THE POLITICAL CLIMATE TRAP

JOSSE DELFGAAUW AND OTTO SWANK

ABSTRACT. We develop a simple political-economic model of a climate trap. We apply our model to gasoline taxes, which vary dramatically across countries. Externalities cannot fully account for this. Our model shows that group interests, resulting from the composition of a country's car fleet, can explain differences in gasoline taxes even among countries with identical fundamentals. Endogenous car ownership can yield multiple equilibria. This can lead to a political climate trap, where a low gasoline tax reflects the views of a majority, but another majority would benefit from transitioning to a high-tax equilibrium with fewer emissions.

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1. Introduction

Governments have been lamented for lackluster efforts to mitigate climate change. In many countries, general support for mitigating climate change among citizens is high. At the same time, specific policies, such as carbon pricing and increases in fossil fuel taxes, are opposed by many (Maestre-Andrés et al., 2019; Fairbrother et al., 2019). In a large, multi-country survey, Dechezleprêtre et al. (2022) find that respondents' stances towards climate policies correlate with their personal costs of adapting to such policies. Opposition to climate policies correlates particularly strongly with respondents' use of cars and poor availability of public transport.

This paper develops a political-economic model showing how voters' interests stemming from endogenous investments in durable goods can lead society into a political climate trap. We tailor our model to a concrete policy: gasoline taxes. By doing so, we offer a novel explanation for the large differences in gasoline taxes across countries. In January 2022, the average total tax on gasoline was almost 5 times as high in the European Union as in the United States.[1] Parry and Small (2005) try to explain the difference between gasoline taxation in Britain and the United States. They focus on three reasons for penalizing gasoline consumption: reducing emissions, reducing traffic congestion and severe collisions, and generating tax revenues. They derive that in 2000 the optimal gasoline tax rate would have been $0.33 per gallon higher in Britain than in the United States. The actual difference between the two taxes in 2000 was $2.40 per gallon. Thus, 87 percent of the difference between the gasoline tax in Britain and the US in 2000 cannot be explained on the basis of efficiency grounds.

Gasoline taxes are correlated with the kind of cars people buy. In 2021, the three best-selling car models in the United States were pick-up trucks: the Ford F-series, the Chevrolet Silverado, and the RAM. In the same year, the three best-selling cars in the European Union were subcompact cars: the Volkswagen Golf, the Peugeot 208, and the Dacia Sandero.[2] These cars consume about one-third of the amount of gasoline that a typical pick-up truck consumes. Across all new cars bought in the US in 2020, the average fuel efficiency was 25.4 miles per gallon (EPA, 2022). In Europe, this was 39.2 miles per gallon in 2019 (IEA, 2021).

[1] https://taxfoundation.org/gas-taxes-in-europe-2022/#:~:text=The%20average%20excise %20duty%20on,1.98%20per%20gallon)%20on%20diesel.

[2] https://www.best-selling-cars.com/europe/2021-full- year-europe-top-25 -best-selling-car-models/

Our model highlights the interaction between citizens' decisions on purchasing a fuel-efficient or fuel-inefficient car on the one hand and the median voter's decision on the gasoline tax on the other. We show that this interaction can put society into a political climate trap, where a majority enacts a low gasoline tax while another majority would benefit from a higher gasoline tax and fewer emissions.

In our model, a gasoline tax can correct a negative externality. It also redistributes income from citizens who drive in fuel-inefficient cars, often big cars, to citizens who drive in fuel-efficient cars, often small cars.[3] As illustrated above, the composition of the car fleet differs dramatically between Europe and the United States. A high gasoline tax benefits a *majority* of *small-car* owners in Europe but hurts a *majority* of *big-car* owners in the United States. As a result, a typical median-voter model predicts that gasoline taxes are higher in Europe than in the United States. These redistributive consequences help to explain differences in gasoline taxes across countries.[4]

The composition of a country's car fleet is not exogenous, neither in the real world nor in our model.[5] In our model, citizens make decisions on which cars to buy before the gasoline tax is determined. However, they anticipate the gasoline tax when they buy cars. The interaction between the composition of the car fleet and redistribution may lead to multiple equilibria. In the low-tax equilibrium, most citizens buy big cars. In the high-tax equilibrium, most citizens buy small cars. We show that, generally, redistributive motives distort taxes on gasoline. In the low-tax equilibrium, the tax is lower than the socially efficient level. In the high-tax equilibrium, the tax can be above or below the socially efficient level. This prediction is consistent with the empirical evidence reported by Parry and Small (2005).

On the basis of the parameters and the outcomes of our model, three environments can be distinguished. In the first environment, the low-tax equilibrium is unique. This requires that the net benefits of driving big cars are sufficiently high and that citizens should not be too ambitious regarding environmental goals. For instance, in rural areas the net benefits of big cars are larger than in urban areas. These areas

[3] Citizens without a car belong to the latter group.

[4] Our results do not imply that differences in gasoline taxes across countries can be defended on equity grounds. Poterba (2017) presents evidence for the US that gasoline taxes are slightly regressive. For Chile, Agostini and Jiménez (2015) find that the tax on gasoline is slightly progressive. We are not aware of empirical studies that show that gasoline taxes are highly progressive or highly regressive.

[5] Allcott and Wozny (2014) present evidence for the US that when citizens buy cars, they take into account future gasoline costs; see also Busse et al. (2013). Gerlach et al. (2018) find similar results for the European Union.

usually experience little traffic congestion, have plenty of room for parking, and offer few alternatives for traveling by car.

