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A Baseline Model of Behavioral Political Cycles and Macroeconomic Fluctuations

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Keywords

Behavioral Macroeconomics, Disequilibrium, Discrete Choices, Macroeconomic Fluctuations, Political Cycles, Polarization

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A Baseline Model of Behavioral Political Cycles and Macroeconomic Fluctuations

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Although the rational choice approach remains the theoretical modeling paradigm in economics and political sciences, the relevance of behavioral factors such as heuristics and biases has been increasingly acknowledged in both fields over the last decades. Against this background, and in honor the lifetime work of Peter Flaschel, we set up a baseline political-macroeconomic model of the Keynes-Metzler-Goodwin (KMG) variety enhanced with endogenous political choices as in Di Guilmi and Galanis (2021). The mutual feedback between the political and the macroeconomic spheres, generated by our framework, gives rise to cyclical dynamics around moving long-term trends for certain parameter constellations. The results of both the stability analysis and the simulations illustrate the existence of multiple political equilibria in the presence of endogenous electoral presences resulting from the crucial role of income distribution not only as a determinant of aggregate investment and aggregate output, but also, of the political climate.

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1 Introduction

Even though Peter Flaschel was a prolific scholar in quite many research areas, his main interest was the study of the very core issue of capitalist societies, namely the struggle for the distribution of the income generated by the production process (Marx), the role of aggregate demand, and of bounded rationality (Keynes) and the creative destruction process as a driver of long-term growth (Schumpeter). Throughout the years, Peter Flaschel and his coauthors of the so-called "Bielefeld School" aimed at developing a theoretical framework that incorporated these dimensions coherently, calling it the Marx-Keynes-Schumpeter (MKS) framework (see e.g. Flaschel, 2009). In contrast to the predominant dynamic stochastic general equilibrium (DSGE) modeling paradigm (see e.g. Woodford, 2003), he considered the MKS framework, and capitalist economies in general, as dynamical systems subject to many destabilizing forces or mechanisms which, if not properly held at bay, would endanger the stability and in fact the society's very sustainability. In his late years, Peter became increasingly interested in the interplay between the political and the economic spheres, following with great interest, but also great concern, the increasing polarization of politics on both sides of the Atlantic.

We intend to honor Peter's lifetime work by taking this next step in the development of the MKS framework and incorporating a political sphere into a short-term variant of the MKS framework, namely the Keynes-Metzler-Goodwin (KMG) framework, see e.g. Chiarella and Flaschel (2000), Chiarella et al. (2005) and more recently Chiarella et al. (2021). We believe that this endeavor honors Peter's contributions to macroeconomic modeling and reflects his intrinsic interest on the viability of capitalist economies embedded in democratic systems, as well as his research direction together with the "Bielefeld School" group. Indeed, while the importance of bounded rationality and heterogeneous expectations for macroeconomic dynamics was already thematized in Flaschel et al. (1997, ch. 7), the exploration of the interplay of heterogenous expectations and disequilibrium macrodynamics either through the use of the Weidlich-Haag-Lux approach (Weidlich and Haag, 1983, Lux, 1995) or the Brock-Hommes discrete choice approach (Brock and Hommes, 1997, 1998) was undertaken systematically only in the last decade, as in Proaño (2011, 2013), Franke (2012, 2014), Flaschel et al. (2015), Flaschel et al. (2018). In this sense, the current paper extends the work of Peter Flaschel and the "Bielefeld School" on the KMG framework (see also Asada et al., 2011) in a direction not explored so far, namely the explicit incorporation of a political dimension.

Coupling such a framework with the political sphere is a particularly worthwhile exercise given the current development in world economics and politics, characterized by the significant increase in income and wealth inequality (see e.g. Atkinson et al., 2011, Stiglitz, 2012 and Piketty, 2014), as well as in political polarization (see e.g. Inglehart and Norris, 2016). As discussed e.g. by Proaño et al. (2022), these two developments are intrinsically linked: the rise in political polarization in Western democracies in the last twenty years, and in particular in the support for far-right parties, can be associated with (and in fact, may be driven by) the dramatic increase in income inequality,

and in particular by the relative deterioration of the economic conditions of the poorest share of the population. These findings are in line with related recent studies such as Voorheis et al. (2015) and Duca and Saving (2016) for the United States. Similarly, Han (2016), finds that income inequality encourages poorer people to vote for radical right parties, while it discourages more affluent people from doing so (see also Han and Chang, 2016). By contrast, Engler and Weisstanner (2020) find that rising income inequality increases the probability of voting for far-right parties, *but* this effect is "strongest among individuals with middle incomes and high status" facing the risk of losing social status (rather than income), see also Burgoon et al. (2019).

While the rational choice approach has been the theoretical modeling paradigm in political science over the past decades, the importance of behavioral factors such as heuristics and biases has been being increasingly acknowledged, see e.g. Bendor (2010) and Bendor et al. (2011). For instance, Di Guilmi and Galanis (2021) develop a behavioural dynamic model with heterogeneous individuals with endogenously evolving preferences (in the Brock-Hommes tradition) and two policy-oriented parties. The parties have different core values in terms of income redistribution but the extent to which their policies are actually implemented depends on the relative support that they enjoy. Their policies change the income distribution and generate a feedback effect on electoral preferences. As the dynamics of income distribution and the macroeconomy in general Di Guilmi and Galanis (2021) are quite parsimoniously specified, we aim in the proposed paper to integrate it with the KMG framework in order to model these dynamics, and in general the evolution of the macroeconomy, in a more structured manner, and to investigate how party politics may interact with macroeconomic dynamics in such a theoretical framework.

Setting these issues aside, our work contributes in general to various fields of research. On the one hand, this paper adds to the vast literature on the macroeconomic and political consequences of income inequality. The significant increase in income and wealth inequality around the world in recent decades documented by Atkinson et al. (2011), Stiglitz (2012) and Piketty (2014) has brought this issue to the center of the political debate, and particularly as a possible explanation of the increasing political polarization in many societies. Indeed, income inequality has become one of the main drivers for the growing electoral support of far-right parties in many European countries in the last 20 years, as shown e.g. by Proaño et al. (2022). On the other hand, our work is part of and contributes to the growing behavioral economics literature which analyses economies with boundedly rational interacting agents based on the seminal contributions by Lux (1995) and Brock and Hommes (1997, 1998). While the early works of this literature focused on asset pricing (also see Chiarella and He, 2002, 2003; Westerhoff and Dieci, 2006; Dieci and Westerhoff, 2010, among others), models with heterogeneous interacting agents have been used to study diverse phenomena such as monetary (De Grauwe, 2011; Proaño, 2013, 2011; Hommes and Lustenhouwer, 2019; Hommes et al., 2019; Assenza et al., 2021) and fiscal policy (Hommes et al., 2018) exchange rate dynamics (De Grauwe et al., 1993; De Grauwe and Grimaldi, 2005; Flaschel et al., 2015), a low carbon transition (Cahen-Fourot et al., 2022; Campiglio

