Trade, Inequality and Costly Redistribution*

Pol Antràs
PAntras@FAS.Harvard.Edu

Alonso de Gortari
deGortari@FAS.Harvard.Edu

Oleg Itskhoki
Itskhoki@Princeton.Edu

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Abstract

This paper studies the welfare implications of trade liberalization in a model in which trade may increases income inequality, and in which redistribution policies are constrained by information frictions (as in Mirrlees 1971). We first consider an extreme case in which redistribution is not feasible, and study the model's quantitative implications for the effect of trade opening on aggregate income and on (standard measures of) inequality. Adopting a welfarist approach, we compute the welfare gains from trade according to social welfare functions featuring various degrees of inequality aversion. We next consider an environment in which redistribution is feasible but only via (non-linear) income taxation. More specifically, the government only observes agents' income but not their skills or other characteristics. We solve for the (constrained) optimal redistribution policy and show how it is affected by trade opening. We also re-compute the welfare effects from trade taking into account the redistributive and efficiency effects of the optimal tax policy. Even when evaluating the welfare effects of trade based purely on its effect on aggregate income, the resulting gains from trade are typically adjusted downwards whenever income taxes are set by an inequality-averse government.

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> "If, as will often happen, the best methods of compensation feasible involve some loss in productive efficiency, this loss will have to be taken into account." (Hicks 1939, p. 712)

1 Introduction

[To be written]

Not even Hicks believed in Kaldor-Hicks...

How do we measure gains from trade? Kaldor-Hicks Compensating Principle. Compute compensating variation (monetary transfers required to bring agents back to autarky welfare level) or equivalent variation (monetary transfer that an agent would be willing to accept to avoid a move to free trade). Aggregate across agents and show that it is positive.

- Advantages of this approach: do not need to take a stand on cardinal features of utility functions; statements free of value judgments
- Disadvantages: uncertainty, inequality aversion in the absence of actual transfers; not free of value judgments

Walk through example. Isoelastic preferences. Pareto.

Notes: Behavioral elasticity Kaplow Ch 4, Quotes in Coate

2 A Motivating Example

Consider a society composed of a measure one of individuals indexed by an ability level φ with associated (real) earnings $r(\varphi)$. Agents' preferences are represented by an indirect utility function v defined over real disposable income

$$r^d(\varphi) = (1 - \tau(r(\varphi)))\, r(\varphi) + T(\varphi),$$

where $\tau(r(\varphi))$ denotes a nonlinear income tax and $T(\varphi)$ represents a lump-sum transfer. The distribution of φ in the population is fixed and given by the c.d.f. $H(\varphi)$, while the associated income distribution for real earnings is denoted by $F(r)$. The society is evaluating the consequences of a trade liberalization that would generate heterogeneous effects on agents' incomes, thereby leading to a shift from some initial $F_0(r)$ to a new distribution of income $F_1(r)$. How does one characterize and quantify the welfare consequences of the move from $F_0(r)$ to $F_1(r)$?

The Kaldor-Hicks The standard approach in the field of international trade is to characterize the welfare effects of trade by appealing to the Kaldor-Hicks compensation principle. In particular, one first computes the compensating or equivalent variation associated with trade opening for each individual, and then one aggregates over all individuals. Let us illustrate this in our example above for the case of the equivalent variation. For simplicity, assume away income taxation and suppose that the government budget is initially balanced, so that $\int T(\varphi)\, dH(\varphi) = 0$. The equivalent variation for individuals of type φ is defined by

$$v\left(r_0^d(\varphi) + EV(\varphi)\right) = v\left(r_1^d(\varphi)\right), \tag{1}$$

from which it follows that

$$\int EV(\varphi)\, dH(\varphi) = \int r_1(\varphi)\, dG(\varphi) - \int r_0(\varphi)\, dH(\varphi). \tag{2}$$

Clearly, his corresponds to the change in aggregate real income, which we can denote by $R_1 - R_0$. If this quantity is positive, it means that the amount of money that the winners from trade liberalization are jointly willing to give up for this change to happen exceeds the amount of money necessary to restore the losers' welfare to its pre-trade-opening level. In order to quantify the gains from trade, it is standard to express the change in (2) as a percentage change relative to the initial level of aggregate real income R_0, which we can denote by

$$\left.\frac{\Delta W}{W}\right|_{\text{Kaldor-Hicks}} = \mu \equiv \frac{R_1 - R_0}{R_0}. \tag{3}$$

Although we have assumed that all agents have a common indirect utility function v, it is clear from equation (1) that the result in (2) will apply even when agents are heterogeneous not only in income but also in preferences. This is in fact the key appealing feature of the Kaldor-Hicks criterion: it does not rely on the interpersonal comparisons of utility.

