The Paradox of Redistribution:
A System Dynamics Translation

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33rd International Conference of the System Dynamics Society
Cambridge, Massachusetts, USA

Key Words

Inequality, endogenous point of view, system dynamics, paradox of redistribution, poverty, inequality, system dynamics translation

Abstract

Inequality has received renewed attention in the public as well as in the academic debate. According to one theory, the development of redistribution and inequality reflects the initial structure of the social insurance institutions. In countries with social insurance institutions that target the poor and low-income earners the result is smaller redistributive budgets and higher levels of poverty than in countries with social insurance institutions with lower levels of low-income-targeting. This result could be explained by the fact that inequality, and poverty rates, are more dependent on the total size of the redistributive budget than to the extent that the system targets the poor. This has been referred to as the paradox of redistribution. In this paper, the paradox of redistribution is translated to system dynamics and the coherence of the theory is analyzed by a system dynamics model. The system dynamics translation results in a model that reproduces the reference modes. The result shows that system dynamics ought to have a profound role in the discussions of inequality, as a tool to explain and discuss concepts and in suggesting structural explanations with an endogenous point of view.

The Paradox of Redistribution:

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1. Introduction

"For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken even that which he hath."
—Matthew 25:29, King James Version.

Inequality has lately received renewed attention in the public as well as in the academic debate. Examples of contributions include Wilkinson & Pikett (2009), Stiglitz (2012) and Piketty (2013). This debate has, among other things, focused on how welfare state redistribution mechanisms affect inequality and poverty outcomes.

According to political economy theories of the mature welfare states, the development of redistribution and inequality reflect the initial structure of the welfare state institutions (Pierson, 1996; Korpi & Palme, 2003 and Korpi & Palme, 1998). A critical aspect of the welfare state institutions is their degree of low-income targeting. I.e., to what extent the redistribution mechanisms target the population with low (or no) incomes in relation to the rest of the population, e.g. middle- and high income earners (Pierson, 1996). Walter Korpi and Joakim Palme (1998) suggest that inequality and poverty are higher in societies with social insurance institutions with high degree of low-income-targeting (e.g. in societies with targeting or basic security social insurance institutions), comparing to societies with lower degrees of low-income targeting (e.g. in societies where the social insurances are more encompassing). The reason seems to be that inequality- and poverty rates are more dependent on the total size of the redistributive budget than to the extent the institutions target the poor. Encompassing models of social insurance institutions, i.e. social insurance institutions in which not only the low income earners but also middle income earners are eligible to benefits, tend to lead to larger redistributive budgets (Korpi & Palme, 1998). This results in the counterintuitive consequence that the more the social insurance institutions are structured to

target the poor, the greater the inequality and poverty. This is what Korpi and Palme (1998) refer to as "the paradox of redistribution" (p. 661). They refer to feedback mechanisms within the structures of the welfare states to explain the paradox. Furthermore, they argue for the need to "open the black box of causal processes assumed to mediate the effects from institutions to redistributive outcomes" (Korpi & Palme, 1998, p. 673). Despite the call for opening the black box, they use what Yaman Barlas (1996) refers to as correlational or "black-box" models in their attempt to corroborate the theory. The focus on feedbacks makes Korpi and Palme's theory suitable to be analyzed by a causal-descriptive or "white-box" system dynamics model (Barlas, 1996). With a focus on feedbacks as the *"basic structural elements"* (Forrester, 1969, p. 12), system dynamics could have a profound role in the discussions of inequality, as a tool to explain and discuss concepts and in suggesting structural explanations to the development of inequality with an "*endogenous point of view*" (Richardson, 2011, p. 221).

1.2 Research objective and research question

The research objective is to translate Korpi and Palme's 'paradox of redistribution' into a system dynamics model and analyze the theory's coherence. The paper follows what David Wheat (2007) refers to as system dynamics translations, beginning with identifying the theory and converting it to causal links and loops. Further, the model is simulated to analyze the paradox of redistribution's predictive claims. In order to limit the scope of the research, the focus is on how the degree of low-income-targeting, over time, affects the redistributive budget and poverty.

Research question

The research question is:

- Is Korpi and Palme's paradox of redistribution coherent when translated to, and analyzed by, a system dynamics model?

The paper is outlined as follows: first, a theoretical background is presented. Then the theory is translated into a system dynamics model, and simulations are analyzed. The paper ends with a discussion and conclusion.

2. Background

Section 2.1 presents the paradox of redistribution and section 2.2 presents system dynamics translations. The section ends with sketched reference mode graphs.

2.1 The Paradox of Redistribution

Based on the structure of old-age pensions and sickness cash benefits, Korpi and Palme (1998) present five ideal-typical models of social insurance institutions. The ideal-typical models are the targeted, the voluntary state subsidized, the corporatist, the basic security and the encompassing. They are presented by three characteristics: bases of entitlement, benefit level principle, and employer-employee cooperation in program governance. Korpi and Palme (1998) also present data associated with these characteristics for 18 OECD countries. Here follows short presentations of the ideal-typical models based on Korpi and Palme (1998).

In the targeted model, a means test determines eligibility. For citizens who fall below the poverty line, minimum or relatively similar benefits are provided. Of the 18 OECD countries only Australia belongs to this category.

In the voluntary state-subsidized model, citizens that have voluntarily contributed to the scheme are eligible for benefits. Benefits are flat-rate or earnings-related with low ceilings for earning replacements. None of the 18 countries belongs to this category.

In the corporatist model, membership is compulsory and tied to occupational categories. The social insurance programs are reserved for the economically active population. Benefits levels are earnings-related and depend on contribution and belonging to the occupational category. Austria, Belgium, France, Germany, Italy and Japan belong to this category.

In the basic security model, eligibility is based on contribution or citizenship. Everyone is insured by the same program. However, high income groups are in general also protecting their standards of living by private insurance programs. Canada, Denmark, Ireland, Netherlands, New Zealand, Switzerland, United Kingdom and United States belong to this category.

Finally, the encompassing model combines elements of the corporatist- and basic security models. Universal programs providing basic security for all are combined with earnings-

related benefits for the economically active population. Thereby, the demand for private insurances is reduced comparing to the basic security model. Finland, Norway and Sweden belong to this category.

A particular focus of Korpi and Palme's theory is how welfare institutions affect redistribution over time. This includes the creation of risk pools of citizen groups. Korpi and Palme (1998) hypothesize that the social insurance institutions either emphasize the differences in risks and resources "by increasing homogeneity within risk pools in terms of their socioeconomic composition" (p.671), or downplay these differences "by pooling resources and sharing risks across socioeconomically heterogeneous categories.*"* (p. 671). This may shape the citizens rational choices and how they organize for collective action. Particularly important is the impact of the institutional structure on the interests of the poor and the better off; do the interests diverge or converge and does the institutional structure encourage or discourage coalition formation between the groups?

For the purpose of this paper we concentrate on the direct ways the institutional structure affect coalition formation through the 'strategies for equality', defined by their degree of low-income targeting. Low-income targeting refers to "the extent to which budgets used for redistribution go to those defined as poor" (Korpi & Palme, p.671). Three such strategies are presented: the *Robin Hood strategy*, the *simple egalitarian strategy* and the *Matthew principle* strategy. In the *Robin Hood strategy* of the targeted model, money is taken from the rich and given to the poor. In the flat-rate benefits of the basic security model, the equal benefits for all means in relative terms giving more to low-income earners than to the better off reflecting a *simple egalitarian strategy*. Finally, the corporatist and encompassing models, through the earnings-related benefits, give more, in absolute terms, to the better off. They also give more to the better off in relative terms by having limited low-income targeting –thereby deploying what the authors refer to as the *Matthew principle*[1].

Because the targeted model only includes minimum benefits to those with proven needs, it risks creating a zero-sum conflict of interests between those receiving the benefits that belong to low income groups, and the middle classes that do not receive benefits but need to pay for them through taxation. The better-off categories have to rely on private insurances and the poor need to trust the altruism of the better-off. Likewise, the basic security model displays

[1] Referring to the Bible's Matthew 25:29 King James Version: *"For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken even that which he hath."*

similar dynamics and sets the high income strata against the poor. In contrast, the encompassing model is inclusive; all citizens are included in the same programs and the earnings-related benefits for the better-off and the worse off are provided within the same institutional structures. This reduces the demand for private insurances and encourages cross-class coalition formation between people with low and middle incomes. Similar dynamics is at play in the corporatist model, with the difference that not all citizens are covered by the same programs – there are no flat-rate benefits.

