SMALL GOVERNMENT AND MAJORITY ANTIPATHY TOWARD A POOR MINORITY: THE ROLE OF PROGRESSIVE TAXATION

James E. Rauch*
UCSD, NBER and CESifo

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Abstract

I modify a simple model of public choice of the tax rate used to finance public goods provision to allow for antipathy of a majority toward a minority. I show that, if the tax system is constrained to take a lower share of minority than majority income, the representative majority voter chooses a lower tax rate, hence a lower allocation to the public good, the stronger is his antipathy. In particular, this will occur under a progressive tax system if the minority is poorer than the majority. Moreover, an increased minority population share exacerbates this effect. I also show that lower minority income in the presence of equal tax rates does *not* lead the majority to choose a lower tax rate in response to antipathy. In addition, progressive taxation does not lead the majority to choose a lower tax rate if the minority is poorer but the majority does not have antipathy toward the minority.

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*jrauch@ucsd.edu; Department of Economics, UCSD, La Jolla, CA 92093-0508.

I. Introduction

The worldwide rise of "populist" movements following the Great Recession has attracted the attention of economists and other social scientists to the underlying causes. The timing has led economists to focus on economic explanations, but other social scientists have pointed to "cultural" explanations. Margalit (2019) has noted that, in Europe and the United States, "immigration is often the signature issue of populist parties," and surveys a wide variety of evidence indicating that opposition to immigration by natives is determined more by immigrant country of origin and religion than by whether immigrants are perceived as competitors for jobs.

In the United States, cultural preferences have also been used to explain opposition to social safety net spending. Craig and Richeson (2014) contrast whites who were randomly assigned a reading about projections that racial minorities will constitute a majority of the U.S. population by 2042 with whites randomly assigned a control reading about increased geographic mobility in the United States. They find that the former group was less supportive of health care reform than the latter group. Craig and Richeson (p. 1196) write, prophetically, "should White Americans (on average) respond to the changing demographics by becoming more politically conservative, the U.S. political landscape is likely to become increasingly racially polarized." Lee and Roemer (2006) argue that negative feelings toward nonwhites translate into whites voting (indirectly) for lower income tax rates because federal government spending, hence the income taxes that finance it, disproportionately benefits non-whites. Similarly, Gilens (1999) and Wetts and Willer (2018) find that opposition to federal spending for "welfare" is driven by white perception that welfare programs primarily benefit nonwhites.

A cultural explanation consistent with these studies is that, in the United States, majority (white) agents receive disutility from both the number and utility of minority (nonwhite) agents. The main purpose of this note is to ask if this cultural explanation for majority opposition to non-European immigration and social safety net expenditure can also help us understand other U.S. populist policy positions. These include opposition to taxes and government spending in general (not only in the area of transfer payments), and in particular opposition to taxes or government spending to combat climate change. It is hard to rationalize these positions in terms of disproportionate benefits to minorities. Yet the strength of populist sentiment behind these positions seems clear given the rise of the "tea party" movement after the election of President Barack Obama and the change from conservative support to conservative opposition to fighting global warming between the late 1980s and now.[1] The opposition to taxation and expenditure to protect the environment runs counter to the suggestion by Lee, Roemer, and Van der Straeten (2006, p. 454) that the environmental issue could be "unbundled" from tax rates and used to "move equilibrium economic values in a leftward direction."

In this note I consider a simple, textbook model of public choice, in which the representative majority voter has single-peaked preferences regarding the tax rate used to finance public goods provision. Since the representative majority voter is the median voter, his choice determines the tax rate. Suppose that the representative majority voter has antipathy toward the minority, and that majority and minority agents value public goods equally relative to private goods. I show that, if the tax system is constrained to take a lower share of minority than majority income, the representative majority voter chooses a lower tax rate, hence a lower

[1] In a 1988 campaign speech, George H.W. Bush said, "Those who think we are powerless to do anything about the greenhouse effect forget about the 'White House effect.' As president, I intend to do something about it." Cited in https://www.eenews.net/stories/1060108785/.

allocation to the public good, the stronger is his antipathy. In particular, this will occur under a progressive tax system if the minority is poorer than the majority. Moreover, an increased minority population share exacerbates this effect, consistent with findings in the literature regarding white reactions to prompts that the nonwhite population share is increasing relative to the white population share. I also show that lower minority income in the presence of equal tax rates does *not* lead the majority to choose a lower tax rate in response to antipathy. In addition, progressive taxation does not lead the majority to choose a lower tax rate if the minority is poorer but the majority does not have antipathy toward the minority.