As noted in the Introduction, there are however two key limitations of the Kaldor-Hicks criterion. First, the fact that there is the *potential* for the winners from trade to compensate the losers does not mean that this compensation *actually* takes place in practice, thus raising the issue of whether prescriptions based on that criterion are really free of value judgements. Second, lump-sum transfers are a useful theoretical tool, but they are informationally intensive and rarely feasible in practice. Naturally, compensation may also be achievable via other forms of redistribution and, in fact, Dixit and Norman (1980, 1986) have shown that the use of commodity and factor taxes and subsidies is sufficient to ensure such compensation. However, these alternative instruments are likely to impact economic efficiency and thus the magnitude of the welfare gains from trade. In light of these limitations, we next discuss two alternative approaches.

The Welfarist Approach The welfarist (or social welfare) approach to policy evaluation instead begins by positing the existence of a social welfare function that maps the vector of agents' utilities into a single real number. It is customary to express this function as an integral of monotonic transformations of agents' utilities over their *actual* (and not potential) disposable income, or

$$W|_{\text{Welfarist}} = \int g\left(v\left(r^d\left(\varphi\right)\right)\right) dH\left(\varphi\right). \tag{4}$$

When $g\left(v\left(r^d\right)\right) = r^d$, it is clear that this welfare function will quantify the welfare effects of changes in the environment in the same manner as the compensation principle in (3) would. The welfarist approach typically posits, however, that the composite function $g\left(v\left(\cdot\right)\right)$ is instead concave. There are two possible justifications for this assumption. First, because given two distributions of disposable income with the same mean, one would expect society to prefer the one with the lowest dispersion or inequality (c.f. Atkinson 1970). And second, because whenever agents' are risk averse, such a concavity would arise whenever computing the individual welfare implications of changes in the environment from the point of view of ex-ante identical individuals in some sort of "original position" behind a "veil of ignorance" (c.f. Vickers 1945; Harsanyi 1953).

To fix ideas, we shall consider the often-used case in which

$$g\left(v\left(r^d\right)\right) = \frac{\left(r^d\right)^{1-\rho} - 1}{1-\rho} \text{ for } \rho > 0, \tag{5}$$

where ρ can alternatively be interpreted as reflecting a constant degree of inequality aversion on the part of the social planner or a constant degree of of risk aversion on the part of agents in the original position (or a combination of both). When ρ goes to 1, we have $g\left(v\left(r^d\right)\right) = \ln\left(r^d\right)$. We shall also assume that the distribution of disposable income in the population is well approximated by a Pareto distribution. We are aware that this distribution provides a better fit of the top percentiles of the income distributuion than of the lower ones, so below we will repeat the exercise assuming a Log-normal distribution, which is well-known to fit the bottom 80-90% of the income distribution particularly well.

It turns out that with a Pareto distribution of income, a simple monotonic transformation $\tilde{W} =$

$((1-\rho)W+1)^{1/(1-\rho)}$ of the social welfare function in (4) and (5) can be written as (see the Appendix)

$$\tilde{W}\Big|_{\text{Welfarist}} = \left(\frac{1+G}{1-G(1-2\rho)}\right)^{1/(1-\rho)} \frac{1-G}{1+G} R,$$

where $R = \int r(\varphi)\, dG(\varphi)$ is again aggregate real income in the economy, and G is the Gini coefficient of inequality associated with the distribution of disposable income. Naturally, $\tilde{W}$ is increasing in R and decreasing in G.[1] The transformation $\tilde{W}$ is convenient because it implies that the percentage welfare gains from trade (or from any policy, for that matter), can be expressed as

$$\frac{\Delta\tilde{W}}{\tilde{W}}\Big|_{\text{Welfarist}} = \frac{\left(\frac{1+G_1}{1-G_1(1-2\rho)}\right)^{1/(1-\rho)} \frac{1-G_1}{1+G_1}}{\left(\frac{1+G_0}{1-G_0(1-2\rho)}\right)^{1/(1-\rho)} \frac{1-G_0}{1+G_0}} \times (1+\mu) - 1, \tag{6}$$

and thus in the absence of any effect of trade on inequality (as captured by the Gini coefficient), the change in welfare corresponds exactly to the percentage change in real income ($\mu \equiv (R_1 - R_0)/R_0$), as in the Kaldor-Hicks compensation principle approach in (3).