According to Korpi and Palme (1998), the discussion of redistributive outcomes of the welfare state programs have focused mainly on how to distribute the money available for transfer, and often ignored variations in the size of the redistributive budget. However, the degree of final redistribution is a function of both how it is distributed and the size of the budget. Korpi and Palme (1998) suggest that the degree of redistribution achieved "can be seen as including a multiplicative element – final redistribution is a function of *degree of low-income targeting* × *redistributive budget size*." (p. 672). The neglect of the budget size is unfortunate as there seems to exist a trade-off between the degree of low-income targeting and the size of the redistributive budget, "such that the *greater the degree of low-income targeting, the smaller the redistributive budget"* (Korpi & Palme, 1998, p. 672). This trade-off suggests that it is impossible to maximize both the degree of targeting and the redistributive budget size.

Accordingly, encompassing institutions are expected to generate the largest redistributive budget as they generate broad support for the welfare state expansion. The corporatist institutions are also expected to rend broad support for redistributive budget expansions from the middle classes based on their own earnings-dependent benefits. The basic security welfare institutions, with relatively low benefits for the middle classes, are expected to generate less support for welfare state expansion. Finally, the targeted institutions, with no benefits for the middle classes, are expected to generate the least support for welfare state expansion.

To analyze their hypotheses, Korpi and Palme (1998) emphasize the *"*need to open the black box of causal processes assumed to mediate the effects from institutions to redistributive outcomes."(p. 673), but states that "it is possible to take only a partial look into this black box by following the subsequent stages in the causal processes and attempting to verify these different steps." (1998, p. 673). They underline that "At the best we can hope for a partial agreement between our hypotheses and comparative empirical data. As is often the case in

comparative research, we lack good quantitative indicators for some relevant variables and will have to use available proxies" (p. 673). To study the hypothesized processes, Korpi and Palme (1998) use secondary data retrieved from the two data sets: the Social Citizenship Indicator Program (SCIP) and the Luxembourg Income Study (LIS). They present two multi-variable regressions to test their theory. This method to "partially open" the black box is however what Yaman Barlas (1996) refers to as a "correlational", black-box and purely data-driven model, with no claim of causality within the model structure. As such, one may argue that it keeps the "black box" closed. This paper instead aims to translate Korpi and Palme's theory to what Barlas (1996) refers to as a causal-descriptive, white-box and theory-like system dynamics model to study the claimed causal processes, using what David Wheat (2007) refers to as a "full system dynamics translation"(p. 5).

2.2 System Dynamics Translation

David Wheat (2007) presents two levels of system dynamics translations; a partial system dynamics translation and a full system dynamics translation. A partial system dynamics translation (1) "…identifies a theory in text or diagrams" (Wheat, 2007, p. 4) and (2) "converts the theory to causal links & loops" (Wheat, 2007, p. 4). The previous section has completed the first step (1) by presenting Korpi and Palme's theories. The second step (2) includes drafting a causal links and loops. Further, a full system dynamics translation also (3) "…formulates and simulates the theory" (Wheat, 2007, p. 4) and (4) "tests the theory's predictive claims.". To complete the third step (3) within this study, a system dynamics model is constructed and simulated. Korpi and Palme's predictive claims are analyzed by the use of different inputs, i.e. different parameter values, in the simulation model.

2.3 Reference modes:

There are many possible reference modes that would satisfy decreases in redistributive budgets and transfers to low income earners for welfare state institutions with high degrees of low-income targeting, and increases in redistributive budgets and transfers to low income for welfare state institutions with low degrees of low-income targeting. Possible shapes include e.g. straight lines, second derivatives and S-shaped reference modes.

If we expect that the resulting size of redistributive budgets depend on the degree of low income targeting, there may be different equilibrium values of redistributive budgets and transfers to low income that they move towards over time. Such equilibrium-seeking or goal-

seeking behavior may be represented by second derivative reference modes. Such shapes are portrayed in Figure 1 and Figure 2.

The reference modes for high levels of low-income targeting include decreasing redistributive budget and decreasing transfers to low income, Figure 1.

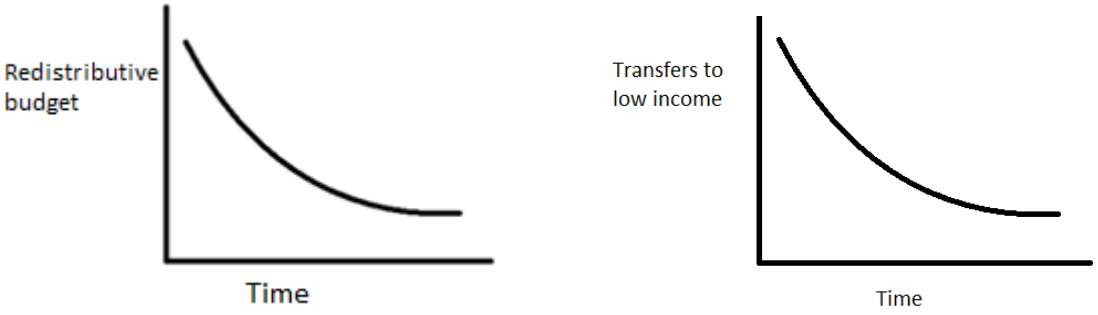

Figure 1: Reference modes for high levels of low-income targeting. The size of the redistributive budget (left) and the transfers to low income (right) are both going down, in line with the claims made by Korpi & Palme (1998)

The reference modes for low levels of low-income targeting include decreasing size of the redistributive budget and decreasing transfers to low income, Figure 2

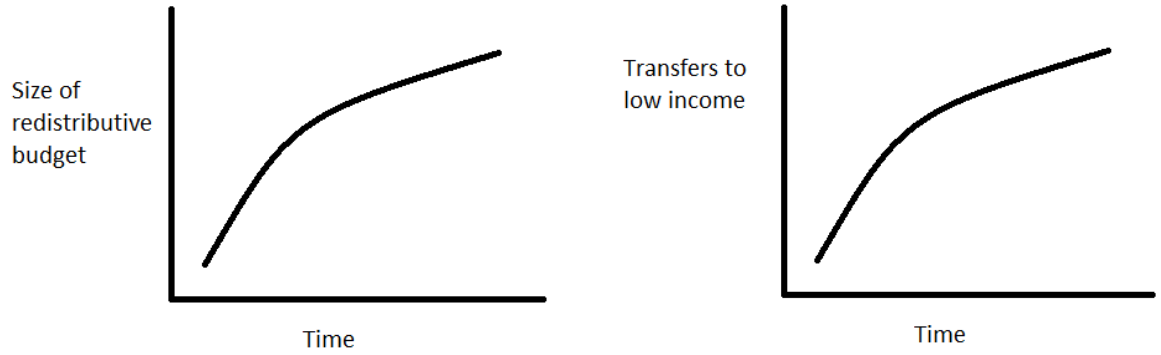

Figure 2: Reference modes for low levels of low-income targeting. The size of the redistributive budget (left) and the transfers to low income are both going up, in line with the claims made by Korpi & Palme (1998)

3. Model

In modeling the theories[2], we will start with a simple model of the claim that "The debate about the redistributive outcomes of welfare state programs has focused almost exclusively on how to distribute the money available for transfers" (Korpi & Palme, 1998, p. 672), and the proposed equation for final redistribution: *"degree of low-income targeting* $\times$ *redistributive budget size*" (Korpi & Palme, 1998, p. 672).

This static theory is portrayed in the stock and flow diagram in Figure 3. The stock (represented by a box) in the lower part of Figure 3 is the non-changing size of redistributive transfers, i.e. the 'Redistributive budget R'. The equation for 'Transfers to low income TL' is $Ratio\ to\ low\ income\ RL \times Redistributive$ budget R. The equation for 'Transfers to middle income TM' is $(1 - Ratio\ to\ low\ income\ RL) \times Redistributive\ budget\ R$. It suggests that the ratio that does not go to low income (earners) go to middle income (earners).