The intuition for my main results is that when the tax system that finances provision of public goods takes a lower share of minority than majority income, increasing provision of public goods raises minority relative to majority utility. Antipathy of the majority toward the minority therefore causes the representative majority agent to choose lower provision of public goods.

Suppose it is indeed the case that, in the presence of progressive taxation, antipathy of the majority toward the minority leads to lower majority support for provision of public goods that benefit the majority and minority equally. Are there any practical implications of this conclusion? Consider strategies to build voter support for policies to combat global warming. An approach that has received the endorsement of many economists is to rebate carbon taxes to households in equal dollar amounts. This amounts to a progressive tax scheme and should therefore, according to my analysis, strengthen the opposition of the representative majority voter to fighting climate change. In their study of the impacts of an increase in the U.S. gasoline tax on household income groups, Bento et al. (2009, Figure 2B) found that low-income blacks would gain more than any other group from a flat revenue return scheme. The editorial board of the influential *Investor's Business Daily* writes (2016) that the "goal" of climate scientists is "holding down capitalism and establishing a global welfare state" – a global version of redistribution from people of European to people of non-European origin. Given this opposition, a supplementary approach to building voter support could be federal government expenditures and tax breaks to promote wind and solar "farms" in rural areas where minorities are scarce. When combined with investment in electric power distribution, such a policy can revive depressed rural economies, as the experience of west Texas demonstrates (Martin 2016).

In the next section of this note I describe my model and derive results. Section III concludes.

II. A Simple Model of Public Goods Provision with Altruism

There is only one output in the economy, which can be used for private or public consumption. Denote private consumption by X and public consumption by Y. Public consumption is the same for every agent by definition.

Each agent has an endowment E of output. The government collects a non-negative portion of her endowment as taxes and the agent consumes the remainder privately. The amount of public consumption equals the amount of output collected from all agents by the government as taxes.

Agents are divided into a majority and a minority. Utility for any minority agent j is given by $U_j(X_j, Y)$. Utility for any majority agent i is given by $W_i = U_i(X_i, Y) - \gamma \sum_j U_j(X_j, Y)$, where γ is the intensity of majority antipathy (negative altruism) toward the minority. This formulation of altruism is based on the Barro-Becker (1988) model of altruism of parents toward their children.

Results will be derived for the case where majority and minority agents have identical log-linear preferences for private versus public consumption: $U_i(X_i, Y) = X_i^{\alpha} Y^{\beta}, U_j\left(X_j, Y\right) = X_j^{\alpha} Y^{\beta},\ \alpha \in (0,1),\ \beta \in (0,1)$. This assumption is made to abstract from the influence on social choice of any difference in preferences between majority and minority agents for private versus public consumption. Homotheticity further ensures that differences in incomes between majority and minority agents do not generate differences in preferences for private versus public consumption. Log-linearity delivers especially clean results. I will comment below on the consequences of relaxing the assumption of identical log-linear preferences.

I assume all majority agents are the same and all minority agents are the same. I therefore replace the subscript *i* with the subscript 1 and the subscript *j* with the subscript 2. I normalize the total number of agents to one and denote the minority fraction by ψ. Utility for a majority agent is then given by $W_1 = U_1(X_1, Y) - \gamma\psi U_2(X_2, Y)$. Majority agents pay a proportional tax rate t_1 and minority agents pay a proportional tax rate t_2. This implies $X_1 = (1\text{-}t_1)E_1$, $X_2 = (1\text{-}t_2)E_2$, and $Y = (1\text{-} \psi)t_1E_1 + \psi t_2E_2$.