et al., 2022; Galanis et al., 2022b; Dávila-Fernández et al., 2021) physical distancing in response to COVID-19 (Di Guilmi et al., 2020) and its effects on economic activity (Flaschel et al., 2022; Proaño and Makarewicz, 2021). Finally, this paper also contributes the already vast literature on political business cycles originated by the seminal work by Nordhaus (1975) where incumbent governments are motivated to pursue expansionary economic policies to gain popularity before elections take place, as shown by Tufte (1978) as well as Dubois (2016) in a recent survey of this research area. It is expected that left-wing and right-wing parties design the composition of public spending according to their political ideology and preferences (Bräuninger, 2005). While left-wing politicians are usually associated to the interests of blue-collar workers, right-wing politicians are traditionally linked to the interests of capital owners and high income groups (Alesina et al., 1997, Potrafke, 2020, Potrafke, 2011).

In a nutshell, our macro-political model consists of three dynamic equations describing the joint evolution of the output-capital ratio, the wage share (and thus, of functional income distribution), and a variable that indicates whether the overall political climate is right- or left-leaning, and which is influenced by the state of the economy, a herding or bandwagon term, and a term representing the public's preferences regarding income distribution. This political climate variable influences in turn the tax rate levied to the capitalists relative to the tax rate levied to the workers. This feedback from the political to the macroeconomic sphere, and viceversa, generates cyclical dynamics around moving long-term trends for certain parameter constellations. The results of both the stability analysis and the simulations integrates the findings of Di Guilmi and Galanis (2021) regarding the existence of multiple political equilibria in the presence of endogenous electoral presences, highlighting the crucial role of the income distribution as a determinant of aggregate investment, aggregate output, income distribution and, by extension, the political climate. In particular, it is possible to identify thresholds in the sensitivity of investment to the net profit rate and to the output gap that can lead to political swings or polarization. We kept the model intentionally simple – but not too simple – on the macroeconomic dimension to obtain clear-cut analytical results, but, as we will discuss in the final section, our model could be easily extended in many directions. This stylized Keynes-Goodwin model with endogenous political choices is the first of its kind to the best of our knowledge

The remainder of this paper is organized as follows. First, in Section 2, we describe the model and present the stability analysis. We illustrate the transmission mechanisms at work in the model numerically in Section 3, and investigate the robustness of our findings by means of bifurcation analysis in Section 4. Finally, we draw some concluding remarks from this study in Section 5.

2 The Model

2.1 The Macroeconomic Environment

We model the dynamics of the macroeconomy along the lines of the Keynesian disequilibrium approach put forward by Chiarella and Flaschel (2000), Chiarella et al. (2005) and more recently Chiarella et al. (2021). In particular, we employ a simplified version of the Keynes-Metzler-Goodwin (KMG) model discussed in the above mentioned works, with the Metzlerian inventory dynamics being however abstracted from.[1]

We mostly follow the notation of Chiarella et al. (2021) and denote by

$$\rho = (1 - v)y - \delta \tag{1}$$

the profit rate, with $y = Y/K$ being the output-capital ratio, δ the depreciation rate of capital, and $v = \omega L^d/Y$ being the wage share, with $\omega = w/p$ as the real wage and L^d as the employment level (which in a Keynesian regime is determined by labor demand).

As it is standard in the heterodox literature (see e.g. Blecker and Setterfield, 2019) and recently, also in the new TANK-DSGE literature (see Cantore and Freund, 2021), we assume that aggregate income y (expressed relative to the capital stock) is divided into workers' and capitalists' shares, which are indicated by v and $1 - v$, respectively, and the consumption of each group or social class is determined by group- or class-specific saving preferences: while workers do not save ($s_w = 0$),[2] i.e. are hand-to-mouth consumers, capitalists save a share $0 < s_c < 1$ of their after-tax disposable income. Accordingly, aggregate private consumption (expressed in relation to the capital stock) is the sum of workers' and capitalists' consumption, i.e.

$$c = \frac{C}{K} = \overbrace{vy(1 - \tau_w)}^{C^w/K} + \overbrace{(1 - s_c)\rho(1 - \tau_c)}^{C^c/K} \tag{2}$$

where τ_w and τ_c are tax rates for workers and capitalists.

Regarding the government sector, we assume a balanced budget for the sake of simplicity, and also assume that government spending (expressed here in relation to the capital stock) is fully funded by taxes, i.e.

$$g = \frac{G}{K} \quad = \quad \tau_w v y + \tau_c \rho. \tag{3}$$

[1] As discussed in the above cited works, the class of models proposed there is not based on neoclassical microfoundations, but instead presents aggregate relationships in a descriptive manner based on reasonable and empirically sound behavioral relationships. The focus of the analysis of this type of models is the possible nonlinear and unstable interaction between macroeconomic aggregates stemming from the reaction to disequilibrium situations mostly in the real markets that is often neglected in models based on utility and profit maximization, general equilibrium and rational expectations.

[2] This simplifying assumption can be easily relaxed in more elaborated extensions of the current framework.

The gross investment to capital stock ratio $i = I/K$ is assumed to depend on the difference between the after-tax profit rate $\rho - \tau_c$ and the real rate of interest r, i.e. the profitability gap (Fisher, 1933, Kalecki, 1933 and Keynes, 1936), according to the following functional relationship

$$i = \frac{I}{K} \quad = \quad i_\rho\{(1-\tau_c)\rho - r\} + \delta,$$

with δ being the rate of capital depreciation and the real interest rate r being a positive function of the current output gap:[3]

$$r = \bar{r} + r_y(y - y^*). \tag{4}$$

where r_y is a positive constant. After insertion of eq.(1) and (4), the gross investment to capital ratio can be expressed as

$$i \quad = \quad i_\rho\{(1-\tau_c)((1-v)y - \delta) - \bar{r} - r_y(y - y^*)\} + \delta. \tag{5}$$

In a standard manner, aggregate demand is given by

$$y^d = c + i + g, \tag{6}$$

and the output is assumed to adjust in reaction to the goods market disequilibrium given by the difference between aggregate demand and current aggregate output, i.e.[4]

$$\dot{y} = \beta_y(y^d - y). \tag{7}$$

Finally, and in contrast to the standard approach of the "Bielefeld School" of specifying two separate wage- and price Phillips curves to model the dynamics of the real wage (and for a constant labor productivity, of the wage share), see Chiarella et al. (2005) as well as e.g. Franke et al. (2006), we use here the following reduced-form expression to link evolution of the wage share with the output gap, represented here by $y - y^*$

$$\dot{v} = v(1-v)\beta_w(y - y^*). \tag{8}$$

[3] While in the standard KMG model the (nominal) interest rate was determined by an inverted LM-relationship, in the Keynes-Metzler-Goodwin-Taylor (KMGT) framework proposed by Chiarella et al. (2005, Ch. 9), the (nominal) interest rate was determined by a Taylor (1993)-like interest rate rule. As we have not modelled here price inflation explicitly, we will consider equation (4) as a reduced-form expression that simply makes the reference real rate interest rate as a function of the state of the economy, leaving open to interpretation whether this positive relationship is policy- or market-determined.