According to this theory, 'Transfers to low income TL' can only be altered by changing the level of targeting (since the 'Redistributive budget R' is fixed), represented by a change in the 'Ratio to low income RL'.

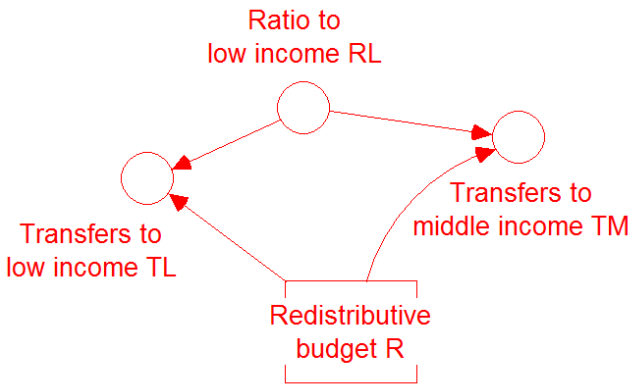

Figure 3: Graphical representation of the static building block of the first part of the theory

Before extending this initial formulation, let us simulate the model. In order to simulate we will first set units and assign parameter values for 'Ratio to low income RL' and 'Redistributive budget R'. 'Ratio to low income RL' is set to 0.80, representing that 80 % of the 'Redistributive budget R' is transferred to people with low incomes. The 'Redistributive budget R' is set to 5 which gives us 5 USD to redistribute. The simulated behavior is presented in Figure 4. The results of Simulation 1 are portrayed in Figure 4. As expected,

[2] The full documentation of the model's equations, units and parameter values are included in Appendix 1.

'Transfers to low income TL' is 4, ($0.80 \times 5 = 4$), and the 'Transfers to middle income TM' is 1, ($0.2 \times 5 = 1$). When the 'Ratio to low income RL' is changed to 0 (that is, all 'Redistributive budget R' goes to middle income), 'Transfers to low income TL' is 0 and 'Transfers to middle income TM' 5 as portrayed in Simulation 2 of Figure 4.

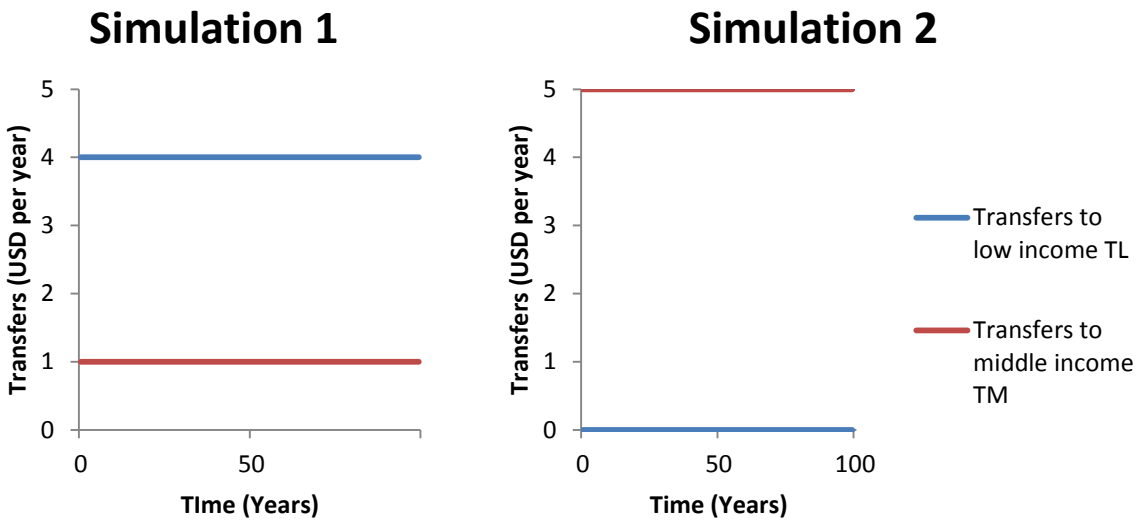

Figure 4: Simulation runs of the basic static structure with two levels of 'Ratio to low income RL'; Simulation 1: 0.8 and Simulation 2: 0.

According to this theory, the welfare state institution that maximizes the 'Ratio to low income RL' results in the largest redistribution to low income. Korpi and Palme (1998) argue that social scientists' main criterion when evaluating success of antipoverty programs has been "the degree of "target efficiency," defined as the proportion of program expenditures going exclusively to those below the official poverty line (…)" (Korpi & Palme, 1998, p. 662). That kind of reasoning is in line with this simple model. In Korpi and Palme's typology, the targeted and the basic security models best targets the poor. However, as Korpi and Palme (1998) point out, this logic limps because "variations in the size of the redistributive budget (i.e., the total sum available for redistribution)" (p. 672) are ignored. Let us therefore extend this initial model.

Crucial in the extended structure is the middle income earners' support for, or opposition against, welfare state expansion. Korpi and Palme (1998) refer to this as "coalition formation between the poor citizens and better-off citizens and between the working class and the middle class, thus making their definitions of interest diverge or converge" (p. 671). If the middle income earners on the one hand do not benefit from the governments' welfare state institutions, they will obtain private insurances and form a majority with the high income earners against welfare state expansion. If they, on the other hand, benefit from the welfare

state institutions, their attitudes toward welfare state expansions will be predominantly positive, and they may form majority with the lower income citizens for welfare state expansion. In order to study the dynamics of welfare state expansion we, as a matter of simplification, only need to look at the support from the middle classes. I.e. we are assuming that the low income earners will always support welfare state expansion and the high income earners will always oppose welfare state expansion. Moreover, we are assuming that the shape of income distribution does not change over time.

To translate this theory into the language of system dynamics we may add a structure consisting of the two categories 'Opposition against redistribution O' and 'Support for redistribution S', as portrayed in Figure 5. The two stocks represent ratios of the middle income earners, and together make up 1 (100 % of the middle income earners). The 'Support for redistribution S' may change over time through the flow 'change in support CS' if 'Support for redistribution S' differs from 'Indicated support for redistribution IS'. The equation for 'Change in support for redistribution CS' is $\frac{\text{Indicated support for redistribution IS} - \text{Support for redistribution S}}{\text{Time for support to change TCS}}$. The 'Time for support to change TCS' represents the average time it takes for the middle income earners to change their opinion on redistribution, and is set to five years. The support for redistribution is changed by good or bad experiences of redistribution.

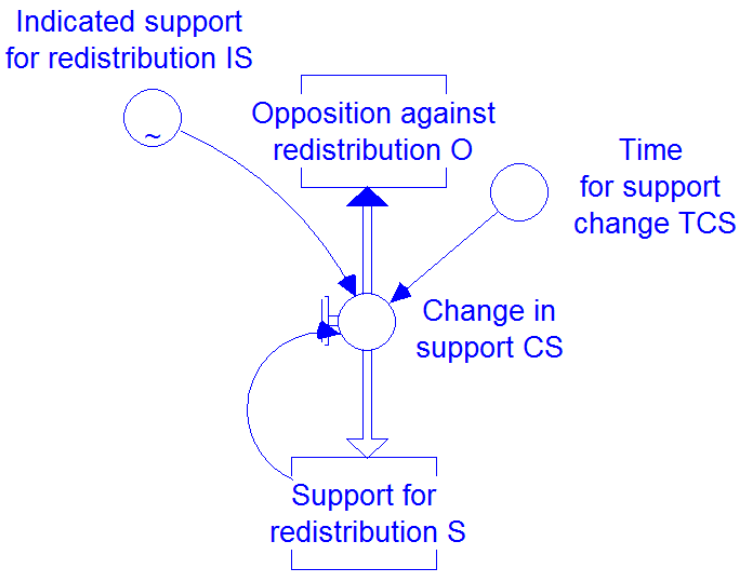

Figure 5: Graphical representation of the structure of the middle classes' support and opposition to redistribution.