How large is the negative correction to social welfare associated with trade-induced inequality? In Section 3, we will attempt to provide an answer to this question by specifying a general equilibrium model of trade and carefully tracing its implications. For the time being, we can provide a preliminary quantitative investigation of the first term in the social welfare changes in (6) for arguably plausible parameter values. We shall focus on the case of the U.S. during the period 1979–2007 in which the U.S. trade share – defined as the average of U.S. exports and imports over GDP – increased from 0.092 to 0.140 (see World Development Indicators). Over the same period, the United States Congressional Budget Office estimates that the Gini of *disposable* income – defined as market income adjusted by government transfers and federal taxes – increased from a value of 0.367 in 1979 to a value of 0.489 in 2007 (CBO, 2011).[2] We set $G_0 = 0.367$ and consider various potential extents to which trade contributed to the increase in the Gini coefficient, setting $G_1 = 0.367 + s \times (0.489 - 0.367)$ for s equal to 5%, 10%, and 20%. The coefficient of inequality or risk aversion is much harder to calibrate, so we report results for various values ranging from $\rho = 0$ (for which the adjustment is trivially 0) all the way to $\rho = 2$. The results are reported in the first three columns of Table 1.

[1] This is a particular case of Chipman (1974), who showed that for *any* composite function $g\left(v\left(r^d\right)\right)$ that is twice continuously differentiable, nondecreasing, concave, and nonlinear, one can express social welfare W in (4) as a function of R and G, with $\partial W/R > 0$ and $\partial W/\partial G < 0$.

[2] Data downloadable at http://www.cbo.gov/publication/42729

Table 1. Social Welfarist Inequality Correction to Welfare Effects of Trade Integration

	Pareto Correction (6)			Log Normal Correction in (7)		
	Contribution of Trade to Inequality			Contribution of Trade to Inequality		
	$s = 5\%$	$s = 10\%$	$s = 20\%$	$s = 5\%$	$s = 10\%$	$s = 20\%$
Inequality Aversion	(1)	(2)	(3)	(4)	(5)	(6)
$\rho = 0$	0%	0%	0%	0%	0%	0%
$\rho = 0.1$	-0.15%	-0.30%	-0.62%	-0.08%	-0.17%	-0.34%
$\rho = 0.25$	-0.32%	-0.65%	-1.33%	-0.21%	-0.42%	-0.85%
$\rho = 0.5$	-0.52%	-1.05%	-2.14%	-0.41%	-0.83%	-1.70%
$\rho = 0.75$	-0.66%	-1.33%	-2.69%	-0.62%	-1.25%	-2.53%
$\rho = 1$	-0.76%	-1.53%	-3.09%	-0.82%	-1.66%	-3.36%
$\rho = 2$	-0.99%	-1.98%	-3.96%	-1.64%	-3.29%	-6.61%

As can be seen from the table, even for modest degree of inequality aversion, the social welfarist correction for inequality is nonnegligible, particularly when compared to standard estimates of the real income gains from trade. For instance, in their recent survey, Costinot and Rodríguez-Clare (2013) report estimates of the real income gains μ for the U.S. of a move from autarky to 2008 trade levels that range from 1.8% to 10.3%. Because the U.S. was far from autarky in 1979, the associated real income gains from trade for the period 1979-2007 are likely to be significantly lower. In particular, using the Arkolakis, Costinot, and Rodríguez-Clare (2012) benchmark formula with a trade elasticity equal to 5 and with the increase in the U.S. trade share from 0.092 to 0.140 mentioned above, delivers real income gains from trade of just 1.09% between 1979 and 2007. It is then clear from columns (1)-(3) in Table 1 that even for modest degrees of inequality aversion and for small contributions of trade to inequality, the correction is sizeable. Furthermore, for large degrees of inequality aversion, these real income gains are entirely wiped out by even modest levels of trade-induced inequality increases.[3]