[4] In a proper KMG framework, intended and unintended inventories, together with the firms' output expectations, would determine aggregate output. As this channel is not central for the current analysis, we opted for this simplified specification instead.

with y^* being the output/capital ratio below which v, decreases.[5]

2.2 Voting Dynamics and Political Choices

Following Di Guilmi and Galanis (2021), we consider two political parties and $2N$ boundedly rational voters with evolving preferences, N being very large. The voters choose between two parties: left, denoted by L, and right, denoted by R. The parties differ in their taxation policy with R favoring a flat tax across capitalists and workers and L aiming for a higher tax on capitalist income. The actual level of taxes is given by the population's relative support of the two parties. In the original paper, Di Guilmi and Galanis (2021) assume that the L (R) redistributes income from the top (bottom) to the bottom (top) of the distribution, therefore lowering (increasing) inequality, proxied by the Gini index. The integration of political partial model within a more elaborate macroeconomic framework allows us to make the mechanism of redistribution explicitly quantifiable and study in more detail the interaction of the political and the macroeconomic spheres.

Let the x be the relative support of the left, such that

$$x = \frac{n^L - n^R}{2N}, \tag{9}$$

where n^L is the share of the left voters and n^R the share of voters who support the right, such that $n^L + n^R = 2N$. This implies that $x \in [-1, 1]$, with $x > 0$ when $n^L > n^R$. We assume that the relative tax contributions from the two classes are given by

$$\tau_c = \tau_w(2 + x) \tag{10}$$

such that when all voters support L ($x = 1$), capitalists are taxed three times as much as workers, and when all voters choose R ($x = -1$) the tax rate is the same across social groups.[6]

Along the lines of discrete choice models, we assume that individual preferences depend on observable variables, which are common for the whole population, and unobservable characteristics, which vary across agents. More specifically, we hypothesize that political preferences for individual i are given by

$$U_i = \gamma \mathbf{V} + \epsilon_i, \tag{11}$$

where $\mathbf{V}$ is a column vector of the observable factors, γ a row vector that captures the relative importance of each of the elements of $\mathbf{V}$, and ϵ_i represents the unobservable characteristics for agent

[5] The generally acknowledged procyclicality of real wages $\omega = w/p$ and labor productivity Y/L^d implies an ambiguous reaction of $v = \omega L^d/Y$ with respect to an increase in output. As Galí and van Rens (2021) document a vanishing procyclicality of labor productivity in the United States, we will assume in the following that the wage share increases for $y > y^*$.

[6] The assumption of having a maximum tax rate for capitalist income of three times the one for workers is a simplifying assumption which allows for a tractable functional form as per equation (10).

i. According to (11), agent i chooses to vote L if $U_i > 0$ and prefers R, otherwise. The vector $\mathbf{V}$ includes three types of factors: the *bandwagon effect*, captured by x, the *responsibility hypothesis* captured by the output gap $(y - y^*)$, and the public's *distributional preferences*, quantified by v^*. Denoting with $\gamma = [\gamma_x,\ \gamma_y,\ \gamma_v]$ the relative importance of each of the effects, we can write

$$\gamma \mathbf{V} = \gamma_x x + \gamma_y x(y - y^*) + \gamma_v(v^* - v). \tag{12}$$

Accordingly, an economic boom ($y > y^*$) will benefit the party with the political majority at that moment (recalling that $x > 0$ and $x < 0$ imply a left-wing and right-wing majority, respectively), whereas none of the two parties will benefit from such a situation when $x = 0$. Further, regarding the third term, we assume that if the wage share is lower than the steady state value v^* (assumed to be known by the public in the following), the electorate will turn to the left-party, which is traditionally associated to more equality-oriented policies. By contrast, if $v > v^*$, the public will turn to the right-wing party. This third term replaces the inequality factor in Di Guilmi and Galanis (2021) because, in line with the KMG tradition, here we consider the functional rather the personal distribution of income.

Postulating that ϵ_i in (11) follows a logistic distribution,[7] the probability $P(L|\mathbf{V})$ that a randomly chosen individual chooses L, for a given $\mathbf{V}$, is

$$P(L|\mathbf{V}) = \frac{e^{\gamma \mathbf{V}}}{1 + e^{\gamma \mathbf{V}}}. \tag{13}$$

Accordingly, the probability for given $\mathbf{V}$ of choosing R is

$$P(R|\mathbf{V}) = 1 - P(L|\mathbf{V}) = \frac{1}{1 + e^{\gamma \mathbf{V}}}. \tag{14}$$

From (13) and (14), the change in the relative proportion of voters is

$$\dot{x} = (1 - x)\frac{e^{\gamma \mathbf{V}}}{1 + e^{\gamma \mathbf{V}}} - (1 + x)\frac{1}{1 + e^{\gamma \mathbf{V}}} = \frac{e^{\gamma \mathbf{V}} - 1}{1 + e^{\gamma \mathbf{V}}} - x \tag{15}$$

2.3 Stability Analysis

The model discussed above can be represented as a dynamical system in x, y and v. To provide the reader with a better appreciation of the effect of the interaction of macroeconomic dynamics and political choices, we first discuss the existence and stability of steady states in the macroeconomic and political spheres separately, and then, in the last subsection, the full model is analyzed.

[7] The assumption of a logistic distribution implies a logit model for the discrete choice process, as it is common in empirical research (Train, 2009). The logistic distribution is also the standard implicit assumption in the theoretical models drawing on discrete choice theory. We refer the interested reader to the survey by Hommes (2006), for example, and to the discussion in Galanis et al. (2022a).

2.3.1 The Macroeconomic Submodel

In order to isolate the political influences, we assume $x = 0$ in the following. Plugging (2), (3), (5) and (10) into (7) we get

$$\dot{y} = \beta_y\{(i_\rho - s_c)(1 - 2\tau_w)[(1 - v)y - \delta] - i_\rho[\bar{r} + r_y(y - y^*)]\}. \tag{16}$$

Together with (8), the above expression implies the existence of three possible steady states, namely

- A first, economically not relevant, steady state where $v = 0$ for which

$$y = \frac{(i_\rho - s_c)(1 - 2\tau_w)\delta + i_\rho(\bar{r} + r_y y^*)}{(i_\rho - s_c)(1 - 2\tau_w) - i_\rho r_y}. \tag{17}$$

- A second, also economically not relevant, steady state where $v = 1$, for which we get

$$i_\rho[\bar{r} + r_y(y - y^*)] = -\frac{\delta(i_\rho - s_c)(1 - 2\tau_w)}{i_\rho r_y} - i_\rho(\bar{r} - r_y y^*), \tag{18}$$

  which for reasonable parameter values appears to be negative.