I first consider the case where the tax system is neither progressive nor regressive, i.e., $t_1 = t_2 = t$. The majority agent is the median voter and chooses t to maximize W_1. In the Appendix I prove

Proposition 1. When $t_1 = t_2 = t$, the choice of t that maximizes W_1 is invariant with respect to γ and with respect to the ratio of minority to majority income.

With an identical tax rate for majority and minority agents, the majority voter chooses a public good allocation that is unaffected by his antipathy toward the minority. This happens because the ratio of majority to minority agent utility cannot be changed by varying t, regardless of γ. Given that endowments of majority and minority agents can differ, identical log-linear preferences are needed for this result. Also note that lower minority income in the presence of equal tax rates does not lead the majority to choose a lower (or higher) tax rate.

Next, consider the case where minority agents can be taxed at a higher or lower rate than majority agents. Let $t_1 = t$ and $t_2 = \lambda t$. (No additional insight is gained from considering the more general case $t_2 = f(t)$.) If $E_2 < E_1$, so that minority agents are poorer than majority agents, then $\lambda > 1$ corresponds to regressive taxation and $\lambda < 1$ corresponds to progressive taxation. I demonstrate my main results in the following proposition, proved in the Appendix:

Proposition 2. When t is chosen to maximize W_1:

i) $dt/d\lambda = 0$ when $\gamma = 0$

ii) for $\lambda < 1$, $dt/d\gamma < 0$ and t is strictly smaller than when $\gamma = 0$;

for $\lambda > 1$, $dt/d\gamma > 0$ and t is strictly larger than when $\gamma = 0$

iii) for $\lambda < 1$, $d^2t/d\gamma d\psi < 0$; for $\lambda > 1$, $d^2t/d\gamma d\psi > 0$.

For ii) and iii), the solution for t must be interior. Sufficient conditions for the solution to be interior are provided with the proof.

Proposition 2 shows that, without antipathy, the majority agent will choose exactly the same tax rate regardless of λ. Thus progressive or regressive taxation has no effect on the preferred tax rate of the median voter (this is a consequence of log-linear preferences), but it does reduce or increase the allocation to the public good by reducing or increasing taxes collected from the minority agents. With antipathy, the preferred tax rate of the median voter is strictly lower than without antipathy when $\lambda < 1$ and strictly higher when $\lambda > 1$. In the empirically relevant case of progressive taxation, majority antipathy toward the minority leads to a strictly lower allocation to the public good. Finally, Proposition 2 shows that the impact of antipathy on the preferred tax rate of the median voter is increased when the population share of the minority is increased. This is consistent with the evidence reported in my introduction: when the majority is informed that the minority share of the population is increasing, they support more conservative policies. In my model this result ultimately stems from the Becker and Barro (1988) formulation of altruism, where the impact of altruism on utility of a majority agent increases with the number of people toward whom he has altruistic feelings.

Remark: The Social Planner's Problem. Can a social planner take into account majority antipathy toward the minority,[2] yet avoid its distorting impact on allocation to the public good? Consider the equal-weight social welfare function $W = (1-\psi)W_1 + \psi U_2$. If the social planner chooses t to maximize W, it is easily shown that the impact of γ on t will be qualitatively the same as in Proposition 2. Suppose, instead, that the social planner can choose t_1 and t_2 independently. As shown in the Online Appendix, t_1 and t_2 will be chosen such that Y is invariant with respect to γ and $(1-t_1)/(1-t_2)$ is increasing in γ. That is, the social planner uses the difference between t_1 and t_2 to satisfy majority antipathy toward the minority while using the weighted average of t_1 and t_2 to optimally allocate resources between private and public goods.[3]

The contrast between Propositions 1 and 2 calls attention to the role of using marginal tax rates to redistribute income in causing majority antipathy toward the minority to reduce

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[2] It is not clear whether the social planner *should* take into account majority antipathy toward the minority. Kaplow (1998), in his discussion of optimal taxation in the presence of gifts, argues that the donor's altruism should be included in the social welfare function. Hammond (1987) presents arguments for the opposite position.