The second environment mirrors the first one. Here, the high-tax equilibrium is unique because big cars are inconvenient. In many urban areas, public transport is an alternative to traveling by car.[6] Furthermore, congestion makes traveling by car time-consuming. Strong preferences for reducing carbon dioxide emissions relax the conditions for the existence of the high-tax equilibrium.

In the third environment, the low-tax and high-tax equilibrium coexist. This result indicates that different policies between countries cannot always be explained by differences between the fundamentals of countries.[7] If multiple equilibria exist, society can be stuck in a climate trap. Low gasoline consumption is technologically feasible but does not eventuate due to the interaction between vested interests and politics. The low gasoline tax reflects the views of a majority of citizens [*cf*. Besley and Persson (2019)], even though an (other) majority would have been better off in the high-tax equilibrium.

We are not the first to identify a climate trap. In Besley and Persson (2023), a climate trap can arise from externalities between citizens' values and producers' choice of technology, which coevolve endogenously. In Nyborg (2020), multiple equilibria exist due to peer effects and endogenous social norms. We contribute by providing a concrete illustration of a political climate trap arising from the interaction between citizens' investments in durable goods and their voting behavior. We also offer a politically viable solution for escaping it. Van der Ploeg and Venables (2022) argue that radical policies are needed to overcome a climate trap resulting from strategic preferences and/or technology complementarities. We show that to escape a climate trap, commitment to a high gasoline tax *in the future* is a politically feasible option. Some current big-car owners who intend to replace their cars in the near future would support such a commitment.

A key feature of our model is that citizens buy cars *before* the median voter determines the gasoline tax. Theoretically, this makes our paper closely related to Alesina and Angeletos (2005) and Torvik et al. (2021). Alesina and Angeletos (2005) analyze

[6]Arguably, the quality of public transport is endogenous. Explicitly modelling this endogeneity would enlarge the parameter set under which the third environment arises.

[7]Dechezleprêtre et al. (2022) documents sizable differences in levels of support for several climate policies among quite similar countries.

a situation where citizens can invest in a productive activity before society chooses a redistributive policy. In Torvik et al. (2021), citizens choose an occupation before they vote on a tax. In both studies and in our model, multiple equilibria can arise because citizens' early decisions affect their later interests. In our model, the motivation for this assumption is that cars are durable goods with periods between successive purchases that are usually longer than periods between elections.[8] As a result, most citizens do not buy a car in the period between two successive elections. Of course, the tax on gasoline is relevant to citizens' decisions on which car to buy. When making these decisions, citizens must form expectations about future gasoline taxes.

Another feature of our approach is that we do not explicitly model the political process. We assume that the median voter chooses the gasoline tax. In the context of gasoline taxes, the median-voter approach is a good first approximation. Gasoline prices are typically visible. This makes the gasoline tax a salient issue for many citizens. In such environments, politicians cannot easily ignore the majority's interests (Persson and Tabellini, 2002). The yellow-vest protests in 2018 in France are illustrative. They were sparked by announced increases in fuel taxes. These protests forced president Macron to cancel fuel tax increases. Less-developed, oil-rich countries often subsidize gasoline. Attempts to reduce such subsidies often meet strong public resistance (see, for example, Akimaya and Dahl (2022), who describe the Indonesian government's attempts to cut gasoline subsidies).

We present the model in Section 2 and our main results in Section 3. We conclude by discussing several assumptions and extensions in Section 4.

2. THE MODEL

In this section, we present a rudimentary political-economic model of gasoline taxation. To obtain analytical results, we deliberately keep the model simple. Two simplifications are worth mentioning. First, we abstract from sales, value-added, and motor vehicle taxes on cars. Obviously, these taxes affect citizens' decisions on which cars to buy. In Section 4, we discuss the implications of these taxes for our model. Second, we assume that citizens can purchase either a small or a big car. In Section 4, we also elaborate on the continuous case.

[8] In 2019, the average age of the EU vehicle fleet was 11.5 years (ACEA vehicle in use report 2021). In the United States, the average vehicle age was 12.1 years in 2021, according to IHS Markit. On average, owners keep their car for 8.4 years in the United States.

Consider a society with many citizens of mass one indexed by i. Each citizen i makes three decisions. First, before the election, citizen i buys either a small car, $x_i = 0$, or a big one, $x_i = 1$. Let b_i denote citizen i's benefit of owning a big car relative to a small car unrelated to fuel consumption. b_i captures various aspects, such as car prices, comfort, neighborhood characteristics, safety, image concerns, etc. For example, owning a big car might be inconvenient in densely populated areas. For citizens in those areas, b_i is possibly negative. A society is characterized by a density function $f(b_i)$ with cumulative distribution function $F(b_i)$. Different societies typically have different density functions.[9]

Citizens' decisions on x_i divide society into two groups: a group of citizens owning small cars and a group of citizens owning big cars. Once each group has been formed, its members have identical interests. Small and big cars differ in gasoline consumption, g_i:

$$g_i = (1 + x_i v)\, m_i,$$

where m_i is the number of miles citizen i travels, and $v \geq 0$ is a measure of the extra gasoline a big car consumes per mile.

After each citizen has bought a car, an election is held to determine the tax $\tau \geq 0$ or subsidy $\tau < 0$ on gasoline. We assume that the representative of the group that forms the majority chooses τ. With two homogeneous groups, this assumption is equivalent to assuming that the median voter chooses τ. Tax revenues, $t = \tau \int g_i di$, are given back to the citizen in the form of a lump-sum transfer.