- Finally, a third economically relevant steady state where $0 < v < 1$ and $y = y^*$, for which the steady state capitalist income is given by

$$(1 - v^*)y^* = \frac{i_\rho \bar{r}}{(i_\rho - s_c)(1 - 2\tau_w)} + \delta. \tag{19}$$

  The elements of the Jacobian for this economically relevant steady state are given by

$$\begin{aligned}
J_{11} &= \frac{\partial \dot{y}}{\partial y} = \beta_y[(i_\rho - s_c)(1 - 2\tau_w)(1 - v^*) - i_\rho r_y] \\
J_{12} &= \frac{\partial \dot{y}}{\partial v} = \beta_y(s_c - i_\rho)(1 - 2\tau_w)y^* \\
J_{21} &= \frac{\partial \dot{v}}{\partial y} = \beta_w v^*(1 - v^*) = J_{21} > 0, \quad \text{and} \\
J_{22} &= \frac{\partial \dot{v}}{\partial v} = 0.
\end{aligned}$$

Given that $J_{21} > 0$ and $J_{22} = 0$, and under the assumption that $1 - 2\tau_w > 0$, local stability of this third steady state requires that

1. $i_\rho > s_c$, and
2. $r_y > \frac{(i_\rho - s_c)(1 - 2\tau_w)(1 - v^*)}{i_\rho}$.

Under these two conditions, $J_{12} < 0$ and $J_{11} < 0$, so that

$$\mathrm{tr}J = J_{11} + J_{22} < 0 \quad \text{and} \quad \det J = J_{11}J_{22} - J_{12}J_{21} > 0.$$

2.3.2 The Political Submodel

The evolution of political preferences given by (15) implies different possibilities for existence of steady states for which $\dot{x} = 0$. From (15), it is straightforward to observe that for $x = 0$, for any y, and for $v = v^*$, we have that $\dot{x} = 0$. For simplicity, we refer to the $x = 0$ steady state as *centrist*. Apart from the centrist steady state and depending on the parameter values and the values of the variables, other steady states may exist.

Since $\frac{e^{\gamma \mathbf{V}}-1}{1+e^{\gamma \mathbf{V}}} \in (-1, 1)$, if $x = 1$, $\dot{x} < 0$, while for $x = -1$, $\dot{x} > 0$. However, for different values of $x \in (0, 1)$ there exist different parameter configurations values for which, given y and v, it is possible to verify that

$$e^{\gamma \mathbf{V}} - 1 > x(1 + e^{\gamma \mathbf{V}})$$

or

$$e^{\gamma \mathbf{V}} > \frac{1+x}{1-x}.$$

For example, for $x = 1/2$, in order to have $\dot{x} = 0$ the values of $\gamma \mathbf{V}$ should verify

$$e^{\gamma \mathbf{V}} > 3,$$

or equivalently

$$\frac{1}{2}[\gamma_x + \gamma_y(y - y^*)] + \gamma_v(v^* - v) > \ln(3). \tag{20}$$

This result implies the existence of two more possible steady states with $x \in (0, 1)$ for which $\dot{x} = 0$ holds. In a similar way, for $x \in (0, -1)$ it is possible that two further steady states exist, when $\gamma \mathbf{V}$ is such that

$$e^{\gamma \mathbf{V}} - 1 < x(1 + e^{\gamma \mathbf{V}})$$

or

$$e^{\gamma \mathbf{V}} < \frac{1+x}{1-x}.$$

For example, for $x = -1/2$, if

$$-\frac{1}{2}[\gamma_x + \gamma_y(y - y^*)] + \gamma_v(v^* - v) < -\ln(3)$$

or

$$\frac{1}{2}[\gamma_x + \gamma_y(y - y^*)] - \gamma_v(v^* - v) > \ln(3). \tag{21}$$

Note that for the two previous examples with symmetric values for x, both conditions depend positively on the value of γ_x and positively (negatively) on γ_y when output is sufficiently high (low). The effect of the functional income distribution is different depending on the political majority. When $x > 0$, γ_v plays a positive role on the existence of other steady states, while this effect is negative when $x < 0$. Obviously, for $v = v^*$ the two conditions become the same and for a given value of x, we see that the existence of more steady states requires $\gamma_x + \gamma_y(y - y^*)$ to be sufficiently high. At the more special case of the (y^*, v^*) macro steady state to be discussed below, the existence of multiple "political" steady states depends on γ_x (the importance of the bandwagon effect).

Intuitively, the curve $\dot{x} = 0$, when plotted against x, would cross the horizontal axis at $x = 0$ for any values of the parameters and other variables. Note that from (15) we get

$$\frac{\partial \dot{x}}{\partial x} = \frac{[\gamma_x + \gamma_y(y - y^*)]e^{\gamma \mathbf{V}}(1 + e^{\gamma \mathbf{V}}) - [\gamma_x + \gamma_y(y - y^*)]e^{\gamma \mathbf{V}}(e^{\gamma \mathbf{V}} - 1)}{(e^{\gamma \mathbf{V}} - 1)^2} - 1 = \frac{2[\gamma_x + \gamma_y(y - y^*)]e^{\gamma \mathbf{V}}}{1 + (e^{\gamma \mathbf{V}})^2}$$

and for $x = 0$, the stability condition is

$$\gamma_x + \gamma_y(y - y^*) < 2. \tag{22}$$

Given that if $x = 1$, $\dot{x} < 0$, while for for $x = -1$, $\dot{x} > 0$, if conditions along the lines of (20) and (21) do hold, the $\dot{x} = 0$ curve is crossing the horizontal axis (at least) four more times. We should note at this point that for low values of $\gamma_x + \gamma_y(y - y^*)$, a single steady state exists and is stable while for higher values of $\gamma_x + \gamma_y(y - y^*)$, more steady states exists and the middle one ($x = 0$) loses stability. Intuitively we expect that for high $\gamma_x + \gamma_y(y - y^*)$ two of the steady states, one for $x > 0$ and one for $x < 0$ will be stable.

This set of results is consistent with and extends those of Di Guilmi and Galanis (2021), where the output y was considered as a constant in the baseline scenario. Let us now examine how the analysis changes when we allow for feedback between the political and the macroeconomic subsystems.

2.3.3 The Macro-Political Model

The previous analysis of the political "submodel" shows that both the existence and the stability of the "political" steady states depends on the macroeconomic variables. Furthermore, also the specific values of x for the non-centrist steady states depend on the values and hence the macroeconomic steady states.

