Distribution of Wealth and Interdependent Preferences

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ABSTRACT

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We examine the socially optimal wealth distribution in a two-person two-good model with heterogeneous workers and asymmetric social interactions where only one (social) individual derives positive or negative utility from the leisure of the other (non-social) individual. We show that the interdependence can effectively counter-act the need to transfer wealth to low-wage individuals and may require them to be poorer by all objective measures. We demonstrate that in the presence of social interactions it can be socially desirable to keep substantial wealth inequality.

JEL Classification: D31, D63

Keywords: wealth inequality, earnings inequality, social welfare, social interactions

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1. Introduction

The traditional trade-off discussed in economics is between equity and efficiency. The free market may help best allocate resources but also generates higher inequality of incomes. Thus, the notion of equity-efficiency trade-off implicitly assumes that higher equality of incomes may improve welfare. The government may in turn be tempted to affect total income inequality through lowering wealth inequality (as opposed to reducing earnings inequality), because it does not directly affect incentives to invest in human capital. Here we provide another argument why one needs to be careful in providing greater wealth equality when there are social interactions present. We show that under asymmetric positive (altruism) or negative (envy) social interactions there are reasonable cases where wealth inequality is desirable for higher social welfare.

The benefits of unequal incomes has been shown in the context of different risk aversion (Pestieau et al. 2002), uncertain incomes (Kreider 2003), and subjective levels of welfare (Alesina and La Ferrara, 2001). Further, in certain circumstances identical households may not necessarily be treated equally at the social welfare optimum (Mirrlees 1972, White 1981). The intuition behind the unequal treatment result is that there may be different resource costs of making various households equally well off. We extend the literature on evaluation of economic inequality by introducing social interactions, which have been shown to affect social welfare (Bernheim and Stark 1988, Kooreman and Schoonbeek 2004) and provide explanation for a greater concentration of wealth than labor earnings (De Nardi 2004).

We model heterogeneous agents in terms of wage distribution and introduce

asymmetric social interactions where only one individual is either altruistic or envious. For simplicity, we use a quasi-linear utility function and assume an economy with two workers and two goods (leisure and consumption). The results suggest that when workers have different wages it is optimal to redistribute wealth from high-wage workers to low-wage workers. When workers have the same wages but one individual is social, the optimal wealth distribution suggests taking wealth away from the individual who derives more utility from wealth when given the same resources (with negative social interactions -- from the non-social individual; with positive social interactions -- from the social individual). However, when low-wage individuals are altruistic or high-wage individuals are envious, we demonstrate that there are cases where it may be welfare-improving to increase wealth inequality by redistributing wealth from low-wage (low-earnings) individuals to high-wage (high-earnings) individuals.

2. Organizing Model

We begin with a two-worker, two-good economy where each worker has the same individual preferences for consumption and leisure. Heterogeneity of agents comes in via differences in wages. Social interactions are introduced to only one individual's preferences similarly to the approach in Brock and Durlauf (2001), where in addition to his or her individual utility the worker has a social portion in total utility. Social utility represents the fact that one cares for the other person's leisure. The simple setup allows for group distinctions such as selfish young vs. altruistic old or envious rich vs. altruistic poor.

Our approach is different from the standard general equilibrium framework where the social planner maximizes social welfare by choosing particular combinations of

3

consumption and leisure for each individual, and where wealth is treated as an exogenous endowment. In the following setup the social planner redistributes total wealth (Y) between two workers to maximize social welfare (W) subject to the population wealth constraint, where each worker individually maximizes utility subject to the individual budget constraint. The approach has been used in Moreno-Tenero and Roemer (2006).