We may now integrate the two structures, portrayed in Figure 6. In line with Korpi and Palme (1998), the 'Indicated support for redistribution IS' depends on the 'Transfers to middle

income TM' which (as earlier emphasized) is an effect of both the poor people targeting ('Ratio to low income RL') and the size of the total transfers ('Redistributive budget R'). The 'Transfers to middle income TM' is the only factor within the function for 'Indicated support for redistribution IS', following the theory that middle income earners will have a rational basis for supporting redistribution if they get a share of the benefits.

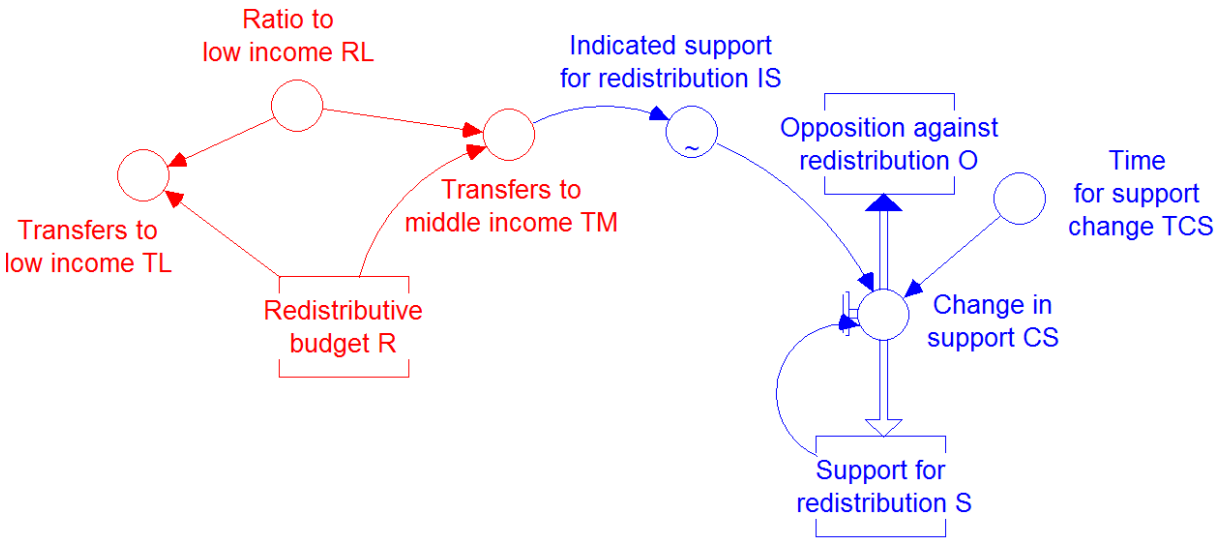

Figure 6: Graphical representation of extended stock and flow structure, including the structures presented in Figure 4 and Figure 3.

The relationship between 'Transfers to middle income TM' and 'Indicated support for redistribution IS' is portrayed in the graph in Figure 7. It reads: the larger the transfers to middle income earners (which is measured as USD per year), the higher the 'Indicated support for redistribution IS'. The shape of the graph indicates a decreasing marginal effect on 'Indicated support for redistribution IS' of increases in 'Transfers to middle income TM'. The shape of this relationship cannot be derived from Korpi and Palme (1998). Other shapes may be plausible and may be tested in the model. The reasoning behind the suggested shape is that the additional benefit the middle income earners derive from increased social protection, in the form pensions or sick cash benefits, diminishes with every increase in the social protection they already have. Relevant to this theory is that the benefits are in the form of social insurances and, accordingly, even people who do not receive benefits may benefit from their perceived security attained by the social security safety nets. Also, people that do not receive benefits directly may appreciate the benefits received by people they know.

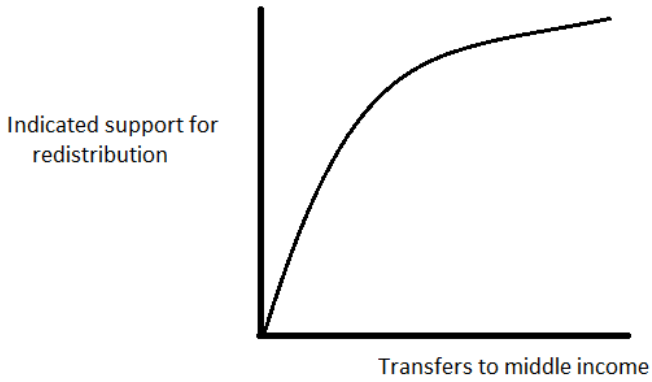

Figure 7: The relationship between 'Transfers to middle income TM' and 'Indicated support for redistribution IS'. The full model documentation is included in Appendix 1.

Now, we may include the part of the structure that entails the dynamics, i.e. the link between 'Support for Redistribution S' and the 'Redistributive budget R'. The full model is portrayed in Figure 8. The link from 'Support for redistribution S' to 'Desired redistributive budget DR' suggests that the higher the percentage of the middle income earners that are supporting redistribution, the higher the 'Desired redistributive budget size DR'.

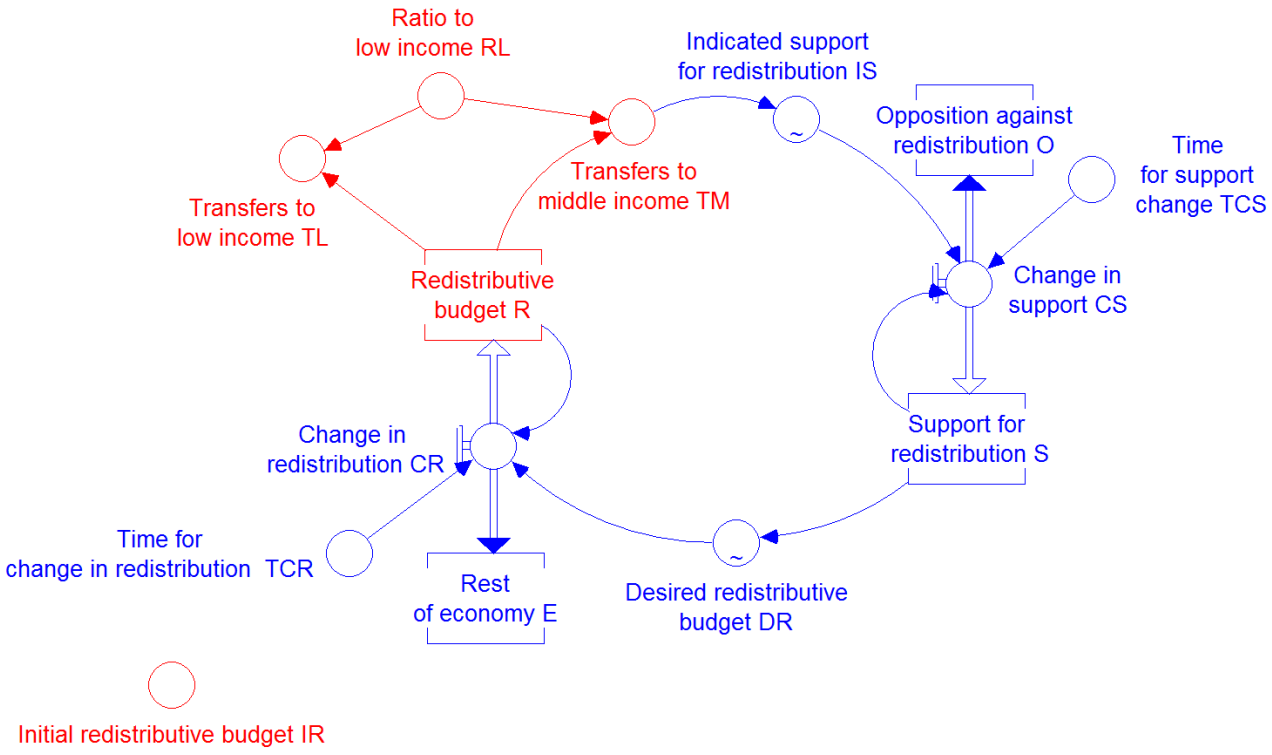

Figure 8: Graphical representation (stock and flow diagram) of the full model.