In columns (4)-(6) we repeat the exercise but assuming a Log-normal distribution of disposable income. As shown in the Appendix, in such a case we continue to obtain a closed-form expression for social welfare as a function of aggregate disposable income R and the Gini coefficient G, and the change of welfare analogous to (6) is now given by

$$\left.\frac{\Delta \tilde{W}}{\tilde{W}}\right|_{\text{Welfarist}} = \frac{\exp\left\{-\rho\left[\Phi^{-1}\left(\frac{1+G_1}{2}\right)\right]^2\right\}}{\exp\left\{-\rho\left[\Phi^{-1}\left(\frac{1+G_0}{2}\right)\right]^2\right\}} \times (1+\mu) - 1, \tag{7}$$

where Φ is the standard normal distribution. Setting $G_0 = 0.367$ and $G_1 = 0.367 + s \times (0.489 - 0.367)$ for s equal to 5%, 10%, and 20%, delivers the welfare correction in columns (4), (5) and (6), respectively, of Table 1. Comparing these numbers with the analogous ones for the Pareto distribution in columns

[3] A reason to be wary of these numbers is that Federal Reserve Economic Data indicates that real disposable income per capita rose from $20,251 in 1979 to $35,866 in 2007, that is by 77.1% (FRED). If trade accounts for at most 1 to 5% of those income gains, perhaps contributions of trade to inequality higer than 5% (i.e., column (1)) are implausible as well. This is precisely why one needs a formal general-equilibrium model of trade to better discipline the exercise.

(1)-(3), it is clear that the correction terms are similar in both cases. Relative to the Pareto case, assuming a Log-normal distribution tends to produce lower correction terms for low values of ρ, but higher ones for high values of ρ. It continues to be the case, however, that it does not take an enormous amount of trade-induced inequality to significantly correct downwards standard estimates of the welfare gains from trade.

Kaldor-Hicks with Costly Redistribution Although its widespread use in the optimal policy literature, the welfarist approach remains controversial. This is in large part due to the sensitivity of its prescriptions to the value of certain parameters, such as the degree of inequality aversion (or, more generally, the social marginal weights assigned to agents with different income), that are difficult to measure and over which people have vastly different ethical views.

Let us thus consider an alternative approach that is more akin to the Kaldor-Hicks compensation principle, but that explicitly models the fact that redistribution is typically costly. For that purpose, let us return to our previous example but suppose now that lump-sum transfers are not feasible (i.e., $T(\varphi) = 0$ for all φ) and redistribution has to have through the income tax system. Above, we have introduced a general nonlinear income tax $\tau(r(\varphi))$, but it will be convenient to focus on the particular case in which we can write

$$1 - \tau(r(\varphi)) = k(r(\varphi))^{-\phi}, \tag{8}$$

for some constant k which can be again set to ensure that the government budget is balanced. Average net-of-tax rates thus decrease in reported income at a constant rate ϕ, with this parameter governing the degree of progressivity of the tax system. This specification may seem quite ad hoc, so later in the paper we will consider arbitrary nonlinear tax schedules. Having said this, the log-linear relationship between market income and income after taxes and transfers implied by equation (8) fits the data remarkably well. This is illustrated in Figure 1 using CBO data for several percentiles of the income distribution for the period 1979-2010.[4] The implied average degree of progressivity ϕ over the period is equal to 0.182, although when estimating progressivity year by year, it is clear that it is lower in recent years than at the beginning of the period, when ϕ was in the neighborhood of 0.25 (see Figure 2).[5] Heathcote, Storesletten, and Violante (2014) find an equally remarkable fit of this log-linear relationship with data from the Panel Study of Income Dynamics (PSID) for survey years 2000, 2002, 2004, and 2006, with an implied value $\phi = 0.151$, which is very much consistent with the estimates from CBO during the 2000-06 period.

A simple though fairly standard way to introduce costly redistribution is to posit the existence of a behavioral response to taxation in the form of a positive, constant elasticity of reported income to the

[4] In particular, Figure 1 depicts market income and income after taxes and transfers for the first four quintiles of the income distribution, as well as the 81st to 90th percentiles, the 91st to 95th percentiles, the 96th to 99th percentiles, and the top 1 percent, for the period 1970-2010. Market income consists of labor income, business income, capital gains (profits realized from the sale of assets), capital income (excluding capital gains), income received in retirement for past services, and other sources of income. Government transfers include cash payments and in-kind benefits from social insurance and other government assistance programs. Federal tax liabilities include individual income taxes, social insurance or payroll taxes, excise taxes, and corporate income taxes.