Formally, the model can be represented as

$$\max_{Y_1,Y_2} W = W\left(V_1\left(c_1^*,l_1^*;\beta,S\left(l_2^*;\delta\right)\right),V_2\left(c_2^*,l_2^*;\beta\right)\right) \tag{1a}$$

$$\text{st.} \quad Y = Y_1 + Y_2 \quad \text{population wealth constraint,} \tag{1b}$$

where subscripts index the worker, c is consumption of the generic good, l is leisure, $(\ )^*$ indicates the utility-maximizing choice for each individual of consumption and leisure, Y is wealth, S is social utility (which represents social interactions), V stands for total individual utility, W is the social welfare function (SWF), and β, δ are parameters. The social planner chooses a combination of wealth (Y_1, Y_2) that maximizes social welfare (1a) subject to the individual maximization conditions and the population wealth constraint (1b).

The social maximization condition requires that the social welfare function (SWF) marginal rate of substitution equals minus the slope of the utility possibility frontier

$$W_{V_1} / W_{V_2} = -dV_1 / dV_2, \tag{2}$$

where W_{V_1} and W_{V_2} represent marginal social utilities with respect to individual utilities. Because the distribution is done with respect to wealth, there is no clear relation of the ratio in (2) to a particular wealth distribution. Therefore we want to restate the condition in wealth space as

$$W_{Y_1} / W_{Y_2} = -dY_1 / dY_2 = 1 \tag{3}$$

because the budget constraint is a straight line with the slope of negative one. By representing the SWF (1a) as an indirect social welfare function in w and Y, and considering that condition (3) must be satisfied for the solution of the optimization problem (3) given $(w_1, w_2, \beta, \delta)$, we have

$$\left(W_{V_1} \frac{\partial V_1(w_1, Y_1^{**})}{\partial Y_1} \right) \Bigg/ \left(W_{V_2} \frac{\partial V_2(w_2, Y_2^{**})}{\partial Y_2} + W_{V_1} \frac{\partial V_1}{\partial S} \frac{\partial S(w_2, Y_2^{**})}{\partial Y_2} \right) = 1. \tag{4}$$

where $\left(Y_1^{**}, Y_2^{**} \right)$ is the wealth distribution at the social optimum. Notice that due to social interactions the marginal utility of wealth for the second individual is altered by

$W_{V_1} \dfrac{\partial V_1}{\partial S} \dfrac{\partial S(w_2, Y_2^{**})}{\partial Y_2}$ because the leisure of the second worker affects the first worker's

utility.

Suppose there are no social interactions, then $W_{V_1} \dfrac{\partial V_1}{\partial S} \dfrac{\partial S(w_2, Y_2^{**})}{\partial Y_2} = 0$. For the

social optimum to be at an equal wealth distribution, that is $Y_1^{**} = Y_2^{**}$, either wages have

to be the same $(w_1 = w_2)$, or there is no income effect due to a change in wages

$(dY_i / dw_i = 0)$. Both assumptions are special cases so that wage heterogeneity should

generally result in an unequal optimal distribution of wealth.

By the same token, when there are social interactions but wages are equal

$(w_1 = w_2)$, the optimum in (4) holds only when $\dfrac{\partial S(w_2, Y_2^{**})}{\partial Y_2} = 0$. The effect of income on

social utility is zero only when the second worker's demand for leisure is not affected by

income $\left(dl_2^* / dY_2 \right)$, which again is a (very) special case.

So, in general, both wage dispersion and social interactions should produce unequal wealth distribution at the social optimum. Only when the effects exactly counteract each other is there a possibility of an equal wealth distribution, which we again note needs to be regarded as a special case.

3. An Example of Asymmetric Social Interactions

We now demonstrate the implications of the model in a case with additive, equal weights in the Social Welfare Function and quasi-linear underlying individual utility functions. Here the social utility enters into preferences of one individual additively. Our choice of the utilitarian SWF is to make individuals be treated equally by the social planner and prefer equal distribution of utility (not wealth). Our choice of additive social interactions ensures that the model does not overemphasize the effect of interdependence on individual demands. The simple setup maximizes tractability of the model while maintaining the avenue for social interactions.