Let us now consider the local stability properties of full three-dimensional dynamical model consisting of equations (7), (8) and (15), the law of motion for x for the centrist and economically meaningful steady state $(y^*, v^*, 0)$ where $0 < v^* < 1$.

The elements of the Jacobian at this steady state are given by

$$\begin{aligned}
J_{11} &= \frac{\partial \dot{y}}{\partial y} = \beta_y[(i_\rho - s_c)(1-2\tau_w)(1-v^*) - i_\rho r_y], \quad J_{12} = \frac{\partial \dot{y}}{\partial v} = \beta_y(s_c - i_\rho)(1-2\tau_w)y^*, \\
J_{13} &= \frac{\partial \dot{y}}{\partial x} = -\frac{2\beta_y i_\rho \bar{r}}{(1-2\tau_w)} < 0 \\
J_{21} &= \frac{\partial \dot{v}}{\partial y} = \beta_w v^*(1-v^*) > 0, \quad J_{22} = \frac{\partial \dot{v}}{\partial v} = 0, \quad J_{23} = \frac{\partial \dot{v}}{\partial x} = 0 \\
J_{31} &= \frac{\partial \dot{x}}{\partial y} = 0, \quad J_{32} = \frac{\partial \dot{x}}{\partial v} = \frac{-\gamma_v}{2} < 0, \quad J_{33} = \frac{\partial \dot{x}}{\partial x} = \frac{\gamma_x}{2} - 1.
\end{aligned}$$

Let $a_1 = -\mathrm{tr}(J)$, $a_2 = J_1 + J_2 + J_3$ and $a_3 = -\det(J)$. Then, stability requires

- $a_i > 0$, $i = 1, 2, 3$
- $a_1 a_2 > a_3$.

Under the assumption that the macro stability conditions $\left(i_\rho > s_c \text{ and } r_y > \frac{(i_\rho - s_c)(1-\tau_c)(1-v^*)}{i_\rho}\right)$ hold and $\gamma_x < 2$, the Jacobian of the three-dimensional dynamical system around the economically relevant steady state becomes

$$\begin{bmatrix} - & - & - \\ + & 0 & 0 \\ 0 & 0 & - \end{bmatrix}. \tag{23}$$

This means that $a_1 > 0$. Also,

$$J_1 = \begin{vmatrix} J_{11} & J_{12} \\ J_{21} & J_{22} \end{vmatrix} = \begin{vmatrix} - & - \\ + & 0 \end{vmatrix} = -J_{12}J_{21} > 0,$$

$$J_2 = \begin{vmatrix} J_{11} & J_{13} \\ J_{31} & J_{33} \end{vmatrix} = \begin{vmatrix} - & - \\ 0 & - \end{vmatrix} = J_{11}J_{33} > 0,$$

and

$$J_3 = \begin{vmatrix} J_{22} & J_{23} \\ J_{32} & J_{33} \end{vmatrix} = \begin{vmatrix} 0 & 0 \\ 0 & - \end{vmatrix} = 0.$$

hence $a_2 > 0$

$$a_3 = -\det(J) = J_{12}J_{21}J_{33} > 0.$$

Finally we need

$$-(J_{11} + J_{33})(-J_{12}J_{21} + J_{11}J_{33}) > J_{12}J_{21}J_{33}$$

or

$$J_{11}J_{12}J_{21} - J_{11}^2 J_{33} + J_{12}J_{21}J_{33} - J_{11}J_{33}^2 > J_{12}J_{21}J_{33}$$

or

$$J_{11}J_{12}J_{21} - J_{11}^2 J_{33} - J_{11}J_{33}^2 > 0$$

which is true.

So far, we have focused the analysis of the macro-political model on the centrist steady state, and only demonstrated the existence of non-centrist steady states, but not their stability properties. We next turn to simulations which can provide further insights regarding the behaviour around the non-centrist steady states.

3 Dynamic Adjustments

This section presents the results of the numerical simulations of the model in order to provide a visual representation of its dynamics of adjustment to the steady state. The plots also illustrate the sensitivity of the model to changes in the main parameters. As done for the analytical study, we first present the dynamics of the macroeconomic model abstracting from the feedback from the voting dynamics, and then the full model with both the political and the macroeconomic spheres. More precisely, in section 3.1, political choices are assumed to be insensitive to the functional income distribution ($\gamma_v = 0$) and the political climate is neutral $x(0) = 0$.

3.1 Exogenous and Endogenous Tax Redistribution without Electoral Distributional Preferences

In order to illustrate the mechanisms at work in our model, we first discuss the effects of a reduction of 5 percent points of the capitalists' tax rate from 0.2 to 0.15 (and a corresponding increase in the workers' tax rate from 0.1 to 0.15) that lasts for five periods for the case where $i_\rho > s_c$ using the baseline parameter values reported in Table 1, which imply a government capital ratio of 0.3 and a wage share of 0.7, see (19), using the parameter values reported in Table 1.[8]

Figure 1 illustrates the evolution of the model's two key variables output (more precisely, the output-capital ratio), and the wage share for three values of r_y, the reaction of the real interest rate to the output-capital ratio: 0.09, 0.15 and 0.25. As it can be clearly observed, a reduction of τ_c leads to an initial increase in output and, with some delay, also of the wage share given the assumed procyclicality of the latter. The economic rationale for this result is the following: while the redistribution of the tax burden from capitalists to workers has an unambiguous positive impact on aggregate investment (see equation 5) and capitalists' consumption, it depresses at the same time workers' consumption on impact. As we assume that both positive channels (the investment reaction and the capitalists' consumption) are sufficiently large ($i_\rho > s_c$), the net effect on output is positive. The subsequent

[8]The values are of similar magnitudes as those used in Chiarella et al. (2021).

Table 1: Baseline parameter values

Variable	Symbol	Value
Depreciation rate	δ	0.1
Output adjustment parameter	β_y	0.75
Wage share adjustment parameter	β_v	0.5
Workers' tax rate (for $x = 0$)	τ_w	0.1
Capitalists' tax rate (for $x = 0$)	τ_c	0.2
Steady state real interest rate	$\bar{r}$	0.05
Steady state output capital ratio	y^*	1.0
Capitalists' saving rate	s_r	0.2
Profit rate coefficient in investment function	i_ρ	0.4
Herding coefficient in sentiment expression	γ_x	2.0
Business cycle coefficient in sentiment expression	γ_y	10
Wage share coefficient in sentiment expression	γ_v	0.0/2.5

increase of the wage share leads to a decrease in the firms' profit rate that, if i_ρ is sufficiently large, leads over time to an reduction in aggregate investment that depresses aggregate output beyond its long-term steady state. This of course leads again to a decrease in the wage share that increases the profit rate, boosting aggregate investment and output again.