[5] The log-linear relationship between market income and after-government income is a very good approximation in all years, with the R-squared of the regressions never falling below 0.98.

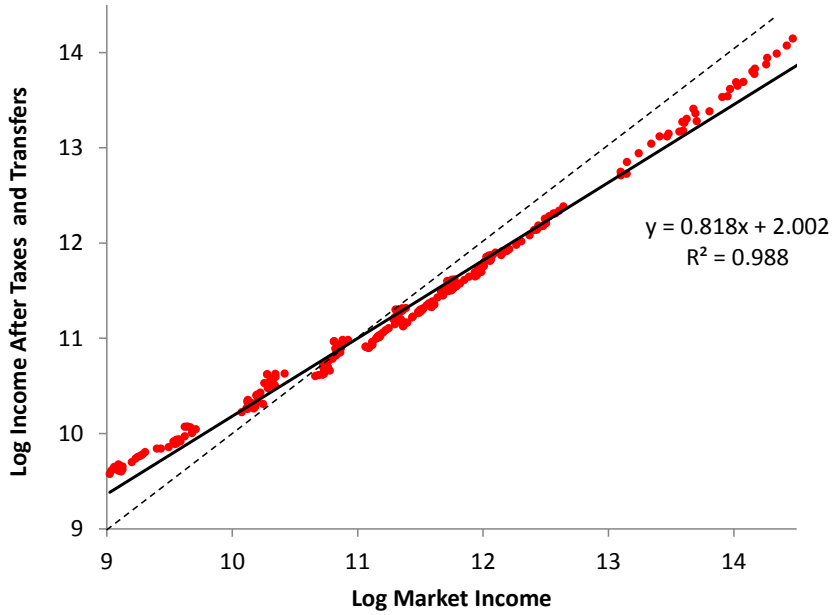


Figure 1: Progressivity

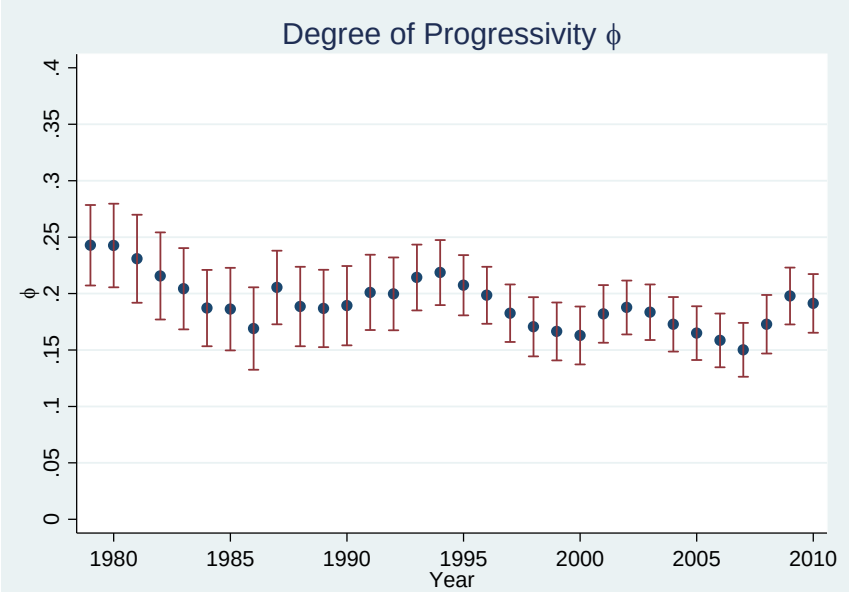


Figure 2: Progressivity Over Time

net-of-tax rate, or

$$\varepsilon \equiv \frac{\partial r(\varphi)}{\partial\left(1-\tau\left(r(\varphi)\right)\right)} \frac{1-\tau\left(r(\varphi)\right)}{r(\varphi)} > 0. \tag{9}$$

The particular value of ε is a matter of heated debate in the academic literature. We shall take $\varepsilon = 0.5$ as a benchmark value in our calculations, but we will report results for both lower as well as higher values of ε.