We define asymmetric interactions as when only one individual responds to the behavior of the other individual, such as in

$$u_1 = \beta_c \sqrt{c_1} + \beta_l \sqrt{l_1} + \delta_l \sqrt{l_2} \tag{5a}$$
$$u_2 = \beta_c \sqrt{c_2} + \beta_l \sqrt{l_2}, \tag{5b}$$

Where once again c is consumption of the generic good, l is leisure, T is total available time, w is the wage rate (price of consumption is 1 and is taken as the numeraire), Y is a non-labor income, and β_c, β_l, δ_l are parameters.[1] Note that $(T - l)$ represents labor supply and $w(T - l)$ is total earnings. The utility function in (5) has the property that

even though it is quasi-linear, the utility possibility frontier is still convex. Finally, each individual faces a similar budget constraint

$$c_i + w_i l_i = w_i T + Y_i, \; i = 1, 2 \tag{6}$$

where i indexes the individual ($i = 1, 2$).

The parameter δ_l represents the effect of social interactions.[2] When $\delta_l > 0$ we can think about the altruistic behavior of the first individual with respect to the second individual (a spouse cares for the partner's leisure or parents care for leisure of their offspring), but when $\delta_l < 0$ we can think about envious behavior (in the family setting, siblings compete over how much attention they are given by their parents because attention translates into higher levels of quality for leisure time).

The demands for both individuals are the same:

$$c_i = \left(w_i T + Y_i \right) P_{c_i} \tag{7a}$$
$$l_i = \left(w_i T + Y_i \right) P_{l_i}, \tag{7b}$$

where $P_{c_i} = 1 / \left(1 + \beta_l^2 / \left(\beta_c^2 w_i \right) \right)$ and $P_{l_i} = 1 / \left(w_i \left(1 + \left(\beta_c^2 w_i \right) / \beta_l^2 \right) \right)$.

However, the indirect utility functions become

$$V_1 = \sqrt{\left(w_1 T + Y_1 \right)} \left(\beta_c \sqrt{P_{c_1}} + \beta_l \sqrt{P_{l_1}} \right) + \delta_l \sqrt{\left(w_1 T + Y_2 \right) P_{l_2}} \text{ and} \tag{8a}$$

$$V_2 = \sqrt{\left(w_2 T + Y_2 \right)} \left(\beta_c \sqrt{P_{c_2}} + \beta_l \sqrt{P_{l_2}} \right). \tag{8b}$$

The problem for the benevolent planner is to maximize the social welfare function subject to the population wealth constraint defined by wealth limits $\left(Y = Y_1 + Y_2 \right)$ and requirement for individuals to maximize their utility (8a and 8b). The optimal allocation of wealth now becomes

$$Y_1 = \left((Y + w_2 T) - P^2 w_1 T \right) / \left(P^2 + 1 \right) \tag{9a}$$

$$Y_2 = \left(P^2 (Y + w_1 T) - w_2 T \right) / \left(P^2 + 1 \right) \tag{9b}$$

where $P = \left(\beta_c \sqrt{P_{c_2}} + (\beta_l + \delta_l) \sqrt{P_{l_2}} \right) / \left(\beta_c \sqrt{P_{c_1}} + \beta_l \sqrt{P_{l_1}} \right)$.

4. Simulation Experiments

Similar to De Nardi (2004), who draws meaningful conclusions when examining the evolution of wealth in a model with bequests through simulation experiments, we discuss implications of our model by setting particular parameter values and performing numerical calculations. In what follows we do not prove that wealth inequality is generally desired, or find conditions for such a situation, or even try to match the U.S. economy's distributions of wealth, earnings, or total income. The goal of our research is to provide cases demonstrating the basic result that when social interactions are present it may be beneficial to redistribute wealth away from low-income individuals, even when it makes them poorer by any objective measure. Because we only attempt to prove the existence of this somewhat counter-intuitive result, it is enough to demonstrate several plausible cases.