The relationship between 'Support for redistribution S' and 'Desired redistributive budget DR' is portrayed in the graph in Figure 9. The larger the 'Support for redistribution S' is, the larger is the 'Desired redistributive budget DR'. The shape of the graph suggests decreasing marginal effect of increased support for redistribution. This shape cannot be derived from Korpi and Palme (1998) and other shapes may be plausible. The reasoning behind the suggested shape is that when around 50 % of the middle income earners support redistribution, there is a majority that supports extensive redistribution and the 'Desired redistributive budget' will thus be around 28 % (of GDP). 28% is the highest level of redistribution in the data presented in the Korpi and Palme paper. This maximum level suggests that even when the support for redistribution is extensive, the 'Desired redistributive budget RB' will not be larger than 28 % of the total economy.

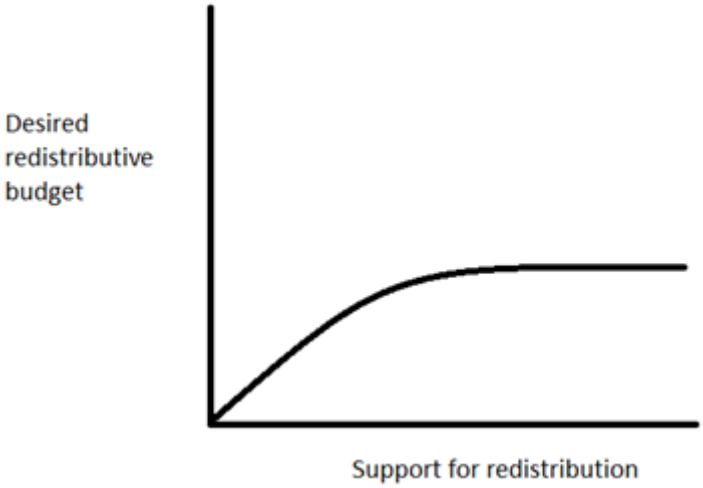

Figure 9: The relationship between 'Support for redistribution S' and 'Desired redistributive budget DR'. The full model documentation is included in Appendix 1.

Finally, Figure 8 portrays that the 'Redistributive budget R', as a part of the 'Rest of economy E' (which together make up 100 US Dollars per year), may change over time through the flow 'Change in redistribution CR'. The 'Time for change in redistribution TCR' is the average time it takes for a policy change to affect the redistributive budget, and is set to 2 years.

Before we move to the simulations we may consider the model boundaries. A concise way to represent the model's boundaries is a Bull's-Eye Diagram (Ford, 2009). The diagram divides the model variables between the three categories endogenous, exogenous and excluded. The Bull's Eye Diagram is portrayed in Figure 10. In the initial model, only transfers to low income and transfers to middle income were endogenous, whereas in the extended model also the size of the redistributive budget, the desired redistributive budget and the support for redistribution are derived endogenously. However, many variables that may be critical such as

unemployment and export and import are still excluded. Also, variables such as GDP and the ratios to low- and middle income may be affected by the redistributive budget or the support for redistribution which suggests that they may be modeled endogenously. Nevertheless, the limitations enable us to concentrate solely on the relationships that concern the paradox of redistribution. The vast simplifications may also be seen as a necessary first step.

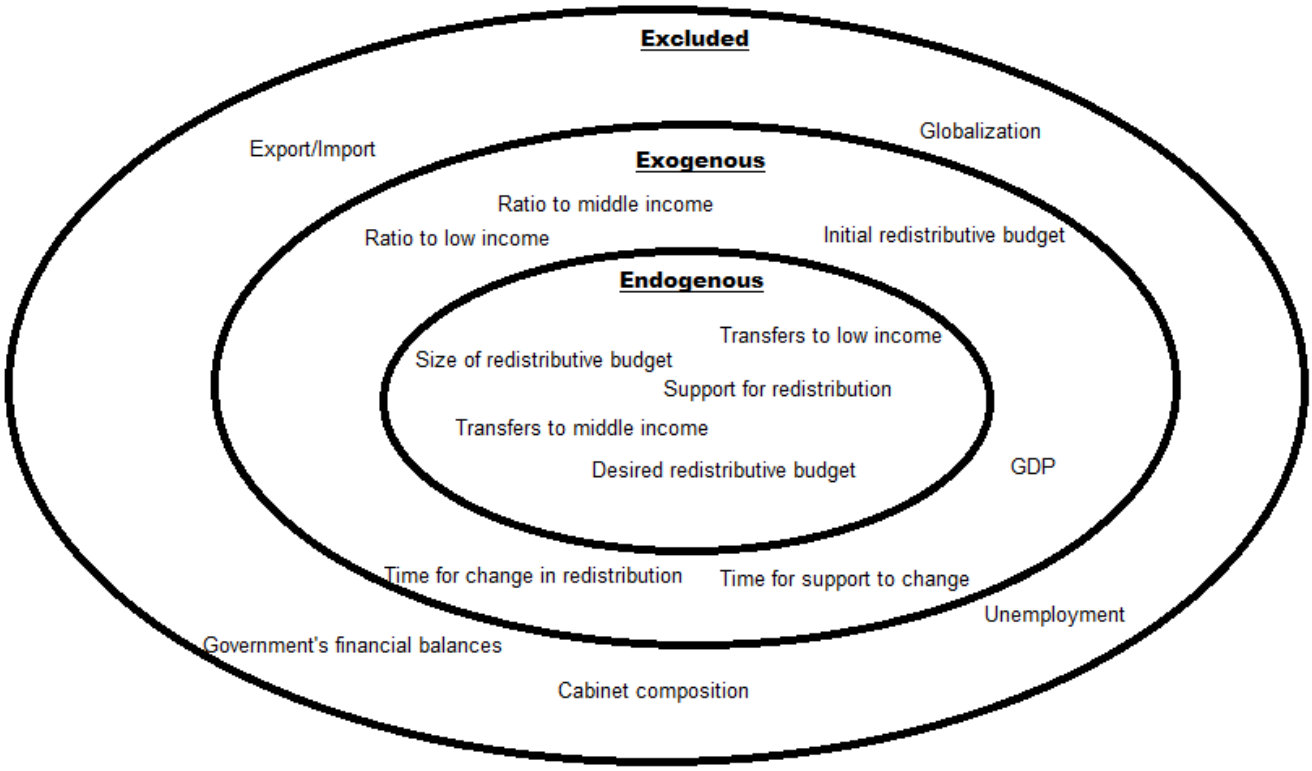

Figure 10: Bull's Eye Diagram of the model structure.

We have now completed the three first steps of a system dynamics translation, and are to move to the final step – to analyze the theory's predictive claims.

3.1 Scenario and policy description

In completing the last step of our system dynamics translation, we consider whether a higher degree of low-income targeting leads to a smaller redistributive budget and higher inequality and poverty. Translated to our model, the degree of low-income targeting is represented by the 'Ratio to low income RL'. The redistributive budget is represented by 'Redistributive budget R', and 'Transfers to low income TL' is used as a proxy for both inequality and poverty (i.e., higher 'Transfers to low income TL' represents lower poverty and lower inequality').

To analyze the theory we may consider four different levels of low-income targeting, each representing one of the social insurance institutions: the encompassing, the corporatist, the basic security and the targeted. The voluntary state-subsidized model is excluded from the analysis because none of the 18 countries presented in Korpi and Palme's paper belongs to this category. In the simulation model, it is the parameter 'Ratio to low income RL' that is changed between the four models of social insurance institutions. Put in order from the highest to the lowest degree of low-income targeting the institutions are: the targeted, the basic security, the encompassing and the corporatist. For simplicity, we translate these to four values of 'Ratio to low income RL'; 1.0, 0.8, 0.4 and 0.2. The values are portrayed in Table 1 together with short motivations based on the background. Note that this is a gross simplification of the theory. We will simulate the model with these four parameter values.