Finally, after the median voter has chosen τ, each citizen i chooses how many miles she drives. If gasoline were for free, each citizen would drive μ miles, $m_i = \mu$.[10] Citizen i's preferences are represented by the utility function

$$u_i(x_i, m_i) = t + x_i b_i - \frac{1}{2}(m_i - \mu)^2 - \tau g_i - \gamma \int_0^1 g_i di. \tag{1}$$

The fourth term of the right-hand side of (1) shows that the price of gasoline solely consists of the tax on gasoline. This assumption leads to shorter expressions in the next section. The last term in (1) provides the justification for a tax on gasoline. The

[9] In our model, b_i is independent of the share of citizens owning a big car. We ignore peer effects and external safety costs of owning a big car. Anderson and Auffhammer (2014) argue that external safety cost is an important rationale for taxing gasoline.

[10] Allowing for differences in μ across citizens does not affect our results qualitatively as long as owners of big cars consume more gasoline than owners of small cars.

usual interpretation of the parameter γ is that it denotes the actual externalities of gasoline consumption, like the costs of local and global pollution, congestion, and accidents.[11] When deriving the socially optimal tax, we use this interpretation. We use the superscript "SO" to refer to this γ, γ^{SO}.

When explaining why gasoline taxes vary across countries, we use an alternative interpretation. We assume that γ is a measure of the median voter's environmental preferences. The median voter takes into account the costs of local emissions and congestion as these costs are borne locally. It is less clear to what extent the median voter takes into account the costs of global pollution, like the emissions of carbon dioxide. These costs are global and raise free-rider problems. With respect to global pollution, γ measures to what extent citizens are willing to do their part. Importantly, γ may vary across societies because of differences in local conditions and environmental preferences.

The timing in our model is important. Citizens buy cars before the median voter determines the gasoline tax. As discussed in the introduction, the motivation for this assumption is that citizens keep their cars longer than the time between two elections. In Section 4, we discuss the situation where a part of the citizens buys a new car after the election.[12]

Our model is a simple, standard dynamic game. In the next section, we solve it by backward induction. When choosing how many miles to drive, citizen i owns a particular car, x_i, and faces a tax on gasoline, τ. Hence, m_i depends on x_i and τ. When choosing τ, the median voter observes the car fleet.[13] Furthermore, she anticipates how citizens' decisions on how many miles to drive depend on x_i and τ. She chooses τ so as to maximize her utility. Citizens' decisions on which car to buy x_i can be described by a threshold, b^T. Citizens with $b_i < b^T$ buy small cars, and citizens with $b_i \geq b^T$ buy big cars. In equilibrium, expectations must be validated. When making

[11]For reducing congestion and accidents, a tax on driven miles seems more effective than a tax on gasoline. A gasoline tax, however, is administratively relatively simple. Anderson and Auffhammer (2014) estimate that the accident-related externality amounts to a gasoline tax of $0.97 per gallon.

[12]We abstract from the second-hand car market including exports. Allowing for the ability to sell one's car in response to the election outcome does not affect our results as long as there is some (transaction) cost involved. This requirement is likely met (Akerlof, 1970).

[13]We assume that citizens follow undominated strategies. As citizens in each group have the same interests when voting, this assumption means that in equilibrium, each citizen votes for her most preferred tax rate.

their decisions on x_i, citizens correctly anticipate the median voter's decision on τ and their own decisions on m_i.

3. Analysis

We first derive how many miles citizen i drives given τ. Maximizing[14]

$$-\frac{1}{2}\left(m_i-\mu\right)^2-\left(1+x_i v\right)\tau m_i$$

with respect to m yields

$$m_i=\mu-\left(1+x_i v\right)\tau. \tag{2}$$

Equation (2) shows that a higher tax reduces miles of travel, especially among big car owners.[15]

To derive the equilibrium tax rate, we first write aggregated gasoline consumption and tax revenues as a function of τ. Let κ denote the share of citizens who own a small car, $\kappa=F\left(b^T\right)$. Then, aggregated gasoline consumption can be written as:

$$\int_0^1 g_i di=\kappa\left(\mu-\tau\right)+\left(1-\kappa\right)\left(1+v\right)\left[\mu-\left(1+v\right)\tau\right], \tag{3}$$

and tax revenues equal

$$\begin{aligned} t &= \tau\int_0^1 g_i di \\ &= \tau\kappa\left(\mu-\tau\right)+\tau\left(1-\kappa\right)\left(1+v\right)\left[\mu-\left(1+v\right)\tau\right]. \end{aligned} \tag{4}$$

Assumption 1. *Owners of big cars consume more gasoline than owners of small cars. This requires*

$$\begin{aligned} \left(1+v\right)\left[\mu-\left(1+v\right)\tau\right] &> \left(\mu-\tau\right) \\ \mu &> \tau\left(2+v\right) \end{aligned} \tag{5}$$

Assumption 1 drives all results in the paper. It implies that a gasoline tax redistributes from owners of big cars to owners of small cars. There is abundant evidence supporting Assumption 1. Feng et al. (2013) and Metcalf (2022) document that owners of SUVs spend more on gasoline than owners of subcompact cars. Furthermore, owners of SUVs drive at least as many miles as owners of smaller and, hence, more

[14] With a large number of citizens, each citizen ignores her own contribution to the externality.