We finally need to take a stance on the shape of the income distribution in the absence of taxes. As

in our welfarist calculations above, we shall begin by considering the case in which, with zero taxes, the distribution of income would be distributed Pareto with shape parameter $\alpha > 1$. It is easy to verify that this assumption, coupled with the functional forms in (8) and (9), imply that the distributions of reported income and disposable income will also be Pareto with shape parameters $\alpha(1+\varepsilon\phi)$ and $\alpha(1+\varepsilon\phi)/(1-\phi)$, respectively. Furthermore, aggregate disposable income can be expressed as

$$R^d = \frac{(1-\phi)(1+G)-(1+\varepsilon\phi)2G}{(1-\phi)(1+G)-2G}\left(\frac{(1-\phi)(1-G)}{(1-\phi)(1+G)-2G}\right)^{\varepsilon}\tilde{R} \equiv \delta(\phi,G,\varepsilon)\times\tilde{R}, \tag{10}$$

where $\tilde{R}$ is aggregate income in the absence of distortionary income taxes and $\delta(\phi,G,\varepsilon)$ thus reflects the distortionary effect of income taxes. It can easily be verified that δ is decreasing in the degree of tax progressivity ϕ and attains its maximum of 1 when $\phi = 0$ (so $\tau(r(\varphi)) = 0$ for all φ). It also easy to verify that δ is decreasing in the Gini coefficient of disposable income G. Unlike in our welfarist calculations in Table 1, this negative effect now reflects the fact that a higher Gini coefficient is associated with more unequal underlying distribution of market (untaxed) income, which in turn leads to larger losses from the behavioral responses to taxation of high-ability individuals. Finally, more cumbersome differentiation demonstrates the intuitive result that δ is also decreasing in the behavioral elasticity ε.

We are now ready to revisit the Kaldor-Hicks criterion whenever compensation needs to occur via a distortionary income tax system. Following the same derivations as in equations (1) and (2), the sum of all individuals' compensating variations will be given by the difference in aggregate disposable income $R_1^d - R_0^d$, and thus we can express the percentage welfare gains from trade with costly redistribution as

$$\left.\frac{\Delta W}{W}\right|_{\text{Costly Kaldor-Hicks}} = \frac{R_1^d - R_0^d}{R_0^d} = \frac{\delta(\phi_1,G_1,\varepsilon_1)}{\delta(\phi_0,G_0,\varepsilon_0)}\times(1+\mu)-1. \tag{11}$$

Whenever trade has no impact on the determinants of δ in (10), the change in welfare corresponds exactly to the percentage change μ in real income of an 'undistorted' Kaldor-Hicks economy that could use lump-sum transfers for redistribution purposes. As argued before, however, it is plausible that trade will impact inequality (i.e., G) and, via this effect, also the overall welfare change in (11). For the time being, we will treat tax progressivity ϕ and the behavioral elasticity ε as being unaffected by trade liberalization. To get a sense of the magnitude of the correction in (11) to the welfare effects of trade, we set $\phi = 0.182$ as implied by the CBO data, as well as $G_0 = 0.367$ and $G_1 = 0.367 + s\times(0.489-0.367)$ as in Table 1, and calculate the ratio of δ's in (11) for various values of ε and for s equal to 5%, 10%, and 20%. The results are presented in columns (1)-(3) of Table 2. The implied corrections are far from negligible even for small values of ε. For our benchmark value of $\varepsilon = 0.5$, the implied correction might easily halve or even entirely wipe out standard estimates of the gains from trade. For even larger values of ε, the correction is remarkably large, reflecting the fact that the observed level of progressivity in the U.S. tax system implies large inefficiencies for even modest increases in inequality.

Table 2. Costly Redistribution Correction to Welfare Effects of Trade Integration

	Pareto Correction (6)			Log Normal Correction in (7)		
	Contribution of Trade to Inequality			Contribution of Trade to Inequality		
	$s = 5\%$	$s = 10\%$	$s = 20\%$	$s = 5\%$	$s = 10\%$	$s = 20\%$
Inequality Aversion	(1)	(2)	(3)	(4)	(5)	(6)
$\varepsilon = 0$	0%	0%	0%	0%	0%	0%
$\varepsilon = 0.1$	-0.04%	-0.08%	-0.17%	-0.00%	-0.01%	-0.02%
$\varepsilon = 0.25$	-0.11%	-0.23%	-0.50%	-0.01%	-0.03%	-0.05%
$\varepsilon = 0.5$	-0.30%	-0.62%	-1.33%	-0.03%	-0.06%	-0.13%
$\varepsilon = 0.75$	-0.58%	-1.21%	-2.61%	-0.05%	-0.11%	-0.22%
$\varepsilon = 1$	-1.01%	-2.10%	-4.53%	-0.08%	-0.17%	-0.34%
$\varepsilon = 2$	-6.52%	-13.6%	-29.7%	-0.25%	-0.50%	-1.01%