In the spirit of the calibration exercise in Grodner and Kniesner (2006) we choose $\beta_c = 0.0492$, $\beta_l = 0.0466$, and $\delta = 0,01$ (altruistic individual) or -0.01 (envious person). Wages range from 0.65 to 0.90 and the total wealth to be distributed equals 1466. In the discussion below we label workers as [1] or [2] where the square brackets distinguish the labels for workers from those of equation numbers. Each table fixes the characteristics for worker [2] and changes either the wage or intensity of social interactions for worker [1], which are presented in the far left column. The numbers inside the tables are ratios of

incomes or utilities for worker [1] versus worker [2]. Income stands for total income and equals wealth plus earnings, which are measured by wage times hours worked. For comparison, the results on the left in each table are for an equal distribution of wealth, and results on the right represent optimal distributions of wealth, which maximize social welfare.

4.1 Wage Heterogeneity

Table 1 presents the comparative outcomes where wages differ. With wage equality, $w_1 = w_2 = 0.77$, we have the baseline case for which wealth is distributed equally between individuals at the social optimum. It is the trivial case where the all the choices are symmetric for two individuals.

As the wage for individual [1] increases the social planner needs to take away wealth from the high-wage worker [1] and distribute it to the low-wage worker [2]. It can be seen in equations (9a) and (9b), when we set $P = 1$ (no social interactions). The intuition is that the marginal utility of wealth for the low-wage worker [2] is higher than the marginal utility of wealth for the high-wage worker [1]. It is then beneficial to transfer wealth to the person whose utility experiences the greater gain due to the transfer. However, there is still equality of total income because the high-wage individual [1] makes up for lower levels of wealth by having higher earnings. The result recasts the long-standing equity-efficiency tradeoff whereby an increase in the inequality of wealth or income creates less inefficiency in the ultimate utility (efficient) outcome.

4.2 Social Interactions

Table 2 presents results with social interactions when wages are equal. The optimal distribution of wealth has the altruistic ($\delta > 0$ and $P > 1$) individual [1] receiving

9

less wealth. The result can be seen in equation (8a) where the social individual [1] derives positive utility from wealth of the non-social individual [2] and needs to make up for the difference with higher earnings. Again, the social planner needs to transfer wealth to the non-social individual [2] for whom the marginal utility of wealth is higher to increase total welfare. However, notice that in all cases the social individual has more utility and by objectives measures it is hard to tell who is better off.

The results can also be seen from studying equations (9a) and (9b). When there are no social interactions, $P = 1$ and the solution is symmetric. When the social individual is altruistic $\delta > 0$, we have $P > 1$, and thus $P^2 > 1$. Then there are two effects why the non-social individual needs to have more wealth: $Y_2 > Y_1$ because (i) in the outcome equation for Y_2, $P^2 Y > Y$, which is a pure wealth effect, and because (ii) $wT(P^2 - 1) > 0 > wT(1 - P^2)$, which is an earnings effect. When the social individual is envious $\delta < 0$, and we have $P < 1$ and $P^2 < 1$. Then there are two effects why the non-social individual needs to have less wealth: $Y_1 > Y_2$ because (i) in the outcome equation for Y_2, $P^2 Y < Y$, which is a pure wealth effect, and because (ii) $wT(P^2 - 1) < 0$, which is an earnings effect. We can also see it as a "make up" for a lower marginal utility of earnings of the social individual, which needs to be compensated with wealth, because in the outcome equation for Y_1 we have $wT(1 - P^2) > 0$. The earnings distribution is primarily determined by wages because even with social interactions the demands for consumption and leisure are the same (7a and 7b).

4.3 Wage Heterogeneity Plus Social Interactions

So far the individual from whom it was beneficial to transfer away wealth is no

worse off either by having equal total income (in the case of wage heterogeneity) or by having higher earnings (in the case of social interactions). Now we turn to the case where an individual can be worse off in both objective measures, and yet be better off in terms of welfare.