[3] As the proof in the Online Appendix makes clear, identical homothetic preferences for private versus public goods are necessary for this result, which otherwise appears to contradict the conditions for independence of the Pareto optimal amount of public goods from income distribution (Bergstrom and Cornes 1983).

allocation to the public good. This suggests that a tax scheme $\tau_i = T_i + tE_i$ could neutralize the impact of antipathy on t by keeping the marginal tax rate equal across the majority and minority and using lump-sum transfers T_i to redistribute income. Suppose we modify the model above by setting $t_1 = t_2 = t$, $X_1 = (1\text{-}t)E_1 - T$, $X_2 = (1\text{-}t)E_2 + \rho T$, and $Y = (1\text{-}\psi)tE_1 + \psi tE_2$. We define $\rho \equiv (1-\psi)/\psi$ to yield a balanced budget, $(1\text{-}\psi)T = \psi\rho T$. Note that T is set independently of t and does not affect the allocation to the public good. We can see immediately that lowering t helps majority relative to minority agents because the former depend more on taxable income for their private good consumption. In the Online Appendix, I prove that, when t is chosen to maximize W_1 with this tax scheme, $dt/d\gamma < 0$, $d^2t/d\gamma d\psi < 0$, and t is strictly smaller than when $\gamma = 0$, just as in Proposition 2 with $\lambda < 1$. Thus the lump-sum redistribution scheme does not solve the problem of the marginal tax rate redistribution scheme that majority antipathy toward a poorer minority leads to lower allocation to the public good.

I end this section with consideration of the consequences of relaxing the assumption of identical log-linear preferences over private versus public goods for the majority and minority agents. It is easy to show that if minority agents care very little for the public good relative to majority agents, majority antipathy toward the minority can cause majority agents to choose a higher rather than a lower tax rate even with progressive taxation and lower minority endowments (incomes). Minority agents might care relatively little for the public good because of different preferences from the majority or because of identical non-homothetic preferences and different incomes. If the assumption of identical homothetic preferences is maintained but log-linearity is relaxed, the changes that can occur in the results are much more subtle. In Proposition 1, the choice of t might increase or decrease with γ. In Proposition 2, the choice of t

might increase or decrease with λ when $\gamma = 0$. It is therefore possible that, without log-linearity, either antipathy or progressive taxation by itself leads the median voter to choose a lower tax rate, rather than needing both together.

III. Conclusions

The literature I surveyed in my introduction focuses on the incidence of public expenditure when explaining the impact on various types of public expenditure of negative feelings of the majority toward the minority. In this note I have argued that the incidence of taxes that finance public expenditure should also be considered.

Consideration of tax incidence yields sharp predictions. To illustrate, suppose that in the United States the white majority was poorer than the nonwhite minority. According to Proposition 2, the demonstrations that emerged after the election of President Barack Obama would not have supported a “tea party” platform of low taxes and small government, but instead would have called for higher taxes to finance greater provision of public goods.

The need for adequate provision of public goods is, arguably, greater than ever. The obstacles are complex and no single approach to understanding voter preferences is likely to suffice. A mix of “cultural” and economic explanations should continue to prove helpful.

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Appendix

Proposition 1. When $t_1 = t_2 = t$, the choice of t that maximizes W_1 is invariant with respect to γ and with respect to the ratio of minority to majority income.

Proof: We have $W_1 = [(1\text{-}t)E_1]^\alpha[(1\text{-}\ \psi)tE_1 + \psi tE_2]^\beta - \gamma\psi[(1\text{-}t)E_2]^\alpha[(1\text{-}\ \psi)tE_1 + \psi tE_2]^\beta =$

$\{[(1\text{-}t)E_1]^\alpha - \gamma\psi[(1\text{-}t)E_2]^\alpha\}[(1\text{-}\ \psi)tE_1 + \psi tE_2]^\beta = \{[(1\text{-}t)E_1]^\alpha - \gamma\psi[(1\text{-}t)E_2]^\alpha\}t^\beta[(1\text{-}\ \psi)E_1 + \psi E_2]^\beta$