Model of Social Insurance Institutions	Relative degree of Low Income Targeting	'Ratio to low income RL'	Motivation
Targeted	Very high	1.0 (100 %)	Only citizens below the poverty line are eligible (means test).
Basic Security	High	0.8 (80 %)	Everyone insured by the same programs.
Encompassing	Low	0.4 (40 %)	Earnings-related benefits.
Corporatist	Very Low	0.2 (20 %)	Social insurance programs reserved for economically active population and earnings-related.

Table 1: A summary of the values for the parameter 'Ratio to low income RL'. Motivations based on the background.

3.2 Results

The results of the simulations of 'Redistributive budget R' are portrayed in Figure 11. The targeted model, with the highest level of low-income targeting (in this simulation, all the redistributive budget goes to 'Transfers to low income TL') results in the lowest redistributive budget. The basic security model with the second highest level of poor people targeting also leads to a low redistributive budget. Furthermore, the encompassing- and corporatist models with lower levels of low-income targeting result in higher redistributive budgets. We may accordingly argue that Figure 11 reproduces the reference modes of the models with high levels of low-income targeting, i.e. both the targeted and the basic security models led to

comparably low redistributive budgets. Figure 11 also reproduces the reference modes of the models with low levels of low-income targeting, i.e. both the corporatist and the encompassing models led to comparably large redistributive budgets.

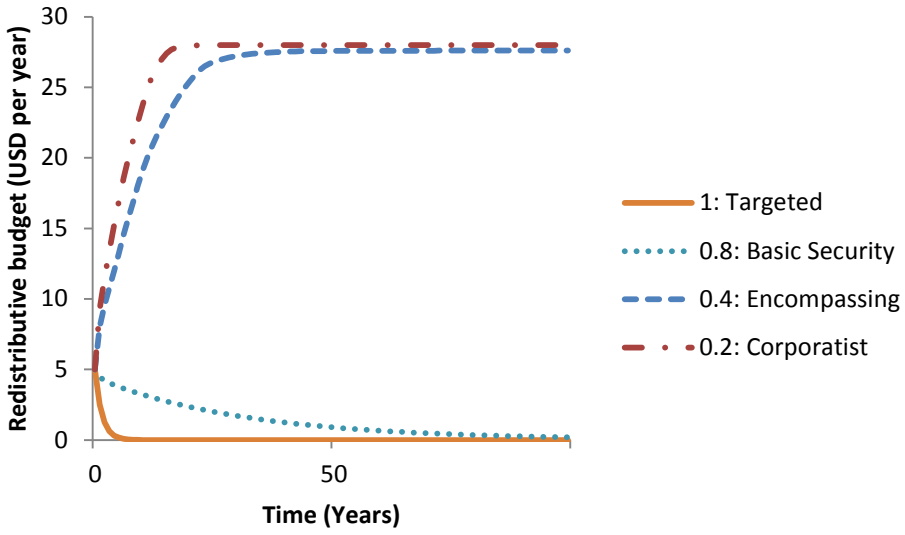

Figure 11: The development of the Redistributive budget. Simulation based on the model formulation in Appendix 1 and the parameter values for 'Ratio to low income RL' presented in Table 1.

Now, let us consider the 'Transfers to low income TL' that we take as a proxy for equality and poverty levels. The simulation results for 'Transfers to low income TL' are presented in Figure 12. The targeted model leads to the lowest amount of transfers to the low income earners. The basic security leads to the second lowest amount of transfers to the low income earners. The encompassing leads to the largest amount of transfers to low income earners and the corporatist to the second highest amount of transfers to low income earners. Furthermore, Figure 12 reproduces the reference modes of the models with high levels of low-income targeting, i.e. both the targeted and the basic security models led to comparably low transfers to low income earners. The graph also reproduced the reference modes of the models with low levels of low-income targeting, i.e. the both the corporatist and the encompassing models led to comparably high transfers to low income earners.

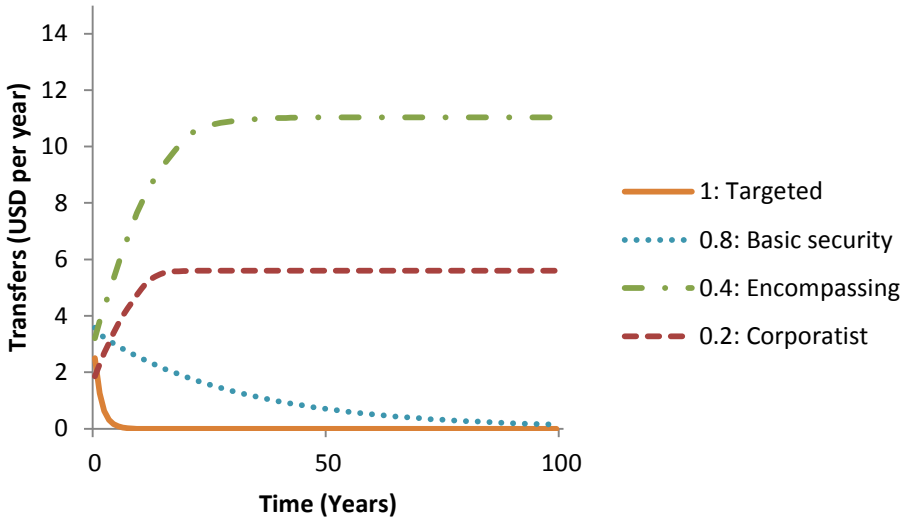

Figure 12: The development of transfers to low income. Simulation based on the model formulation in Appendix 1 and the parameter values for 'Ratio to low income RL' presented in Table 1.

Finally, let us consider the effects of different 'Ratio to low income RL' on 'Transfers to low income TL', portrayed in Figure 13. The transfers are derived after 100 years of simulation. The graph shows that with low 'Ratio to low income RL' (e.g. 0 to 0.2), the 'Transfers to low income TL' are relatively low, and with high 'Ratio to low income RL' (e.g. 0.8 to 1), the 'Transfers to low income TL' are also low. However, in the middle of the range, between around 0.3 and 0.7, the 'Transfers to low income TL' are relatively high.

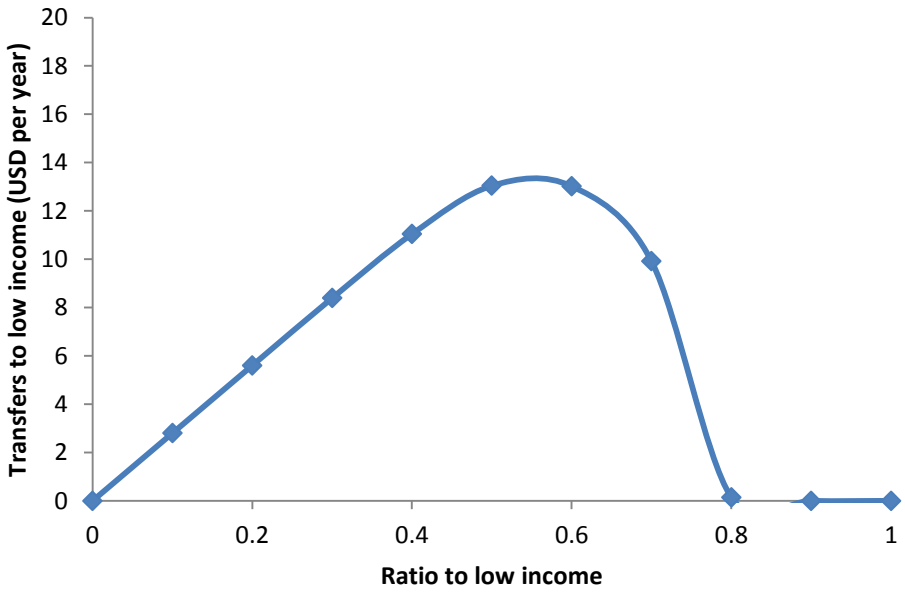

Figure 13: Structure-behavior graph of the Transfers to low income, as an effect of ratio to low income. Simulation based on the model formulation in Appendix 1 and different parameter values for 'Ratio to low income RL'.

4. Analysis and Discussion of Results

The system dynamics translation reproduces the reference modes, i.e. lower levels of low-income targeting led to more redistribution and lower inequality and poverty, and higher levels of low-income targeting led to less redistribution and higher inequality and poverty levels based on the created simulation model.