Table 3.1 presents the case of an altruistic individual [1] who has low wages (below 0.8702, which is the wage for the high-wage worker [2]). Notice that for wages below 0.75 the low-wage worker [1] has more wealth because the wage heterogeneity effect (transfer wealth to [1]) dominates the social interactions effect (transfer wealth from [1]). However, in the range of wages 0.77–0.8702 the low-wage, altruistic worker [1] has both lower wealth and lower earnings but yet higher utility. Table 3.2 demonstrates a similar case with a high-wage, non-social worker having more wealth and earnings and yet lower utility.

4.4 Summary

We have demonstrated the existence of the case where in the presence of low wage inequality it may be beneficial for society to transfer wealth away from altruistic, low-wage workers towards non-social high-wage workers. The result is non-trivial because by objective measures of economic equality (wealth, earnings) one individual is worse off, and yet that worker is better off in terms of utility level. The intuition is that with social interactions the efficiency-equity tradeoff no longer determines the effect of transfers on well-being. Our simulations underscore the importance of incorporating social interactions when studying the policies affecting the distributions of wealth and earnings.

5. Conclusion and Policy Implications

We have presented a model with two heterogeneous individuals deriving utility from consumption and leisure where one of them receives utility from the other's leisure (asymmetric interactions). The presence of a high level of wage dispersion suggests a higher wealth inequality and also higher earnings inequality at the social optimum, so that both distributions have compensating effects that result in equality of total income. When there is interdependence, inequality of wealth may be desirable because it reduces inequality of utility. When there is both wage inequality and utility interdependence then there is a possibility of wealth equality as well as any form of wealth inequality -- it depends on the inter-play of the wage heterogeneity and social interactions effects.

The results of our numerical simulations demonstrate that under limited wage inequality it may be beneficial for society to transfer wealth away from altruistic, low-wage workers. The economically regressive transfer is socially optimal even though by the objective measures of economic well-being (wealth or earnings) the low-wage individual has less resources, while the other individual is worse off in terms of utility. This underlines the importance of considering social interactions when studying the policies affecting distribution of income.

We do not argue that the results of our simulations imply that wealth inequality is always beneficial for a society with unequal wages and social interactions. Rather, we point out the possibility of wealth and income inequalities that maximize social welfare because social interactions in utility can potentially mitigate the adverse effects of economic inequality. In some circumstances optimal inequality creates an outcome that is desirable from a social welfare perspective because it reduces inequality of utility. In the

presence of social interactions the redistribution should be from high-utility individuals to low-utility individuals. A just society may be willing to perform such a redistribution and also regard it as fair. For any sensible policy, though, it will be critical to identify correctly the high-utility individuals, who may either be social or non-social, and that will be a formidable task.

Table 1. Effect of heterogenous wage on the optimal distribution of wealth.

(total wealth always equals 1466, **wage for worker 2 is 0.77**, and ratios indicate how much more (or less) the worker 1 has relative to worker 2)

		Equal wealth distribution				Optimal wealth distribution				% welfare
		Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	loss due to equality
Wage for worker 1	0.6500	1.000	0.695	0.788	0.976	8.578	0.416	1.000	1.099	-0.178%
	0.7000	1.000	0.820	0.875	0.986	2.686	0.639	1.000	1.054	-0.056%
	0.7500	1.000	0.948	0.964	0.996	1.298	0.890	1.000	1.014	-0.004%
	0.7700	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**0.000%**
	0.8000	1.000	1.079	1.055	1.006	0.676	1.177	1.000	0.980	-0.009%
	0.8500	1.000	1.212	1.147	1.017	0.324	1.509	1.000	0.949	-0.059%
	0.9000	1.000	1.347	1.242	1.028	0.096	1.897	1.000	0.922	-0.146%

Table 2. Effect of social interactions in worker 1 on the optimal distribution of wealth.