[15] Davis and Kilian (2011) estimate a price elasticity of gasoline in the US of -0.46.

fuel-efficient cars in the US (Feng et al., 2013), the UK (Craglia and Cullen, 2020), Germany (Gössling and Metzler, 2017), and India (Chugh and Cropper, 2017).[16]

The socially-optimal tax rate

We first derive the social planner's decision on τ. We assume that the social planner chooses τ after citizens have bought cars. Furthermore, we assume that the social planner maximizes the sum of citizens' utility functions:

$$\text{(6)} \quad \int_0^1 u_i(\tau) = \kappa \frac{1}{2}\tau^2 - (1-\kappa)\frac{1}{2}(1+v)^2\tau^2 - \gamma^{SO}\left[\kappa(\mu-\tau) + (1-\kappa)(1+v)(\mu-(1+v)\tau)\right]$$

where we have used (2) and (3). Differentiating (6) with respect to τ, yields $\tau = \gamma^{SO}$. The social planner ignores the redistributive effects of the tax. Consequently, her tax decision is solely driven by environmental concerns.

Equilibrium tax rates

To determine the equilibrium tax rate, two cases have to be distinguished: the case that the median voter owns a small car and the case that she owns a big car. First, suppose that she owns a small car. Using (2-4) with $x_i = 0$, and maximizing

$$u_i(0, m_i) = t - \frac{1}{2}(m_i - \mu)^2 - \tau m_i - \gamma \int_0^1 g_i di$$

with respect to τ yields

$$\text{(7)} \qquad \tau_h(\kappa) = \gamma + \frac{(1-\kappa)v[\mu - \gamma(2+v)]}{1 + 2(1-\kappa)v(2+v)}.$$

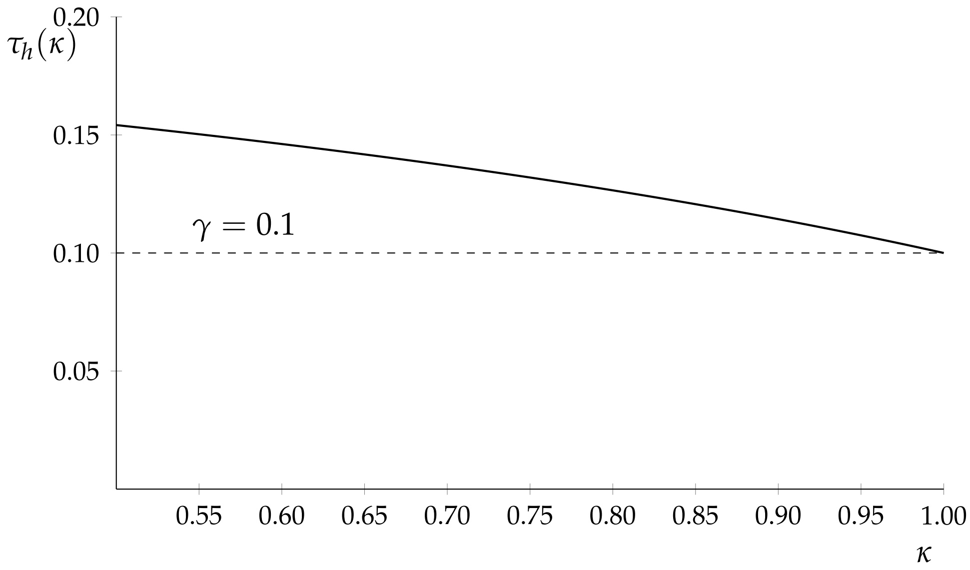
Condition (5) ensures that the last term in (7) is positive.[17] Equation (7) consists of two parts. The first part represents the extent to which society cares about the externality of gasoline consumption. The second part represents the benefit to citizens with small cars from the redistributive consequences of τ. Because citizens owning big cars consume more gasoline, a higher gasoline tax redistributes income from citizens with big cars to citizens with small cars. This redistributive part is decreasing

[16] Equation (2) implies that in our model, owners of big cars drive fewer miles than owners of small cars. Assuming a positive correlation between preferences for big cars and preferences for miles traveled would strengthen our results and unnecessarily complicate the analysis.

[17] To see this, suppose that $\gamma \downarrow \frac{\mu}{2+v}$. Then, $\tau = \gamma$ and (5) is just satisfied. For $\gamma > \frac{\mu}{2+v}$, $\tau > \gamma$ and (5) is violated. Hence, (5) requires that $\mu > \gamma(2+v)$.

in κ (see Figure 1). To understand the intuition for this relationship, consider the extreme cases that $\kappa = 1$ and $\kappa = \frac{1}{2}$. If $\kappa = 1$, all citizens own a small car. No redistribution is possible. Hence, $\tau_h(1) = \gamma$. If $\kappa \downarrow \frac{1}{2}$, almost half of the people owns a big car. Consequently, the base for redistribution is large, and citizens with small cars benefit considerably from a higher tax.

FIGURE 1. **The tax on gasoline (τ_h) as a function of the share of citizens with a small car (κ). The high-tax case.**



Equation (7) also shows that τ_h is increasing in μ. A higher value of μ increases traveling and, thereby, the difference in gasoline consumption between owners of big and small cars. The effect of an increase in v on redistribution is nonmonotonic. Redistribution requires that $v > 0$. As a result, the second term of (7) increases in v for low values of v. On the other hand, a higher value of v discourages citizens with big cars from traveling. For high values of v, the latter effect dominates the former one.