In columns (4)-(6) we repeat the exercise, but assuming now a Log-normal distribution in the underlying distribution of potential (untaxed) income. In such a case, and holding constant ϕ and ε, equation (11) becomes

$$\left.\frac{\Delta\tilde{W}}{\tilde{W}}\right|_{\text{Welfarist}} = \frac{\exp\left\{-\frac{\phi^2\varepsilon(\varepsilon+1)}{(1-\phi)^2}\left[\Phi^{-1}\left(\frac{1+G_1}{2}\right)\right]^2\right\}}{\exp\left\{-\frac{\phi^2\varepsilon(\varepsilon+1)}{(1-\phi)^2}\left[\Phi^{-1}\left(\frac{1+G_0}{2}\right)\right]^2\right\}} \times (1+\mu) - 1,$$

and the first ratio can be computed by assigning values to ϕ, ε, G_0 and G_1 as in the Pareto case. Comparing the results in columns (4)-(6) with those in columns (1)-(3) it is clear that the implied correction in the Log-linear case tend to be much smaller. A possible intuition for this result is that with a Log-linear distribution, the right-tail of the distribution is much thinner than under the Pareto distribution, and thus the inefficiencies caused by the behavioral responses of high-ability individuals will be smaller in that case.

An alternative way to understand the result is to note that the optimal degree of progressivity (for a social planner with inequality concerns) will tend be much higher when income is distributed according to a Log-linear distribution than when it is Pareto distributed. This is actually easily verified in our example by exploring the case in which ϕ is chosen optimally by a social planner to maximize the society's aggregate welfare as captured by social welfare function in (4) and (5). In the Pareto case, one can show (see the Appendix) that we obtain

$$\phi^*(\alpha,\rho,\varepsilon) = \frac{(\alpha-1)(\varepsilon-\varepsilon\rho+\rho)}{2\varepsilon(1-\rho+\alpha\varepsilon+\alpha\rho)}\left(\sqrt{1+\frac{4\varepsilon\rho(1-\rho+\alpha\varepsilon+\alpha\rho)}{(\alpha-1)(\varepsilon(1-\rho)+\rho)^2}}-1\right), \tag{12}$$

while in the Log-normal case, this formula is even simpler

$$\phi^*(\rho,\varepsilon) = \frac{\rho}{\rho+\varepsilon}, \tag{13}$$

and independent of inequality. Setting $\varepsilon = 0.5$ and $\rho = 0.2$, one can then show that for a Gini coefficient

equal to $G = 0.367$, the implied optimal progressivity rate in the Pareto case in (12) is given by $\phi^* = 0.191$, which is in the neighborhood of that observed in U.S. data.[6] For these same parameters, however, the optimal rate of progressivity in the Log-normal case in (13) is much higher and stands at $\phi^* = 0.286$.

One can also use these optimal tax formulae to calibrate reasonable values for the coefficient of inequality aversion in the social welfare function in (4) and (5). In particular, one potential approach is to assume that the optimal degree of progressivity ϕ^* corresponds exactly to the one implied by the U.S. tax and transfer system. Under this interpretation and in light of the striking fit in Figure 1, we would be led to believe that $\phi^* = 0.182$. Setting $\varepsilon = 0.5$, we would then conclude that if the income distribution is Pareto, then $\rho = 0.181$, while if the income distribution is Log-nomal, we instead have $\rho = 0.111$.

An important caveat with the above methodology for backing out ρ and the inequality correction for welfare is that perhaps the U.S. tax system is far from the optimal given a value of ρ. Policies are decided in the political arena, not by a social planner, and lobbying by rich individuals might make the tax system less progressive than 'society' would want it to be. Under this interpretation, a low ϕ might not indicate that inequality concerns should not materially affect welfare calculations based on the Kaldor-Hicks criterion, but quite on the contrary, it might suggest that welfarist measures of the gains from trade liberalization might differ significantly from those using the Kaldor-Hicks criterion. To see this, note that the lower is ϕ in the tax system, the larger will the response be of after-tax inequality to changes in "primitive" before-tax income inequality because the 'safety net' with a low ϕ is rather small. More formally, for a given trade-induced percentage change in the primitive α, the percentage change in the after-tax α will be lower the higher is ϕ. This was not apparent in our discussion of Table 1 because we worked directly with the distribution of after-tax income. But the point here is that the extent to which trade induced inequality translates into after-tax inequality (i.e., s in the table) might be mediated by the degree of tax progressivity ϕ.