$= (1\text{-}t)^\alpha t^\beta[(E_1)^\alpha - \gamma\psi(E_2)^\alpha][(1\text{-}\ \psi)E_1 + \psi E_2]^\beta$. It is now clear that the solution for t cannot be affected by γ, ψ, E_1, or E_2. Note that we assume that γ is not so large that $(E_1)^\alpha - \gamma\psi(E_2)^\alpha$ becomes nonpositive, otherwise the solution for t is either zero or one. Maximizing W_1 with respect to t and solving the first-order condition then yields $t = \beta/(\alpha + \beta)$. *Q.E.D.*

Proposition 2. When t is chosen to maximize W_1:

i) $dt/d\lambda = 0$ when $\gamma = 0$

ii) for $\lambda < 1$, $dt/d\gamma < 0$ and t is strictly smaller than when $\gamma = 0$;

for $\lambda > 1$, $dt/d\gamma > 0$ and t is strictly larger than when $\gamma = 0$

iii) for $\lambda < 1$, $d^2t/d\gamma d\psi < 0$; for $\lambda > 1$, $d^2t/d\gamma d\psi > 0$.

For ii) and iii), the solution for t must be interior. Sufficient conditions for the solution to be interior are provided with the proof.

Proof:

i) With $\gamma = 0$, W_1 reduces to $[(1\text{-}t)E_1]^\alpha[(1\text{-}\ \psi)tE_1 + \psi\lambda tE_2]^\beta$. We then have $W_1 = (1\text{-}t)^\alpha t^\beta(E_1)^\alpha[(1\text{-}\ \psi)E_1 + \psi\lambda E_2]^\beta$. It is now clear that the solution for t cannot be affected by λ, ψ, E_1, or E_2. As in the proof of Proposition 1, maximizing W_1 with respect to t and solving the first-order condition yields $t = \beta/(\alpha + \beta)$.

ii) and iii) We have $W_1 = [(1\text{-}t)E_1]^\alpha[(1\text{-}\ \psi)tE_1 + \psi\lambda tE_2]^\beta - \gamma\psi[(1\text{-}\lambda t)E_2]^\alpha[(1\text{-}\ \psi)tE_1 + \psi\lambda tE_2]^\beta =$

$\{[(1\text{-}t)E_1]^\alpha - \gamma\psi[(1\text{-}\lambda t)E_2]^\alpha\}[(1\text{-}\ \psi)tE_1 + \psi\lambda tE_2]^\beta =$

$\{[(1-t)E_1]^\alpha - \gamma\psi[(1-\lambda t)E_2]^\alpha\}t^\beta[(1-\psi)E_1 + \psi\lambda E_2]^\beta$. Maximizing W_1 with respect to t yields the first-order condition $\{[(1-t)E_1]^\alpha - \gamma\psi[(1-\lambda t)E_2]^\alpha\}\beta t^{\beta-1} - [\alpha(1-t)^{\alpha-1}(E_1)^\alpha - \gamma\psi\alpha(1-\lambda t)^{\alpha-1}\lambda(E_2)^\alpha]t^\beta = 0$. Rearranging, we have

$$[\alpha t(1-t)^{\alpha-1} - \beta(1-t)^\alpha](E_1)^\alpha + \gamma\psi[\beta(1-\lambda t)^\alpha - \alpha\lambda t(1-\lambda t)^{\alpha-1}](E_2)^\alpha = 0. \tag{A1}$$

Consider the case $\lambda = 0$. Plugging $\lambda = 0$ into (A1) and rearranging yields $[\alpha t(1-t)^{\alpha-1} - \beta(1-t)^\alpha](E_1)^\alpha = -\gamma\psi\beta(E_2)^\alpha$. Since the left-hand side of this expression is increasing in t, t is strictly smaller than when $\gamma = 0$, and the results $dt/d\gamma < 0$ and $d^2t/d\gamma d\psi < 0$ follow immediately, provided that the t that solves (A1) yields the optimum. Inspection shows that if the t that solves (A1) satisfies $[(1-t)E_1]^\alpha - \gamma\psi(E_2)^\alpha > 0$, it yields a higher value of W_1 than $t = 0$ or $t = 1$. Since this t is smaller than $t = \beta/(\alpha + \beta)$, plugging $t = \beta/(\alpha + \beta)$ into this inequality yields a condition expressed in terms of the parameters, $\alpha E_1/[(\alpha + \beta)E_2] > (\gamma\psi)^{1/\alpha}$, that guarantees that the solution for t is interior for $\lambda = 0$. It is easily shown that this condition also ensures that the left-hand side of (A1) is increasing in t for $\lambda \in [0,1]$, and that the solution for t is interior for $\lambda \in [0,1]$.