Furthermore, the shape of the graph portrayed in Figure 13 suggests that there is a trade-off between the size of the redistributive budget and the ratio to low income, as Korpi and Palme (1998) suggest.

Figure 12 portrays that the corporatist model leads to lower levels of transfers to low income earners comparing to the encompassing model. This has to do with the fact that, although the corporatist model leads to a great redistributive budget, the ratio of the redistributive budget that is transferred to low income earners is small. One may argue that the redistributive budget of the corporatist model has less of a 'redistributive effect'. Simultaneously, the corporatist model leads to significantly higher transfers to low income comparing to the targeted and basic security models, in line with Korpi and Palme's (1998) reasoning that the size of the redistributive budget is more critical than the ratio of the budget transferred to low income.

However, we need not jump to conclusions based on the model behavior. The interpretations of the theory e.g. with regards to the shapes of the table functions portrayed in Figure 7 and Figure 9, may indicate that a reconstruction rather than translation of the theory has been made. Also, as suggested in relation to the Bull's Eye Diagram of Figure 10, more variables may be modeled endogenously to better capture the dynamics in play. One simplification is that the size of the economy is constant. Hence, there is no influence of the size of GDP on 'Support for Redistribution' and no influence of the 'Redistributive budget' on GDP (assuming that GDP is the sum of 'Redistributive budget R' and 'Rest of economy E'). Moreover, there is no effect of GDP on the table functions of 'Indicated support for redistribution IS' and 'Desired redistributive budget DR'. Furthermore, the income distribution, e.g. Gini is not modelled. Also, we should be careful in drawing conclusions from the comparisons between the modeled behavior and the reference modes as the shapes of the reference modes are very general.

5. Conclusions, Limitations and Future Work

This paper has studied Korpi and Palme's (1998) paradox of redistribution through the construction of a system dynamics model. The theory suggests that social insurance institutions that target the poor and low-income earners result in smaller redistributive budgets and higher levels of poverty than social insurance institutions with lower levels of low-income-targeting. The model was constructed following the steps of system dynamics translations (Wheat, 2007). Moreover, the model was analyzed and compared to a simpler static model in which the size of the redistributive budget did not change over time. The structure was simulated with different values of low income targeting representing four types of welfare state institutions. The resulting behavior supports Korpi and Palme's (1998) hypothesis. Thus, the model indicates that the paradox of redistribution is coherent when translated into a system dynamics model.

However, the model is a very simplified representation of reality and there is a need for caution when it comes to drawing conclusions from the results. The resulting model is a theoretical representation of a theory in political economy. However, it clearly underlines the importance of considering feedbacks and path dependency tendencies of political decision making. As many variables remain excluded and exogenous, there is scope to develop a more endogenous model. Such a model could preferably be compared with data of historical behaviors of the mature welfare states.

As some interpretations of Korpi & Palme's (1998) theory were made during the constructing of the model, the model could benefit from expert reviews, not at least from the authors Walter Korpi and Joakim Palme. Also other aspects of the feedbacks within social insurance policies could be considered in further work. E.g. Korpi and Palme (2003) suggest that their typology may be used to explain the resilience of the welfare states in times of austerity. Their theories may also be extended to not only include elements of so called rational behavior of the middle income earners, but also solidarity with lower income earners.

Summing up, this modeling exercise indicates that system dynamics may play a vital role in the current debate on inequality. The model presented may be further developed and validated. This could give insights and contribute to the structural explanations to the development of inequality.

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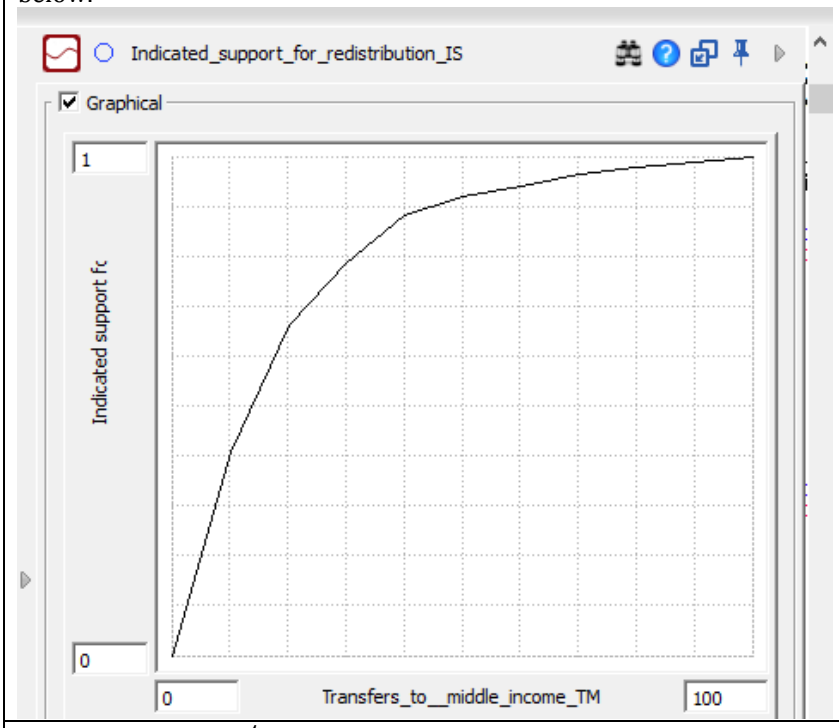
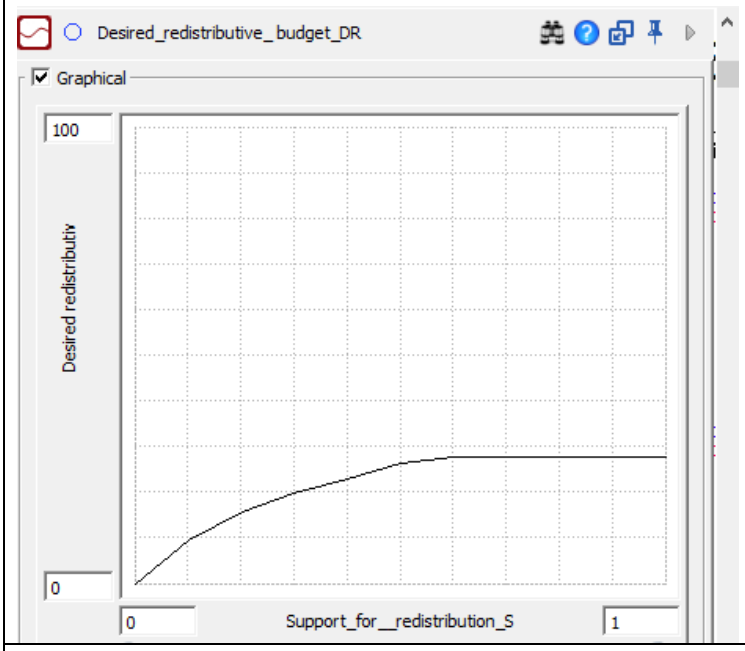
APPENDIX 1: MODEL VARIABLES AND EQUATIONS