[6] To obtain this number, one needs to solve for the values of α and ϕ that jointly solve (12) and $G = 1/\left[2\alpha\left(1+\varepsilon\phi\right)/\left(1-\phi\right)-1\right]$ for $G = 0.367$, $\rho = 0.2$ and $\varepsilon = 0.5$.

3 A Simple Model of Trade-Induced Inequality

Agents are characterized by a random pair $\omega = (x, z) \sim H(\omega)$:

$$\begin{aligned}
u(\omega) &= c(\omega) - \frac{1}{\gamma}\ell(\omega)^{\gamma}, \\
c(\omega) &= \big(1-\tau(\omega)\big)r(\omega) - e^{z}F(\omega) + T(\omega), \\
r(\omega) &= \Upsilon(\omega)^{1-\beta}Q^{1-\beta}y(\omega)^{\beta}, \\
y(\omega) &= e^{x}\ell(\omega), \\
\Upsilon(\omega) &= 1 + n(\omega)\tau^{-\frac{\beta}{1-\beta}}, \\
F(\omega) &= n(\omega)f, \\
Q &= \left[\int \Upsilon(\omega)^{1-\beta}y(\omega)^{\beta}\mathrm{d}H(\omega)\right]^{1/\beta}.
\end{aligned}$$

$\ell(\omega) \geq 0$ and $n(\omega) \in \{0, 1, \ldots, N\}$ are chosen optimally:

$$\begin{aligned}
\ell(\omega) &= \left[\big(1-\tau(\omega)\big)\beta\right]^{\frac{1}{\gamma-\beta}}\Upsilon(\omega)^{\frac{1-\beta}{\gamma-\beta}}Q^{\frac{1-\beta}{\gamma-\beta}}e^{\frac{\beta}{\gamma-\beta}x}, \\
n(\omega) &= \max_{0\leq n\leq N}\left\{n : \left(1-\frac{\beta}{\gamma}\right)\beta^{\frac{\beta}{\gamma-\beta}}\big(1-\tau(\omega)\big)^{\frac{\gamma}{\gamma-\beta}}\left[\Upsilon_{n}^{\gamma\frac{1-\beta}{\gamma-\beta}} - \Upsilon_{n-1}^{\gamma\frac{1-\beta}{\gamma-\beta}}\right]Q^{\gamma\frac{1-\beta}{\gamma-\beta}}e^{\frac{\beta\gamma}{\gamma-\beta}x} > e^{z}f\right\},
\end{aligned}$$

where $\Upsilon_n = 1 + n\tau^{-\frac{\beta}{1-\beta}}$.

$$\begin{aligned}
u(\omega) &= \left(1-\frac{\beta}{\gamma}\right)\beta^{\frac{\beta}{\gamma-\beta}}\big(1-\tau(\omega)\big)^{\frac{\gamma}{\gamma-\beta}}\Upsilon(\omega)^{\gamma\frac{1-\beta}{\gamma-\beta}}Q^{\gamma\frac{1-\beta}{\gamma-\beta}}e^{\frac{\beta\gamma}{\gamma-\beta}x} - e^{z}n(\omega)f + T(\omega) \\
&= \left(1-\frac{\beta}{\gamma}\right)\beta^{\frac{\beta}{\gamma-\beta}}\big(1-\tau(\omega)\big)^{\frac{\gamma}{\gamma-\beta}}Q^{\gamma\frac{1-\beta}{\gamma-\beta}}e^{\frac{\beta\gamma}{\gamma-\beta}x}\left[\Upsilon(\omega)^{\gamma\frac{1-\beta}{\gamma-\beta}} - n(\omega)\left(\Upsilon_{n}^{\gamma\frac{1-\beta}{\gamma-\beta}} - \Upsilon_{n-1}^{\gamma\frac{1-\beta}{\gamma-\beta}}\right)\right] + T(\omega)
\end{aligned}$$

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