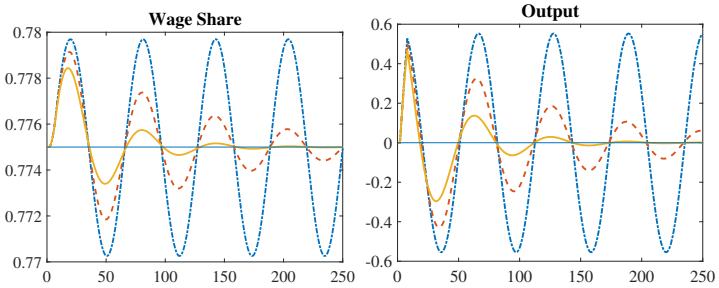

Figure 1: Dynamic adjustments following a decrease of τ_c from 20% to 15% (and an increase of the same amount of τ_w) for the initial 5 periods with $x_t = 0 \; \forall \; t$ for $r_y = 0.9$ (continuous line), $r_y = 0.15$ (dashed line) and $r_y = 0.25$ (dashed-dotted line).

Taken by itself, this process is intrinsically unstable as long as there is no stabilizing mechanism at work. As it can be clearly observed in Figure 1, while for $r_y = 0.09$ the system enters into a period cycle of constant amplitude after the decrease in the capitalists' tax rate, for higher values of r_y the system converges to the initial steady state, as the endogenous reaction of the real interest rate dampens the destabilizing feedback mechanism between the wage share and (through its effect on the profit rate) output.

It is noteworthy that the interaction between the wage share and output does not influence the political climate in the model economy for $\gamma_v = 0.0$. The reason for this firstly counterintuitive result stems from the specification of the impact of the state of the business cycle on the political climate

described in (12): Since the term $(y - y^*)$ is multiplied by x, as long as $x = 0.0$ (and $\gamma_v = 0.0$) at the time of initial shock, output (or the subsequent wage share) developments do not affect the political sphere, as no party is considered as responsible for the development of the macroeconomy by the electorate. As we have discussed previously, this specification is intended to represent the *responsibility hypothesis*, after which booms or busts in economic activity are attributed by the electorate to the parties in power. If $x = 0.0$ (no political majority of neither left nor right), an increase (or decrease) of y would not benefit any side of the political arena.

As we have defined x as the relative number of "left-" vs. "right-"wing voters (see equation 12), an initial negative value of x can be interpreted as a "right-leaning" political shock that shifts the tax burden away from capitalists in detriment of workers (see equation 10).

Figures 2 illustrates how a "right-leaning" political shock that makes $x < 0$ would affect the tax burden distribution between capitalists and workers would affect the economic sphere, and how economic developments would feedback into the political sphere.

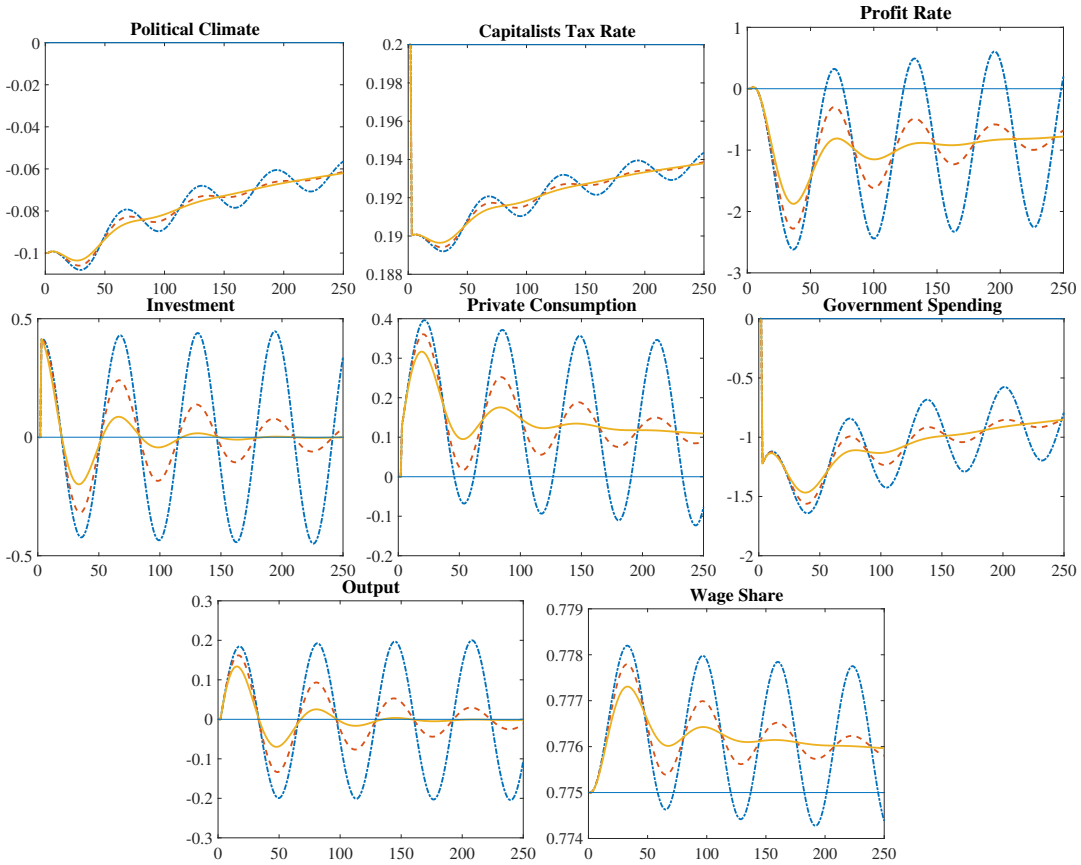

Figure 2: Dynamic adjustments following a decrease in x resulting in a decrease of τ_c and an increase of the same dimension of τ_w for $r_y = 0.9$ (continuous line), $r_y = 0.15$ (dashed line) and $r_y = 0.25$ (dashed-dotted line).

As it can be observed, a right-shift in the political sphere leads – through the shift of the tax burden away from capitalists in detriment of workers – to an economic expansion given the chosen parameter constellation, and over time to an increase in the wage share that in turn decreases the firms' profits as in the previous cases. For the different values of r_y, the dynamics can be either fully unstable (not depicted for the sake of better illustration), enter into a period cycle (for $r_y = 0.9$), or be asymptotically stable for sufficiently large values of r_y.