(total wealth always equals 1466, wage for both workers is 0.77, and ratios indicate how much more (or less) the worker 1 has relative to worker 2)

		Equal wealth distribution				Optimal wealth distribution				% welfare
		Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	loss due to equality
Delta for worker 1	-0.0100	1.000	1.000	1.000	0.884	14.314	0.660	1.278	1.015	-0.187%
	-0.0050	1.000	1.000	1.000	0.942	2.466	0.819	1.126	1.004	-0.044%
	-0.0010	1.000	1.000	1.000	0.988	1.180	0.962	1.024	1.000	-0.002%
	0.0000	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**0.000%**
	0.0010	1.000	1.000	1.000	1.012	0.849	1.039	0.977	1.000	-0.002%
	0.0050	1.000	1.000	1.000	1.058	0.429	1.208	0.894	1.003	-0.039%
	0.0100	1.000	1.000	1.000	1.116	0.127	1.447	0.804	1.012	-0.149%
	0.0120	1.000	1.000	1.000	1.139	0.042	1.553	0.771	1.017	-0.209%

Table 3.1. Effect of heterogenous wage and social interactions in worker 1 on the optimal distribution of wealth.

Positively social individual is a low wage worker (detla = 0.01, wage for non-social worker [2] = 0.8702)

		Equal wealth distribution				Optimal wealth distribution				% welfare
		Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	loss due to equality
Wage for worker 1	0.6500	1.000	0.549	0.665	1.064	5.793	0.362	0.813	1.166	-0.126%
	0.7000	1.000	0.647	0.738	1.074	**2.073**	**0.546**	**0.813**	1.122	-0.029%
	0.7500	1.000	0.749	0.813	1.084	**1.000**	0.749	0.813	1.084	0.000%
	0.7700	1.000	0.790	0.844	1.088	0.758	0.835	0.813	1.070	-0.004%
	0.8000	1.000	0.852	0.890	1.094	0.489	0.973	0.813	1.051	-0.025%
	0.8500	1.000	0.957	0.968	1.105	0.190	1.224	0.813	1.022	-0.095%
	0.9000	1.000	1.064	1.048	1.115	-0.007	1.507	0.813	0.996	-0.200%

Table 3.2. Effect of heterogenous wage and social interactions in worker 1 on the optimal distribution of wealth.

Negatively social individual is a high wage worker (delta = -0.01, wage for non-social worker [2] = 0.66319)

		Equal wealth distribution				Optimal wealth distribution				% welfare
		Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	Wealth 1 / Wealth 2	Earnings 1 /Earnings 2	Income 1 /Income 2	Utility 1 /Utility 2	loss due to equality
Wage for worker 1	0.6500	1.000	0.955	0.972	0.874	19.423	0.488	1.301	1.031	-0.265%
	0.7000	1.000	1.127	1.079	0.884	**3.963**	**0.767**	**1.301**	0.983	-0.109%
	0.7500	1.000	1.303	1.189	0.894	1.843	1.094	1.301	0.941	-0.025%
	0.7700	1.000	1.374	1.234	0.899	1.431	1.241	1.301	0.926	-0.009%
	0.8000	1.000	1.483	1.301	0.905	**1.000**	1.483	1.301	0.905	0.000%
	0.8500	1.000	1.666	1.416	0.916	0.547	1.955	1.301	0.873	-0.022%
	0.9000	1.000	1.852	1.532	0.927	0.263	2.540	1.301	0.845	-0.082%

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END NOTES

[1] We use wealth and non-labor income as equivalent although in practice wealth is a sum of non-labor incomes discounted by the interest rate. For the purposes of tractability in presentation we ignore the distinction.

[2] A more general model would have δ_j being individual-specific or good-specific. In that framework we would choose particular parameters so that $\delta_{ji} \neq 0$, where j represents a good and i indexes an individual. Discussing interactions in only one good and in one other individual is sufficient to draw conclusions that reflect more general models.