Next consider the case $\lambda = 1$. We know from the proof of Proposition 1 that $t = \beta/(\alpha + \beta)$ solves (A1). Plugging this value of t into (A1) also shows that the coefficient on $\gamma\psi$ equals zero. This implies $dt/d\gamma = 0$, which is consistent with Proposition 1.

Inspection shows that the coefficient on $\gamma\psi$ in (A1) decreases monotonically with λt, so if λt increases monotonically as λ increases from 0 to 1 then the coefficient on $\gamma\psi$ in (A1) must decrease monotonically from $\beta(E_2)^\alpha$ to zero, and is therefore positive for $\lambda \in [0,1)$. To show that λt increases monotonically as λ increases from 0 to 1 it is sufficient to show that t increases monotonically as λ increases from 0 to 1. Inspection establishes that the left-hand side of (A1) is decreasing in λ, so $dt/d\lambda > 0$ follows for $\lambda \in [0,1]$. Since the coefficient on $\gamma\psi$ in (A1) is positive for $\lambda \in [0,1)$ and the left-hand side of (A1) is increasing in t for $\lambda \in [0,1]$, we have $dt/d\gamma < 0$ and $d^2t/d\gamma d\psi < 0$ for $\lambda \in [0,1)$. The argument also establishes that for $\lambda \in [0,1)$ t is strictly smaller than when $\gamma = 0$.

Finally we consider the case $\lambda > 1$. In order to prevent private good consumption of the representative minority agent from becoming negative, the upper bound for t must be reduced from 1 to $1/\lambda$. This implies that for λ large enough, the interior solution for t must disappear. In particular, the preceding paragraph implies that, as λ increases from 1, the t that solves (A1) must increase from $\beta/(\alpha + \beta)$, but then it is clear that this t can no longer be the solution if $\lambda \geq (\alpha + \beta)/\beta$. For the solution for t to be interior, we must therefore have λ sufficiently close to 1.

As λ increases from 1 the coefficient on $\gamma\psi$ in (A1) decreases from 0 to become negative, and the left-hand side of (A1) continues to be increasing in t. We therefore have $dt/d\gamma > 0$, t strictly larger than when $\gamma = 0$, and $d^2t/d\gamma d\psi > 0$ for $\lambda > 1$ when the solution for t is interior.

Q.E.D.

Online Appendix

The Social Planner's Problem. I consider the equal-weight social welfare function $W = (1-\psi)W_1 + \psi U_2 = (1-\psi)[U_1(X_1,Y) - \gamma\psi U_2(X_2,Y)] + \psi U_2(X_2,Y)$, where $X_1 = (1-t_1)E_1$, $X_2 = (1-t_2)E_2$, and $Y = (1-\psi)t_1E_1 + \psi t_2E_2$. I then show that maximization of W with respect to t_1 and t_2 yields, if the solution is interior,

i) $(1-\psi)MRS_1 + \psi MRS_2 = 1$, where $MRS_k = \frac{\partial U_k(X_k,Y)/\partial Y}{\partial U_k(X_k,Y)/\partial X_k}$, $k = 1, 2$

ii) A public good allocation Y invariant with respect to γ

iii) The ratio $(1-t_1)/(1-t_2)$ increasing in γ.

