0309		-0.912	-1.592		2.985	4.189
Turning pt., women		3.891	1.676		0.310	0.263		0.359	0.256
Obs.	253	253	242	253	253	242	253	253	242
R2	0.993	0.994	0.997	0.987	0.993	0.994	0.979	0.981	0.983
C_2 inequality									
Inequality, men	0.441***	0.178*	0.291***	0.721***	0.446***	0.622***	0.858***	0.896***	0.830***
	(37.74)	(1.94)	(6.59)	(30.48)	(5.11)	(5.26)	(28.58)	(6.10)	(4.47)
Inequality, women	0.486***	0.603***	0.577***	0.256***	0.0213	-0.0219	0.186***	0.0269	0.0825
	(64.89)	(10.67)	(19.12)	(16.85)	(0.26)	(-0.33)	(10.42)	(0.32)	(0.96)
Inequality men, squared		0.266***	0.236***		0.271***	0.141		-0.0412	-0.0301
		(3.12)	(6.05)		(3.00)	(1.21)		(-0.27)	(-0.17)
Inequality women, squared		-0.0947**	-0.158***		0.181**	0.142**		0.125	0.104
		(-2.25)	(-6.25)		(2.41)	(2.12)		(1.67)	(1.23)
Log GDP			0.000265			-0.00486***			-0.00532**
			(0.38)			(-3.43)			(-2.41)
Female/male income ratio			-0.0911***			-0.0732***			0.0295
			(-8.23)			(-4.78)			(1.43)
Turning pt., men		-0.335	-0.616		-0.823	-2.203		10.89	13.76
Turning pt., women		3.185	1.827		-0.0588	0.0772		-0.107	-0.398
Obs.	253	253	242	253	253	242	253	253	242
R2	0.992	0.993	0.998	0.982	0.987	0.990	0.979	0.980	0.981
C_3 inequality									
Inequality, men	0.507***	0.288***	0.431***	0.715***	0.460***	0.630***	0.850***	0.804***	0.759***
	(42.84)	(3.46)	(11.05)	(30.97)	(6.00)	(6.70)	(27.79)	(6.29)	(4.77)
Inequality, women	0.434***	0.554***	0.465***	0.202***	0.115*	0.0272	0.156***	0.116*	0.153**
	(57.33)	(11.98)	(23.08)	(14.55)	(1.92)	(0.59)	(9.52)	(1.95)	(2.43)
Inequality men, squared		0.268***	0.204***		0.302***	0.156		0.0533	0.0494
		(2.87)	(5.13)		(3.19)	(1.44)		(0.34)	(0.27)
Inequality women, squared		-0.110***	-0.124***		0.0723	0.0756		0.0351	0.0175
		(-2.76)	(-7.13)		(1.13)	(1.43)		(0.57)	(0.26)
Log GDP			0.000485			-0.00431***			-0.00547**
			(0.66)			(-3.06)			(-2.48)
Female/male income ratio			-0.0966***			-0.0730***			0.0228
			(-9.02)			(-4.75)			(1.20)
Turning pt., men		-0.537	-1.054		-0.762	-2.025		-7.546	-7.684
Turning pt., women		2.514	1.876		-0.797	-0.180		-1.653	-4.371
Obs.	253	253	242	253	253	242	253	253	242
R2	0.992	0.992	0.998	0.982	0.985	0.988	0.979	0.979	0.981

(with $L(0) = p(1) = 0$), express the cost of inequality as

$$J_p(L) = 1 + \int_0^1 up'(u)\frac{L(u)}{u}du \tag{19}$$

where $p'(u)$ is the derivative of the weight function. Finally, by replacing the normalized Lorenz curve $L(u)/u$ by the the flocking curve $\Gamma_L(u)$ in (19) we obtain the following family of flocking together measures

$$\Delta_p(L) = \int_0^1 up'(u)\Gamma_L(u)du = J_p(L_r) - J_p(L) \tag{20}$$

To provide a normative justification for flocking curve dominance and the summary measures defined by (20) it is convenient to introduce the following definition:

Definition 1. *A flocking curve Γ_1 is said to dominate the flocking curve Γ_2 if*

$$\Gamma_1(u) \leq \Gamma_2(u) \quad \text{for all} \quad u \in [0, 1]$$

and the inequality holds strictly for some $u \in (0, 1)$.

To define the concept of *correlation-increasing transfers* introduced by Boland and Prochan (1988) consider a multidimensional distribution H_2. If it can be obtained from a multidimensional distribution H_1 by a finite sequence transfers (keeping the marginal distributions fixed) that increase the correlation between dimensions, then H_1 exhibits lower inequality than H_2.

Let the distribution H_1 of couples' incomes be defined by $y = (y_1, y_2, ..., y_n)$, where $y_1 \leq y_2 ... \leq y_n$ and $y_i = x_{i1} + x_{i2}$ and x_{i1} and x_{i2} are the incomes of the husband and wife in couple $i = 1, 2, ..., n$.

Further,

- let couple s have higher income than couple j, that is $y_j < y_s$,
- let the husband in couple s have higher income than the husband in couple j, that is

$x_{j1} < x_{s1}$

- let the wife of couple s have lower income than the wife of couple j, that is $x_{j2} > x_{s2}$

Then H_1^* is obtained from H_1 by a distribution-preserving correlation-increasing transfer. as long as the distribution H_1^* is defined by $y = (y_1^*, y_2^*, ..., y_n^*)$, where $y_j^* = \min(x_{j1}, x_{s1}) + \min(x_{j2}, x_{s2})$, $y_s^* = \max(x_{j1}, x_{s1}) + \max(x_{j2}, x_{s2})$ and $y_i^* = y_i$ for all $i \neq j, s$.

Proposition 4. *Let Γ_{L1} and Γ_{L2} be members of the family of inequality associated flocking curves, defined by (3). Then the following statements are equivalent,*

(i) $\Gamma_{L1}(u)$ first-degree dominates $\Gamma_{L2}(u)$, meaning $\Gamma_{L1}(u) \leq \Gamma_{L2}(u)$ for all $u \in [0, 1]$

(ii) $\Gamma_{L2}(u)$ can be obtained from $\Gamma_{L1}(u)$ by a sequence of correlation-increasing transfers

(iii) $\Delta_p(L1)) < \Delta_p(L2)$ for all positive non-increasing p

Proof. See appendix □

Skrive ut bevis – the prooof for sharing is similar???

We can use these properties when we now move to the ranking of tail-sensitive measures.