Now suppose that the median voter is a member of the group of citizens who own big cars, $\kappa < \frac{1}{2}$. Using (2-4) with $x_i = 1$, and maximizing

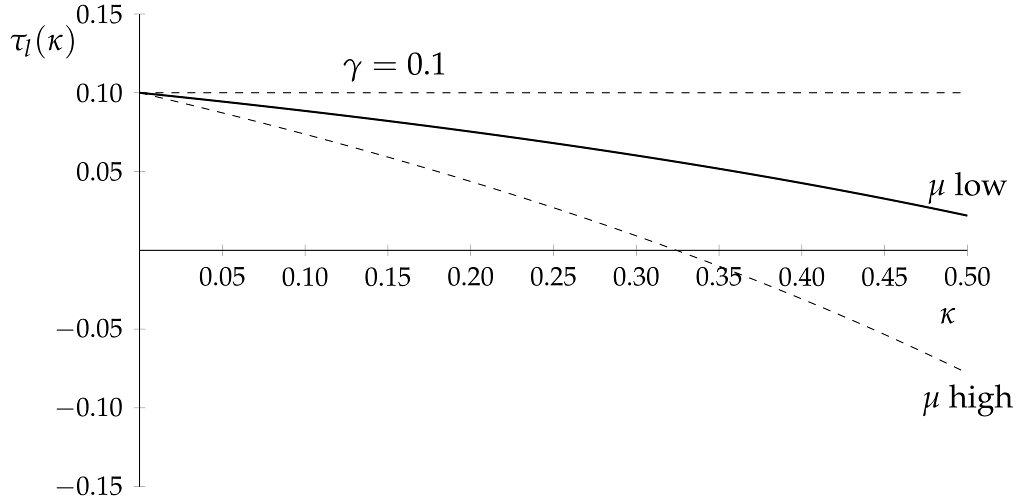
$$u_i(1, m_i) = t + b_i - \frac{1}{2}(m_i - \mu)^2 - \tau(1 + v)\, m_i - \gamma \int_0^1 g_i di$$

with respect to τ yields

$$\tau_l(\kappa) = \gamma - \frac{\kappa v\left[\mu - \gamma(2 + v)\right]}{1 + (1 - 2\kappa)\, v\,(2 + v)}. \quad (8)$$

Equation (8) shows that if the median voter owns a big car, she chooses a low tax to reduce redistribution from big car owners to small car owners.

FIGURE 2. **The tax on gasoline (τ_l) as a function of the share of citizens with a small car (κ). The low-tax case.**



Equation (8) mirrors (7). Redistributive concerns do not exist if all citizens own a big car ($\kappa = 0$) and become important if κ approaches one-half (see Figure 2). Furthermore, the higher is μ, the more the tax deviates from the tax rate that only targets the externality. Finally, it is worth noting that $\tau_l(\kappa)$ can be negative. Distributive concerns can become that important that gasoline consumption is subsidized (see dashed curve in Figure 2).[18]

Let us now turn to citizens' decisions on which cars to buy. As discussed above, these decisions can be characterized by a threshold, b^T. We first show that the higher is the anticipated tax rate, τ^a, the higher is b^T. For citizen i, buying a big car yields a higher utility than buying a small one if

$$b_i - \frac{1}{2}(1+v)^2(\tau^a)^2 - \tau^a(1+v)(\mu - (1+v)\tau^a) > -\frac{1}{2}(\tau^a)^2 - \tau^a(\mu - \tau^a),$$

implying

$$b_i > b^T(\tau^a) = v\tau^a\left(\mu - \frac{1}{2}(2+v)\tau^a\right). \tag{9}$$

[18]Subsidies on gasoline are not a mere theoretical outcome. In Venezuela, Libya, and Iran, gasoline prices are below \$0,10 per liter, far below the market price.

Condition (5) guarantees that b^T is increasing in τ^a. As $\tau_h(\kappa) > \tau_l(\kappa)$, this implies that

$$b^T[\tau_h(\kappa)] > b^T[\tau_l(\kappa)]. \tag{10}$$

Hence, the share of citizens buying a big car is decreasing in the anticipated tax on gasoline.