i) I will not impose identical preferences for public versus private consumption until ii), so that $U_1 = X_1^{\alpha_1}Y^{\beta_1}, U_2 = X_2^{\alpha_2}Y^{\beta_2}$. We can then write

$$W = (1-\psi)[(1-t_1)E_1]^{\alpha_1}[(1-\psi)t_1E_1 + \psi t_2E_2]^{\beta_1}$$
$$+ \ \phi[(1-t_2)E_2]^{\alpha_2}[(1-\psi)t_1E_1 + \psi t_2E_2]^{\beta_2},$$

where $\phi \equiv \psi - (1-\psi)\gamma\psi$. Maximization of W with respect to t_1 and t_2 yields the first-order conditions

$$(1-\psi)\alpha_1(1-t_1)^{\alpha_1-1}(E_1)^{\alpha_1}Y^{\beta_1}$$
$$= [(1-\psi)(X_1)^{\alpha_1}\beta_1Y^{\beta_1-1} + \ \phi(X_2)^{\alpha_2}\beta_2Y^{\beta_2-1}](1-\psi)E_1 \tag{A2}$$

$$\phi\alpha_2(1-t_2)^{\alpha_2-1}(E_2)^{\alpha_2}Y^{\beta_2} = [(1-\psi)(X_1)^{\alpha_1}\beta_1Y^{\beta_1-1} + \ \phi(X_2)^{\alpha_2}\beta_2Y^{\beta_2-1}]\psi E_2. \tag{A3}$$

Combining (A2) and (A3) yields

$$\alpha_1(X_1)^{\alpha_1-1}Y^{\beta_1} = (\phi/\psi)\alpha_2(X_2)^{\alpha_2-1}Y^{\beta_2}. \tag{A4}$$

By rearranging (A2), we obtain

$$(1-\psi)\,(\beta_1X_1)/(\alpha_1Y) + \ \phi[(X_2)^{\alpha_2}\beta_2Y^{\beta_2-1}]/[\alpha_1(X_1)^{\alpha_1-1}Y^{\beta_1}] = 1.$$

Substituting (A4) into this expression yields

$$(1-\psi)\,(\beta_1X_1)/(\alpha_1Y) + \ \psi\,(\beta_2X_2)/(\alpha_2Y) = 1, \tag{A5}$$

or $(1-\psi)MRS_1 + \psi MRS_2 = 1$.

ii) We can rewrite (A5) as

$$(1-\psi)(\beta_1/\alpha_1)X_1 + \psi(\beta_2/\alpha_2)X_2 = Y.$$

We now have two expressions for Y, which we can equate to each other:

$$(1-\psi)t_1E_1 + \psi t_2E_2 = (1-\psi)(\beta_1/\alpha_1)(1-t_1)E_1 + \psi(\beta_2/\alpha_2)(1-t_2)E_2.$$

We can rearrange this expression to obtain

$$(1-\psi)(1+\beta_1/\alpha_1)t_1E_1+\psi(1+\beta_2/\alpha_2)t_2E_2=(1-\psi)(\beta_1/\alpha_1)E_1+\psi(\beta_2/\alpha_2)E_2.$$

Now impose identical preferences for the public relative to the private good, $\beta_1/\alpha_1=\beta_2/\alpha_2$:

$$Y=(1-\psi)t_1E_1+\psi t_2E_2=(\beta/\alpha)[(1-\psi)E_1+\psi E_2]/(1+\beta/\alpha).$$

iii) We can rearrange (A4) to obtain

$$[\alpha_2(X_2)^{\alpha_2-1}Y^{\beta_2}]/[\alpha_1(X_1)^{\alpha_1-1}Y^{\beta_1}]$$

$$=\{\alpha_2[(1-t_1)E_1]^{1-\alpha_1}Y^{\beta_2}\}/\{\alpha_1[(1-t_2)E_2]^{1-\alpha_2}Y^{\beta_1}\}=\psi/\phi.$$

As we saw in ii), Y is invariant with respect to γ when we impose $\beta_1/\alpha_1=\beta_2/\alpha_2$. Since ϕ is decreasing in γ, it follows from the last expression that $(1-t_1)/(1-t_2)$ is increasing in γ. Note that the increase in $(1-t_1)/(1-t_2)$ must result from a decrease in t_1 and an increase in t_2 since Y is constant.