In contrast to the previous Figure 1, however, we can observe in Figure 2 the emergence of cyclical dynamics at the political sphere following the initial right-shift driven by the responsibility hypothesis term in (12), as well as through the bandwagon effect given by the first term in the same equation. Accordingly, the right-wing party is able to gain electoral support from the economic boom ($y > y^*$) taking place in the first 50 simulation periods. However, when the economy enters into a recession phase, the support for the right-wing party fades away, and x begins to decrease in absolute terms. Given the relatively strong bandwagon effect, x features a significant degree of persistence that keeps x in the negative (right-wing) territory, through with a clear tendency towards a balanced political sphere. When the next economic booms sets in (between approximately periods 110 and 160), the political climate turns again to the right, but – as the economic boom is less pronounced – for a shorter period of time and with less strength. This development is followed again by a loss of political support of the right-wing party once the next recession starts.

3.2 Endogenous Tax Burden Redistribution with Electoral Distributional Preferences

Let us now discuss how the dynamics of the current model is affected by explicit electoral distributional preferences. For this, we set $\gamma_v > 0$ in (12).

Figure 3 illustrates clearly how the introduction of explicit distributional preferences affects the dynamics of the current macro-political system for different values of γ_v. As it can be clearly observed, for $s_v = 2.5$, the decrease of τ_c following the initial "right-wing" shift ($x < 0$) leads to an increase in output and in the wage share, both of which – together with the bandwagon effect still at work – lead to a persistently lower (negative) level of x. This, in turn, translates in persistently lower capitalists tax rates that lead to higher private consumption, but lower government spending given our balanced budget assumption. The fact that taxes affect the steady state wage share – see (19) – is key to understand the evolution of the profit rate and, by extension, of aggregate investment: As lower (capitalists) taxes increase the steady state aggregate wage share v^*, the profit rate $(1 - v^*) - \delta$ is decreased permanently, leading by extension to a persistently lower aggregate investment level.

It is interesting to note that while the aggregate demand components fluctuate around a different level after the initial shock, aggregate output appears to move around the same long-run value as before the shock. The composition of aggregate demand – lower government spending and private investment – is different than in the original situation, though.

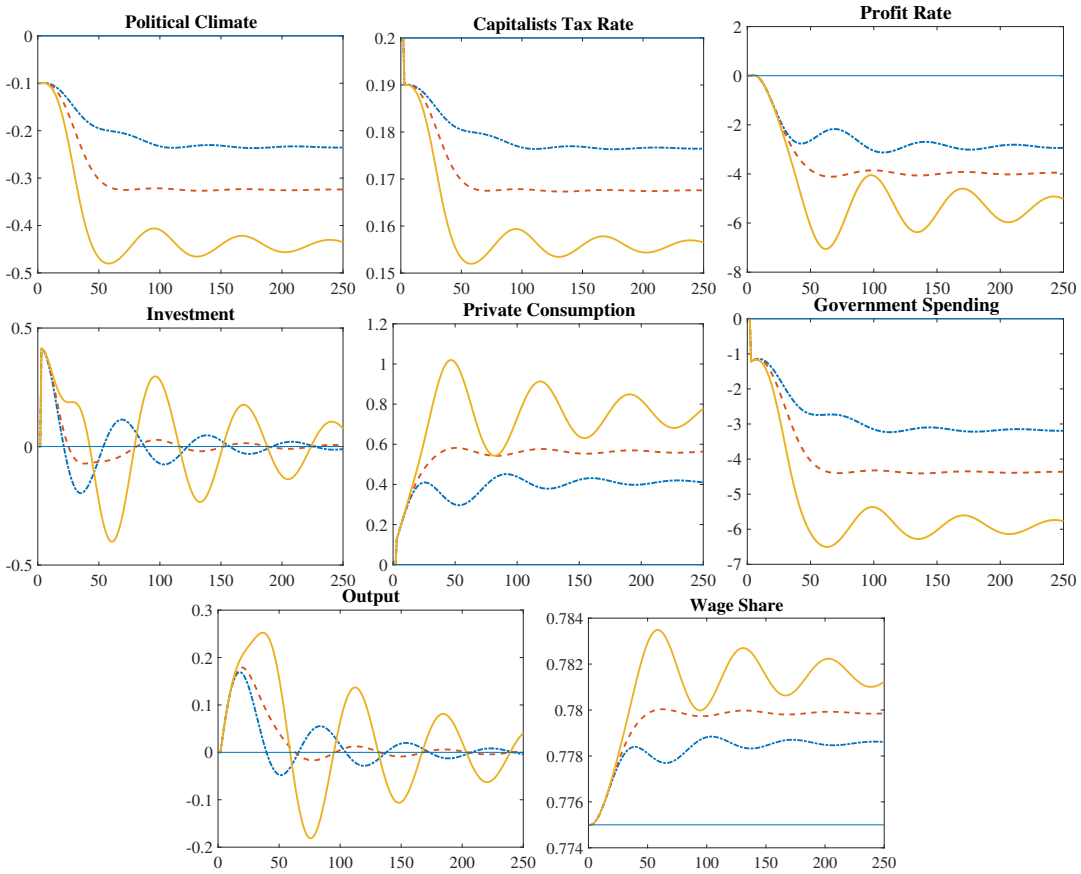

Figure 3: Dynamic adjustments following a decrease in x resulting in a decrease of τ_c and an increase of the same dimension of τ_w for $\gamma_v = 2.5$ (continuous line), $\gamma_v = 5.0$ (dashed line) and $\gamma_v = 10.0$ (dashed-dotted line) for $r_y = 0.15$.

The above analysis shows that, in the presence of feedback between the political and the macroeconomic subsystems, the political swings found by Di Guilmi and Galanis (2021) become less likely, even in the presence of fluctuations in output. In the next section we test the sensitivity of this result to the parameter configuration.

4 Robustness Analysis

Having now understood the transmission mechanisms at work in our simple theoretical framework, we now check the robustness of the stability analysis through bifurcation diagrams. The plots also complete the sensitivity analysis by providing a visualization of the full range of variation of the most relevant parameters.

The effect on of the parameter γ_x the stability of political choices has been extensively analyzed in Di Guilmi and Galanis (2021) and therefore not shall be discussed again here. The bifurcation analysis reveals that the main conclusions of that study do not change: the system is stable for $\gamma_x < 2$ and an apparently chaotic behavior for all three variables appears for higher values. Consistently with the results in Di Guilmi and Galanis (2021), an increase in the bandwagon effect leads to a polarization whose sign depends on the initial conditions.