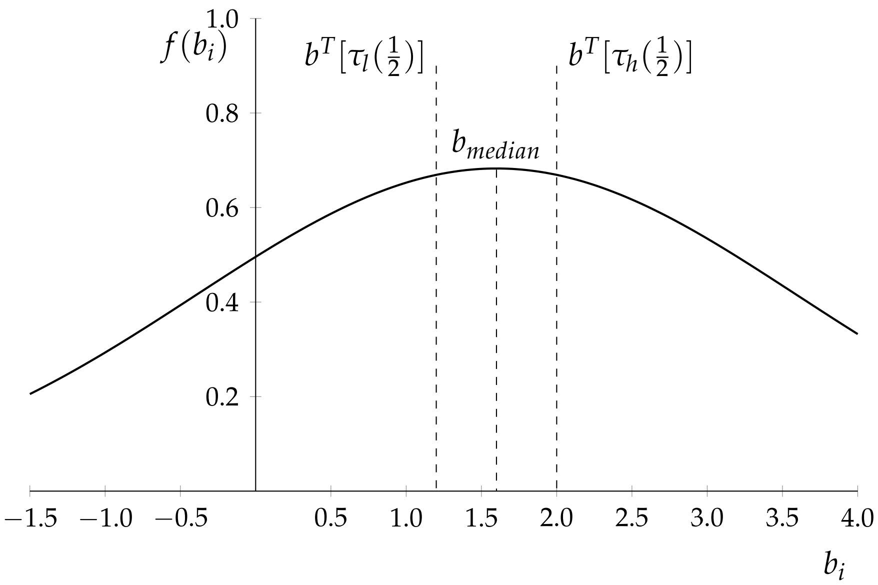
We are now ready to identify the equilibria of our model. Let τ^* denote the equilibrium gasoline tax and let κ^* denote the equilibrium share of citizens who buy a small car. In equilibrium, the anticipated tax is equal to the tax chosen by the median voter, $\tau^* = \tau^a$, with $\tau^* = \tau_l(\kappa^*)$ if $\kappa^* < \frac{1}{2}$ and $\tau^* = \tau_h(\kappa^*)$ if $\kappa^* > \frac{1}{2}$. An equilibrium with a high tax requires that a majority of citizens own a small car: $F\left\{b^T\left[\tau_h\left(\frac{1}{2}\right)\right]\right\} > \frac{1}{2}$. If this condition is met, the highest possible tax ($\tau_h(\frac{1}{2})$ in Figure 1) induces a majority to drive small cars. An equilibrium with a low tax requires that $F\left\{b^T\left[\tau_l\left(\frac{1}{2}\right)\right]\right\} < \frac{1}{2}$. Now the lowest possible tax ($\tau_l(\frac{1}{2})$ in Figure 2) induces a majority to drive big cars. Define b_{median} implicitly as $F(b_{median}) = \frac{1}{2}$. Proposition 1 presents the first main result of this paper.

Proposition 1. *If $b_{median} > b^T\left[\tau_h\left(\frac{1}{2}\right)\right]$, then a unique low-tax equilibrium exists, in which $\kappa^* < \frac{1}{2}$ and $\tau^* = \tau_l(k^*)$. If $b^T\left[\tau_l\left(\frac{1}{2}\right)\right] > b_{median}$, then a unique high-tax equilibrium exists, in which $\kappa^* > \frac{1}{2}$ and $\tau^* = \tau_h(k^*)$. If $b^T\left[\tau_h\left(\frac{1}{2}\right)\right] > b_{median} > b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$, then there exist multiple equilibria: (i) a low-tax equilibrium with $\kappa^* < \frac{1}{2}$ and $\tau^* = \tau_l(k^*)$, and (ii) a high-tax equilibrium with $\kappa^* > \frac{1}{2}$ and $\tau^* = \tau_h(k^*)$.*

Figure 3 graphically illustrates how the positions $b^T\left[\tau_h\left(\frac{1}{2}\right)\right]$ and $b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$ in the density function $f(b_i)$ determine which equilibria exist. If $b^T\left[\tau_l\left(\frac{1}{2}\right)\right] < b_{median} < b^T\left[\tau_h\left(\frac{1}{2}\right)\right]$, as depicted in Figure 3, for the same parameters of the model a high-tax equilibrium exists with $\kappa^* > \frac{1}{2}$ and a low-tax equilibrium exists with $\kappa^* < \frac{1}{2}$. The existence of multiple equilibria suggests that differences in primitives cannot always explain differences across countries. Countries that are similar in all relevant respects may end up in different equilibria. Multiple equilibria are likely to coexist in environments where citizens want to travel a lot, as τ_l is decreasing and τ_h is increasing in μ. A higher value of μ widens the range between $b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$ and $b^T\left[\tau_h\left(\frac{1}{2}\right)\right]$. The intuition is that the more miles citizens drive, the more can be distributed. This does not depend on whether a tax redistributes from big-car owners to small-car owners or vice versa.

Next, consider an environment where the benefits of driving big cars are large, such that $b^T\left[\tau_h\left(\frac{1}{2}\right)\right]$ is smaller than the median of $f\left(b_i\right)$, b_{median}. Relative to Figure 3, this corresponds to a rightward shift of $f\left(b_i\right)$. This means that when the government would impose the high equilibrium tax on gasoline, a majority of citizens nevertheless buys a big car. In this situation, there exists a unique equilibrium in which $\kappa^* < \frac{1}{2}$, and $\tau^* = \tau_l\left(\kappa^*\right)$. This low-tax equilibrium exists and is unique in an environment where the benefits of driving big cars are high and $\tau_h\left(\frac{1}{2}\right)$ is low. For example, rural areas where the population density is low are probably big-car-friendly environments. As discussed above, $\tau_h\left(\frac{1}{2}\right)$ is low for low values of γ and μ.

FIGURE 3. **Multiple equilibra**



A unique equilibrium where a majority drives in small cars, $\kappa^* > \frac{1}{2}$, and $\tau^* = \tau_h\left(k^*\right)$ exists, if $b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$ is higher than b_{median}. Then, for the low equilibrium tax, only a minority would be willing to buy a big car. This high-tax equilibrium is likely to exist and unique in environments where big cars are inconvenient, public transport is an alternative to the car, and the costs of local pollution and congestion are high, as in densely populated areas. Furthermore, this unique equilibrium is more likely in societies that want to contribute to reducing global pollution (high γ).