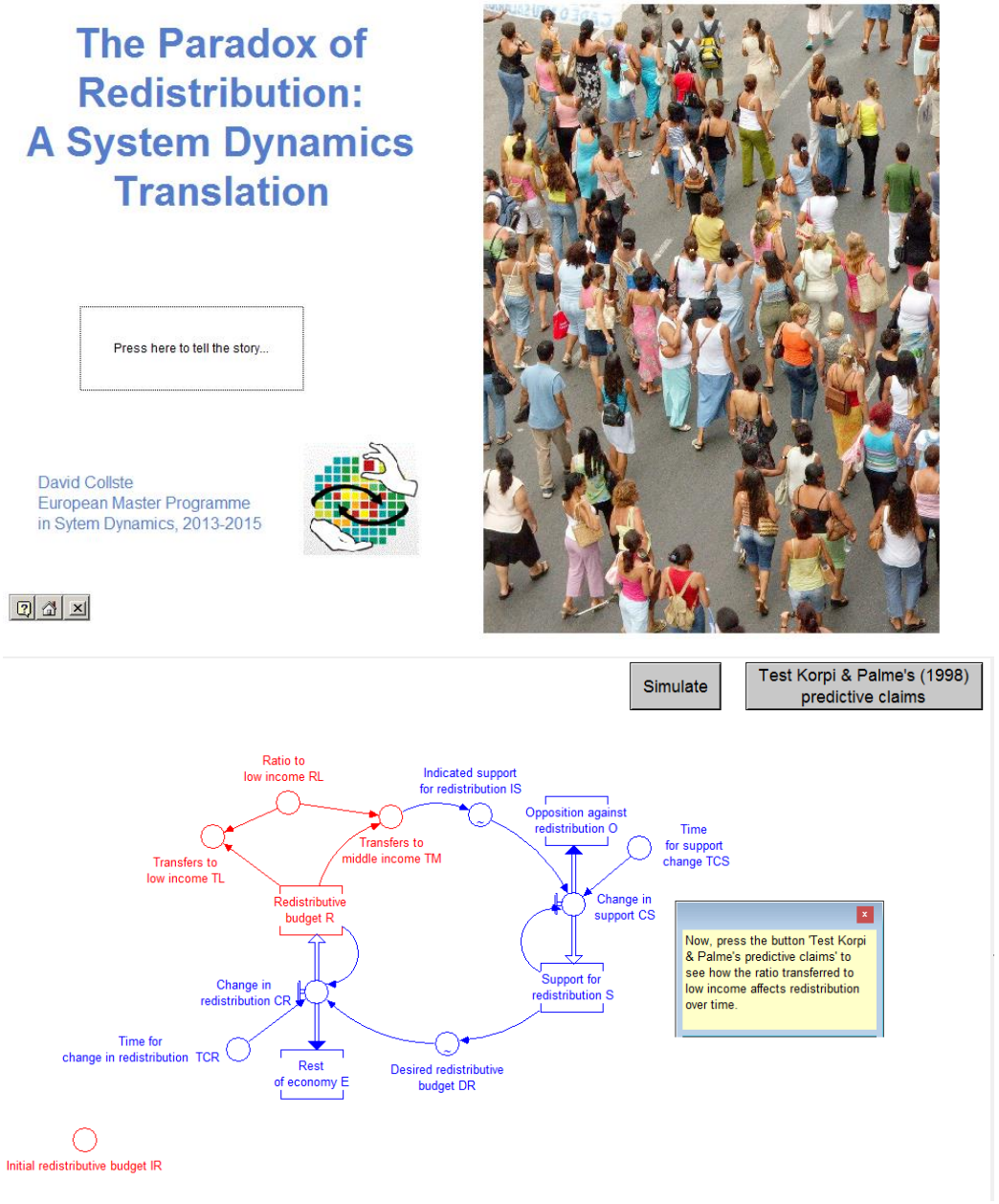
The table shows brief definition of the model's variables. The equations governing these variables can be accessed with the STELLA/iThink model.

TABLE 2: MODEL VARIABLES AND EQUATIONS

Variables and equations	Units
$R(t) = R(0) + \int_0^t CR(s)ds; R(0) = IR = 5$ The stock representing the redistributive budget, R, changes as the 'change in redistribution CR' goes up or down. The initial size of the redistributive budget is given by the 'Initial redistributive budget IR' which is set to 5 years.	*US Dollars/year*
$E(t) = E(0) + \int_0^t -CR(s)ds; E(0) = IR = 100 - IR = 95$ The stock representing the size of the rest of the economy, E, changes as the 'change in redistribution CR' goes up or down. The redistributive budget, R, and the rest of economy, E, together make up 100 US Dollars/year. Accordingly, the initial size of the rest of economy is 100 less the redistributive budget R. It includes the far-reaching assumption that the total size of the economy, i.e. R+E, is not affected by the size of redistributions.	*US Dollars/year*
$CR(t) = \frac{DR(t) - R(t)}{TCR}$ The change in redistribution, CR, is the rate at which the redistributive budget as part of the rest of economy changes. It depends on the gap between the desired redistributive budget, DR, and the redistributive budget, R, and the time for change in redistribution, TCR, which is set to 2 years. It is assumed that it takes some time for a new policy to be realized.	*US Dollars/year^2*
$TL(t) = R(t) \times RL$ Transfers to low income, TL, depends on the redistributive budget and the ratio of the redistributive budget that is transferred to low income earners. The transfers to low income is used as a proxy for determining poverty and inequality (i.e. the higher the transfers to low income, TL, the lower the poverty and inequality). This is a far-reaching assumption, but reasonable given the simplified representation of the causal processes at play.	*US Dollars/year*
$TM(t) = R(t) \times (1 - RL)$ Transfers to middle income, TM, depends on the redistributive budget and the ratio of the redistributive budget that is transferred to middle income earners. For simplification, high income earners are not included in the model. They are assumed not to affect the redistributive budget as they are assumed to always be against expansions of the redistributive budget just as the low income earners are assumed to always support expansions of the redistributive budget.	*US Dollars/year*

$IS(t) = Graphical\ function\ (TM)$ The indicated support for redistribution, IS, is determined through a graphical function of the transfers to middle income. The graphical function is presented below.  	*Dimensionless*
$S(t) = S(0) + \int_0^t CS(s)ds; S(0) = IS(0)$ The stock support for redistribution, S, changes as the change in support, CS, goes up or down. The initial support for redistribution is equal to the initial indicated support for redistribution, IS. Together the stock opposition against redistribution, O, and the support for redistribution, S, make up 1 or 100%, assuming each member of the middle classes is either supporting or opposing redistribution.	*Dimensionless (percentage)*
$O(t) = O(t) + \int_0^t -CS(s)ds; O(0) = (1 - IS(0))$ The stock opposition against redistribution, O, changes as the change in support, CS, goes up or down. The initial opposition against redistribution is one less the initial support for redistribution, S (together the stock opposition against redistribution, O, and the support for redistribution, S, make up 1 or 100%, assuming each member of the middle classes is either supporting or opposing redistribution).	*Dimensionless (percentage)*
$CS(t) = \frac{IS(t) - S(t)}{TCS}$ The change in support, CS, is the rate at which the support for redistribution, S (and accordingly the opposition against redistribution, O) changes. It depends on the gap between the indicated support for redistribution, IS, and the support for redistribution, S, and the time for support change, TCS, which is set to 5 years. It is assumed that it takes some time for the middle classes to change opinion.	*Percentage/Year*

$DR(t) = Graphical\ function\ (S)$ The desired redistributive budget, DR, is determined through a graphical function of the support for redistribution, S. The graphical function is presented below.  	*Dimensionless*
$IR = 5$ The initial redistributive budget, IR, is set to 5 US Dollars per year. The assumption is that the redistributive budget initially is 5 %. The two stocks (R and E) together make up 100 which is a good number to depart from when comparing different models. It can easy be changed for different countries.	*Us Dollars/year*
$RL = 0.8$ The ratio to low income, RL, is set to 0,8 for the initial simulation but is, as explained in the paper, changed according to the respective scenarios.	*Dimensionless*
$TCS = 5$ The time for support to change, TCS, is set to 5 years, assuming that it takes on average 5 years for the change in transfers to the middle income to make their attitude towards redistribution change.	*Years*
$TCR = 2$ Time for change in redistribution, TCR, is set to 2 years. This is based on the assumption that it takes on average 2 years for a policy change to be implemented.	*Years*


The Paradox of Redistribution: A System Dynamics Translation
Press here to tell the story...
David Collste
European Master Programme
in Sytem Dynamics, 2013-2015
Simulate
Test Korpi & Palme's (1998) predictive claims
Ratio to low income RL
Indicated support for redistribution IS
Opposition against redistribution O
Time for support change TCS
Transfers to low income TL
Transfers to middle income TM
Redistributive budget R
Change in support CS
Now, press the button 'Test Korpi & Palme's predictive claims' to see how the ratio transferred to low income affects redistribution over time.
Change in redistribution CR
Support for redistribution S
Time for change in redistribution TCR
Rest of economy E
Desired redistributive budget DR
Initial redistributive budget IR