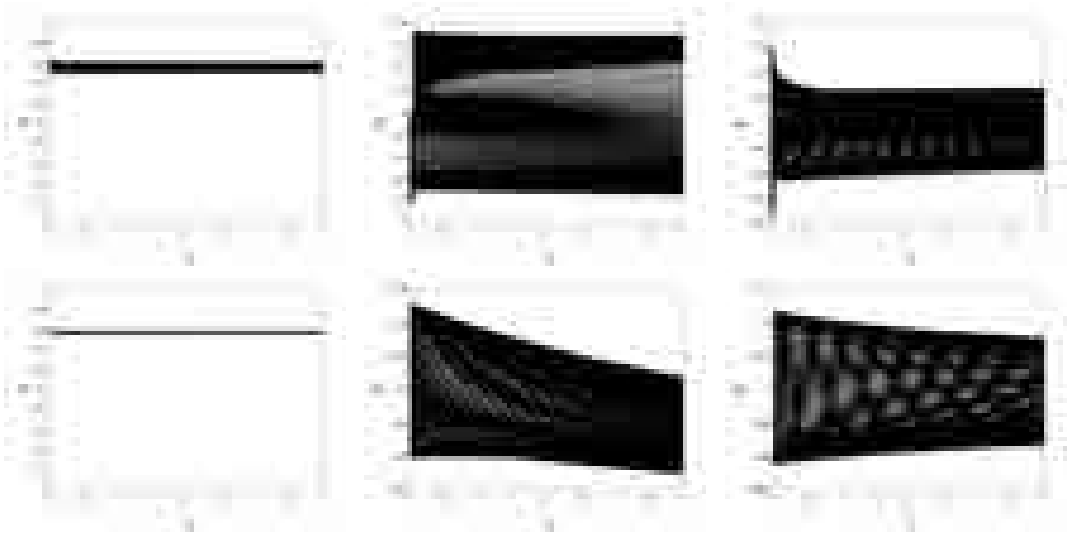

Figure 5: Bifurcation diagrams for γ_v with $r_y = 0.09$ (top row) and $r_y = 0.15$ (bottom row).

Looking at the effect of γ_y, it does not seem to visibly affect v. However, higher levels of the parameter increase the volatility for both x and y although not monotonically for the latter variable. Interestingly, for both variables, a chaotic behavior appears as soon as output starts affecting political choices.

Finally, Figure 5 presents the bifurcation plots for the parameter γ_v. As observed for γ_y, the impact on the parameter is visible for any positive values, although different values of γ_v do not seem to alter the amplitude of fluctuations. Looking at the panel for x, political swings appears for only for positive γ_v and relatively low r_y, consistently with Figure 6.[9]

The interaction between investment behavior and political sentiment revealed by Figure 5 is further investigated in Figure 6. The contrast between the two panels shed some light on the impact of investment behavior on political choices. Looking at the left panel, relatively low (high) values of the sensitivity of investment to the net profit ratio quantified by i_ρ determines a right (left) wing polarization. When a small part of profits is reinvested ($i_\rho \approxeq 0$), voters will be forced to accept a lower taxation on profits to boost investment. On the contrary, a high sensitivity of investment to the

[9] In the bifurcation plots, positive values of x are visible for $\gamma_v > 0.05$ due to numerical approximations for very small values of the parameter.

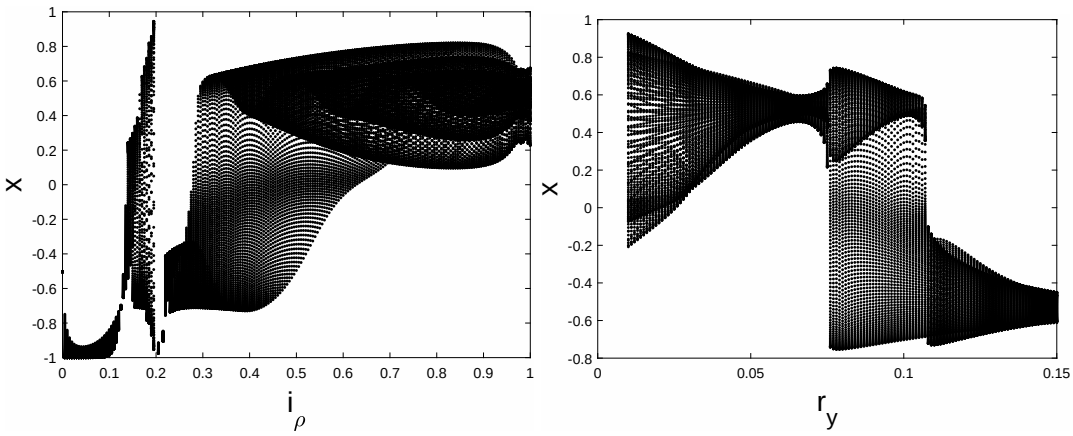

Figure 6: Bifurcation plot for x and i_ρ with $\gamma_v = 2.5$ (left panel) and r_y (right panel).

net profit rate will generate enough growth to achieve the steady state even with a higher taxation on profit, and therefore leading to left-wing majority. The discontinuity in the left panel corresponds to $i_\rho = s_c$.

These findings are consistent with the right panel of the figure, considering (5). For example, in case of a positive output gap, the raise in the real interest rate will have a negative effect on investment, which will be larger the larger is r_y. In order to lessen this depressionary effect, voters will support a lower taxation on profits (and therefore a right-wing political agenda).

We are of course aware that these results are dependent on the particular investment function (and specifically on the modeling choice of a profit-driven economy). While a full exploration of the possible different regimes of the macroeconomy goes beyond the scope of the present study, our analysis highlights a possible interaction among capitalists' investment decision and voters' behavior that can be investigated in a further development by means of suitable framework.

5 Concluding Remarks and Outlook

In this paper in honor of Peter Flaschel we extended a simplified version of his Keynes-Metzler-Goodwin (KMG) framework with the incorporation of endogenous behavioral electoral preferences to analyze the interaction between the political sphere and the macroeconomy, and in particular the dynamics of income distribution. The resulting theoretical framework is not only able to generate cyclical dynamics (and even period cycles under an appropriate parametrization), but feature also multiple equilibria that depended primarily on the political sphere.

Due to the simplicity of the current framework, various meaningful extensions can be thought of. To begin with, the incorporation of fiscal budget imbalances, and thus of government debt, seems appropriate. Further, and along the same lines, one could think of a more elaborate financial system

with various available financial assets within a Tobinian portfolio framework as e.g. in Asada et al. (2011), and/or the incorporation of a banking sector that does not only grant loans to firms, but is also active in the asset markets as in Chiarella et al. (2012) to study e.g. the multifaceted process of financialization. Last but definitely not least, the adaptation of this framework for the study of climate change related political-economy issues seems like a promising venue of research. By integrating a discrete choice political model with the KMG framework, we follow Flaschel's footsteps in bringing together discrete choice models with disequilibrium macroeconomic dynamics. It is our hope that our paper can be a stepping stone continuing this research agenda in two broad directions. The first direction is related to the inclusion of political dynamics in macro models not only explicitly within the KMG framework but also within relevant (post-)Keynesian and or 'Goodwinian' ones. The second more broad direction has to do with further integrating discrete choice models in the macro literature. While the majority of discrete choice models have mainly focused on heterogeneous expectations, our model highlights that other types of discrete choices are relevant for the macroeconomic dynamics and can be investigated.

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