How do the equilibrium outcomes compare with the social-optimal outcome, $\tau = \gamma^{SO}$? In Section 2, we have argued that it is unlikely that the median voter takes all externalities of gasoline consumption into account, so that $\gamma < \gamma^{SO}$. This means that in the low-tax equilibrium, too many citizens drive big cars. In this case, redistributive motives distort citizens' decisions on which car to buy. In the high-tax equilibrium, the tax rate might be too low or too high, depending on the difference between γ^{SO} and γ. Theoretically, distributive concerns may improve welfare in this case.

The following proposition presents the second main result of this paper. Let b^C denote the level of b_i at which a citizen who buys the same type of car as the median voter is indifferent between the low-tax and the high-tax equilibrium.

Proposition 2. *Suppose $b^T\left[\tau_h\left(\frac{1}{2}\right)\right] > b_{median} > b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$ such that multiple equilibria exist. Then $b^C > b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$. If $b^C > b_{median} > b^T\left[\tau_l\left(\frac{1}{2}\right)\right]$, a climate trap exists, where society is in the low-tax equilibrium even though a majority of citizens is better off in the high-tax equilibrium.*

Proof. See Appendix. □

Society can be stuck in a low-tax equilibrium. Given the composition of the car fleet, a majority is in favor of a low gasoline tax. Yet, another majority would be in favor of a (costless) transition to an equilibrium with a higher gasoline tax, more small cars, and fewer emissions.

How could a society end up in a climate trap? Starting from a unique low-tax equilibrium, at least two developments can lead to a climate trap. First, urbanization may make big cars less attractive, leading to a leftward shift in the distribution of b_i. Second, rising environmental concerns in the population γ make the high-tax equilibrium increasingly attractive.[19]

How could a society escape from a climate trap? Two main features of a low-tax equilibrium are a car fleet that is predominantly composed of big cars and citizens who expect low future gasoline taxes. Changing these expectations requires either changing the composition of the current car fleet or changing the composition of the future car fleet. Changing the composition of the current car fleet requires subsidies. This reduces the benefit of transitioning to a high-tax equilibrium for those that do not receive the subsidies, thereby reducing support for the transition.

[19] It can be easily shown that b^C decreases in γ.

Changing the composition of the future car fleet can be achieved without subsidies. Commitment to a high gasoline tax *in the future* would induce more citizens to buy a small car when their current car needs replacement. Given that society is in a climate trap, a majority of citizens favors this commitment, provided this tax increase kicks in after their current car needs replacement.[20] Commitment is required. In the absence of commitment, the low-tax equilibrium remains viable.[21]

4. Discussion

Our political-economic model provides a concrete illustration of a climate trap as well as a novel explanation for the large variation in gasoline taxes across countries. We identified a low-tax equilibrium, in which citizens own big cars, and a high-tax equilibrium, in which citizens own small cars, which can coexist. In both equilibria, distributive motives create distortions in the gasoline tax. These distributional motives can make a current majority of big car owners support low gasoline taxes even though another majority of citizens would be better off after a transition to the high-tax equilibrium with fewer emissions.

In our model, citizens can either buy a small car or a big car. If we had assumed a continuum of cars in terms of fuel consumption and comfort among which citizens can choose, distributive motives would still affect taxes. As in our model, the relative positions of the mean and the median citizen would be important. In an equilibrium where the median citizen consumes more gasoline than the mean citizen, the gasoline tax is lower than in an equilibrium where the median citizen consumes less gasoline than the mean citizen. Again the low-tax and-high tax equilibria can be self-enforcing. This requires that for a low gasoline tax, the median citizen owns a bigger car than the mean citizen, while for a high gasoline tax, the median voter owns a smaller car than the mean citizen.

Our model allows for a climate trap due to the assumption that citizens buy cars before voting on the gasoline tax. Suppose it is common knowledge that after the election, a randomly chosen subset of citizens needs to buy a new car. This has two consequences. First, the gasoline tax now directly affects the share of small cars κ

[20]The exact time path would depend on the durability of cars and the fraction of citizens that buy a new car per year.

[21]Whether commitment is possible likely depends on the quality of institutions. The literature on environmental and energy economics discusses various ways to commit, see e.g. Marsiliani and Renström (2000), Helm et al. (2003), Brunner et al. (2012), and Klenert et al. (2018).

among the newly bought cars. The median voter has an incentive to use the gasoline tax to affect κ. Figures 1 and 2 show that in both equilibria, redistribution towards the median citizen is enhanced if the fraction of small car owners κ is closer to one-half. Consequently, compared to the main analysis, the median voter chooses a lower (higher) gasoline tax in the low (high) tax equilibrium. Second, the range of parameters under which multiple equilibria exist shrinks. In the implausible situation where all citizens buy new cars after the vote on the gasoline tax, the two equilibria cannot coexist; hence, a climate trap does not arise. The assumption that citizens follow undominated strategies (see footnote 13) ensures that the equilibrium outcome would be optimal from the median voter's perspective.

We have abstracted from car-specific sales and vehicle taxes. Car-specific taxes would affect citizens' car choices. A social planner would not use such a tax in our model. Through the Pigouvian gasoline tax ($\tau = \gamma^{SO}$), citizens fully internalize the external cost, which implies that they also make efficient car purchases. However, the median voter would impose a vehicle tax for distributive purposes: A vehicle tax on big cars directly redistributes from big car owners to small car owners. Consider again the situation where a randomly chosen subset of citizens needs to replace their car after the election and suppose the vehicle tax applies to newly-bought cars only. In the high tax equilibrium, this induces the median voter to set a positive vehicle tax on big cars. The level of the tax is limited by its effect on citizens' car choices after the election: from the perspective of the median citizen, a too high vehicle tax induces too many citizens to buy a small car, which defeats the distributive purpose of the tax. In this setting, the gasoline tax is still distorted for distributional reasons, albeit to a lesser extent. The vehicle tax is a more efficient distributional instrument, but only the gasoline tax affects citizens that do not replace their car. Co-existence of the high- and low-tax equilibria (and, hence, the climate trap) remains possible as long as a sufficiently large fraction of citizens keep their car after the election.[22]

[22] The variation in types of taxes levied on car purchases, ownership, and use across countries is large, making empirical comparisons troublesome.