Identical marginal tax rate for the majority and minority (marginal tax rate independent of income), balanced budget lump-sum transfers from majority to minority. Consider the tax scheme $t_1 = t_2 = t$, $X_1 = (1-t)E_1 - T$, $X_2 = (1-t)E_2 + \rho T$, and $Y = (1-\psi)tE_1 + \psi tE_2$, where T is a lump-sum transfer that is independent of t. I define $\rho\equiv(1-\psi)/\psi$ to yield a balanced budget, $(1-\psi)T = \psi\rho T$. We now have

$W_1 = [(1-t)E_1 - T]^\alpha[(1-\psi)tE_1 + \psi tE_2]^\beta - \gamma\psi[(1-t)E_2 + \rho T]^\alpha[(1-\psi)tE_1 + \psi tE_2]^\beta =$

$\{[(1-t)E_1 - T]^\alpha - \gamma\psi[(1-t)E_2 + \rho T]^\alpha\}[(1-\psi)tE_1 + \psi tE_2]^\beta =$

$\{[(1-t)E_1 - T]^\alpha - \gamma\psi[(1-t)E_2 + \rho T]^\alpha\}t^\beta[(1-\psi)E_1 + \psi E_2]^\beta$, where $\rho\equiv(1-\psi)/\psi$. Maximizing W_1 with respect to t yields the first-order condition $\{[(1-t)E_1 - T]^\alpha - \gamma\psi[(1-t)E_2 + \rho T]^\alpha\}\beta t^{\beta-1} -$ $\{[\alpha[(1-t)E_1 - T]^{\alpha-1}E_1 - \gamma\psi\alpha[(1-t)E_2 + \rho T]^{\alpha-1}E_2\}t^\beta = 0$. Rearranging, we have

$$\alpha t[(1-t)E_1 - T]^{\alpha-1}E_1 - \beta[(1-t)E_1 - T]^{\alpha} = \gamma\psi\{\alpha t[(1-t)E_2 + \rho T]^{\alpha-1}E_2 - \beta[(1-t)E_2 + \rho T]^{\alpha}\}. \quad \text{(A6)}$$

We need to ensure that the solution for t is interior and that $(1-t)E_1 - T \geq 0$. Inspection shows that if the t that solves (A6) satisfies $[(1-t)E_1 - T]^{\alpha} - \gamma\psi[(1-t)E_2 + \rho T]^{\alpha} > 0$, it yields a higher value of W_1 than $t = 0$. It is immediately clear that if this condition is satisfied, so is $(1-t)E_1 - T \geq 0$, so we can ignore the latter condition. Plugging $t = \beta/(\alpha + \beta)$ into $[(1-t)E_1 - T]^{\alpha} - \gamma\psi[(1-t)E_2 + \rho T]^{\alpha} > 0$ yields a condition expressed in terms of the parameters, $\{[\alpha/(\alpha + \beta)]E_1 - T\}/\{[\alpha/(\alpha + \beta)]E_1 + \rho T\} > (\gamma\psi)^{1/\alpha}$. This condition ensures that the solution to (A6) when $T = 0$, $t = \beta/(\alpha + \beta)$, yields a higher value of W_1 than $t = 0$. It is then easily shown that under this condition $dt/dT < 0$, and that $t < \beta/(\alpha + \beta)$ satisfies $[(1-t)E_1 - T]^{\alpha} - \gamma\psi[(1-t)E_2 + \rho T]^{\alpha} > 0$. It follows that if $T > 0$ and $\{[\alpha/(\alpha + \beta)]E_1 - T\}/\{[\alpha/(\alpha + \beta)]E_1 + \rho T\} > (\gamma\psi)^{1/\alpha}$, the solution for t is interior.

The solution to (A6) when $T = 0$, $t = \beta/(\alpha + \beta)$, yields a coefficient of zero on $\gamma\psi$ in (A6). As already noted, for $T > 0$ we obtain $t < \beta/(\alpha + \beta)$, and it is easily shown that the coefficient on $\gamma\psi$ in (A6) is negative for $T > 0$ and $t < \beta/(\alpha + \beta)$. Under our sufficient condition for an interior solution, it is then straightforward to demonstrate that for $T > 0$ we obtain $dt/d\gamma < 0$, $d^2t/d\gamma d\psi < 0$, and t strictly smaller than when $T = 0$ and $\gamma = 0$.