Our model is tailored to gasoline tax policy, but its mechanisms apply more broadly. Distributive motives inherent to democratic decision-making can positively and negatively affect green transitions. Citizens' private investments in durable goods depend on (expectations of) public policies, which in turn depend on citizens' investment choices. For those aspiring to prevent or escape a climate trap, this suggests a complementarity between advocating for policy changes and influencing citizens' choices.

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APPENDIX

Proof of Proposition 2

First consider the low-tax equilibrium, in which the median voter buys a big car. The utility of buying a big car in this equilibrium can be found by substituting miles driven (2), total gasoline consumption (3), tax revenue (4), and gasoline tax (8) into utility function (1). After some rewriting, we obtain

$$\text{(A1)}\quad u_i = y + b_i + \frac{v^2\mu^2\left(\kappa_l^*\right)^2 - v\gamma\left(1+v\left(2+v\right)\left(1-\kappa_l^*\right)^2\right)\left(2\mu-\gamma\left(2+v\right)\right)}{2\left(1+v\left(2+v\right)\left(1-2\kappa_l^*\right)\right)} - \frac{1}{2}\gamma\left(2\mu-\gamma\right)$$

where κ_l^* denotes the fraction of citizens that buys a small car in this equilibrium.

Next consider the high-tax equilibrium, in which the median voter buys a small car. The utility of buying a small car in this equilibrium can be found by substituting (2), (3), (4), and (7) into (1). Some rewriting yields

$$\text{(A2)}\qquad u_i = y + \frac{v^2\left(1-\kappa_h^*\right)^2\left(\mu-\gamma\left(2+v\right)\right)^2}{2\left(1+2v\left(2+v\right)\left(1-\kappa_h^*\right)\right)} - \frac{1}{2}\gamma\left(2\mu-\gamma\right)$$

where κ_h^* denotes the fraction of citizens that buys a small car in this equilibrium.

Let b^C be defined as the level of b_i at which (A1) and (A2) are equal:

$$\text{(A3)}\quad b^C\left(\kappa_h^*, \kappa_l^*\right) = \frac{v^2\left(1-\kappa_h^*\right)^2\left(\mu-\gamma\left(2+v\right)\right)^2}{2\left(1+2v\left(2+v\right)\left(1-\kappa_h^*\right)\right)} - \frac{v^2\mu^2\left(\kappa_l^*\right)^2 - v\gamma\left(1+v\left(2+v\right)\left(1-\kappa_l^*\right)^2\right)\left(2\mu-\gamma\left(2+v\right)\right)}{2\left(1+v\left(2+v\right)\left(1-2\kappa_l^*\right)\right)}$$

If $b_m < b^C$, a majority of voters obtain a higher payoff in the high-tax equilibrium.

We now show that if $b_m = b^T\left(\tau^l(\kappa_l^* = \frac{1}{2})\right)$, such that the low-tax equilibrium is just feasible, we have that $b_m < b^C$. Substituting (8) and $\kappa_l^* = \frac{1}{2}$ into the expression for b^T, (10), yields

$$b^T\left(\tau^l(\kappa_l^* = \frac{1}{2})\right) = v\left(\gamma - v\frac{1}{2}\left(\mu-\left(2+v\right)\gamma\right)\right)\left(\mu - \frac{1}{2}\left(2+v\right)\left(\gamma - v\frac{1}{2}\left(\mu-\left(2+v\right)\gamma\right)\right)\right)$$

Substituting $\kappa_l^* = \frac{1}{2}$ into (A3) yields

$$b^C\left(\kappa_h^*, \frac{1}{2}\right) = \frac{v^2\left(1-\kappa_h^*\right)^2\left(\mu-\gamma\left(2+v\right)\right)^2}{2\left(1+2v\left(2+v\right)\left(1-\kappa_h^*\right)\right)} - \frac{v^2\mu^2 - v\gamma\left(4+v\left(2+v\right)\right)\left(2\mu-\gamma\left(2+v\right)\right)}{8}$$

We obtain

$$b^C\left(\kappa_h^*, \frac{1}{2}\right) - b^T\left(\tau^l(\kappa_l^* = \frac{1}{2})\right) = \frac{1}{8}v^2\left(\left(1+v\right)^2+2\right)\left(\mu-\gamma\left(2+v\right)\right)^2 + \frac{v^2\left(1-\kappa_h^*\right)^2\left(\mu-\gamma\left(2+v\right)\right)^2}{2\left(1+2v\left(2+v\right)\left(1-\kappa_h^*\right)\right)} > 0$$

It follows that if $b_m = b^T\left(\tau^l(\kappa_l^* = \frac{1}{2})\right)$, we have that $b_m < b^C$. This implies that all citizens with $b_i \leq b_m$ obtain a higher payoff in the high-tax equilibrium than in the low-tax equilibrium.