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The Implications of UBI on the Utility Function and Tax Revenue: Further Calibrating of Basic Income Effects

By Bernhard Neumärker,** & Jette Weinel*,***

Abstract

Economic modeling of Universal Basic Income (UBI) often fails to consider how individuals' utility calculations shift with unconditional transfers. In this paper we further develop the model of our previous paper - The Implications of UBI on Utility Functions and Tax Revenue (Neumärker, B., Weinel, J., 2022). We contend that, while traditional fiscal models rely on an additively separable relationship between consumption and labor, the utility calculation for individuals influenced by UBI is better represented by a multiplicative relationship. This shift arises from the time sovereignty afforded by UBI, empowering individuals to become self-determined, creative, and intrinsically motivated. We explore the implications of the UBI-adapted utility function on tax revenue. Specifically, we analyze the consumption tax revenue curve under UBI (multiplicative preferences) versus a means-tested welfare system (additive separable preferences).

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Keywords

Basic Income, Laffer Curve, Utility Function, Consumption Tax, Time sovereignty, Intrinsic Motivation

1. Introduction

The concept of an unconditional basic income (UBI) is highly controversial in academic circles. While some economists vehemently advocate the concept, others criticize the lack of incentives and financing problems. This paper addresses the intersection of these two criticisms. It is argued that the lack of incentives in an unconditional subsistence securing transfer system leads individuals to drop out of the labor force (e.g. Jaimovich et al., 2022). This argument follows the standard economic theory and the principal agent theory. The agent will not work if the principal who hired her to perform a job does not (or cannot) sufficiently monitor her. In the context of UBI, this translates into individuals who are not willing to work if they are not exposed to the appropriate extrinsic incentives to work. Hence arises the argument of unsustainable funding of the UBI, as an UBI must be financed by taxes. However, if people stop working or drastically reduce their working hours, the state's tax revenue is also reduced and, consequently, it cannot sustainably finance the transfer system. Why do scholars nevertheless argue for the introduction of a UBI? Proponents of the UBI assume that individuals are willing to work not only because of extrinsic incentives but also because of intrinsic motivation. It is argued that intrinsic motivation is becoming increasingly important in a changing world of work and that the perception of work is evolving (Straubhaar, 2017).[1] Digitalization and globalization are driving the importance of education (Vogler-Ludwig & Kriechel, 2013). This, in conjunction with the high level of prosperity, leads people to choose their jobs in line with intrinsic motives such as self-fulfillment (Pendergast, 2008). At the same time, this development requires a certain financial and time freedom to find the right profession for oneself and to achieve the necessary level of education. This is where UBI becomes relevant. Means-tested social security systems are often characterized by a lot of bureaucracy and a flawed incentive structure. The incentive structure of a means-tested social security system is flawed if it encourages people to choose jobs that do not match their skills. This can then lead to rising mismatch unemployment in the long run (Sachverständigenrat Wirtschaft, 2019). An UBI, on the other hand, is non-bureaucratic and allows every citizen a higher degree of freedom in choosing a profession (e.g., Liebermann,2012)

Thus, we argue that the intersection between the two critics described may be caused by the lack of alignment of economic theory with the basic UBI reasoning, as it is at least partially at odds with mainstream economics. Moreover, it is based on a fundamentally different conception of humankind than most economic models, and it is therefore inherently problematic

[1] Especially, the "Generation Z" seem to be an indicator for these changes in work perception and labor ethics.

to apply these models to an UBI. Thus, while there is growing interest in the concept among policy makers and academics due to the changing landscape of labor, we argue that this difference has not been taken into account in the economic modeling of the UBI.

Therefore, this paper focuses on the comparison of consumption tax revenue with an unconditional transfer for a UBI scheme and a means-tested social security system. In doing so, it is closely oriented on our previous paper (Neumärker & Weinel, 2022). However, while the focus there was on the normative aspect of the consideration, here it is on the model and its further development. Note, however, that this is the beginning of a longer research program. The model is therefore to be understood as a baseline model, as it is a static economy with a representative individual and a single tax.

The focus on the consumption tax is motivated on the one hand by the lively debate about a consumption- or VAT-financed UBI (e.g. Wakolbinger et al., 2020 or Neumärker & Palermo, 2018), and on the other hand by the fact that this paper builds on the results of Hiraga and Nutahra (2016, 2018, 2019, 2021, 2022) as well as Trabandt and Uhlig (2011, 2013).

Throughout this paper, we present four main findings. First, a differentiation in the utility calculation between a UBI scheme and a means-tested social security system is not only necessary but also possible. The utility function in economics is based on a few axioms and is meant to reflect the basic preference structure. We argue that already at this underlying element a distinction can be made between the standard economic theory and the UBI driven economic logic. We develop a utility function that, by accounting for time sovereignty that individuals gain from an UBI and integrating intrinsic motivation released by UBI, is adapted to the assumptions of an UBI system. Hence, we develop a utility function which is endogenous to social policy strategies. Second, we illustrate in a simple static model that accounting for these differences in underlying assumptions, by adjusting the utility function, leads to significantly different results for consumption tax revenues. While the UBI utility function leads to an increasing consumption tax revenue curve, the utility function we assign to the means-tested social security system (MT system) leads to a classical consumption tax revenue Laffer curve. Third, the difference in tax revenue levels is remarkable. In our model, the UBI utility function leads to significantly higher tax revenues than the MT utility function for each tax rate. Fourth, and most significant in the context of this paper, is differentiation of the effects of time sovereignty and intrinsic motivation on tax revenues. It is found that the time sovereignty effect has a stronger impact on consumption tax revenues than the intrinsic factor.

The structure of the paper is as follows. In chapter two we review the related literature. The paradigm shift in time sovereignty will be explained in chapter three. Chapter four is devoted to the model. Chapters five and six present and discuss the results. The paper closes with the conclusion in chapter six.

2. Related Literature

This paper contributes to three bodies of literature. First and foremost, we contribute to the existing literature on the modelling of a UBI. The literature on UBI models is continuously growing. Wakolbinger et al (2020), for example, analyze a consumption tax financed UBI for Germany in different scenarios. Neumärker and Palermo (2018), on the other hand, model the time allocation effects of the UBI. We contribute to this line of literature by providing a model that accounts for the effects of the UBI at the utility calculus level on the one hand and examines the effects on the tax revenue of the consumption tax on the other hand. Thus, we can integrate the traditional UBI arguments from the utility side rather than the production side.

Second, we contribute to the literature on the implications of the utility function by King and Rebelo (1999) on tax revenue. Here we are closely related to the body of research by Hiraga and Nutahara (2016, 2018, 2019, 2021, 2022) which consists of two main research foci. The first research path studies the sensitivity of the tax revenue curve with respect to the utility function (ibid. 2016, 2019, 2021). The authors compare the effects of additive separable and multiplicative utility functions on the consumption tax rate in a neoclassical setting. Thereby, it is shown that the consumption tax revenue curve cannot be hump-shaped for a multiplicative utility function, while it can be hump-shaped for an additive separable utility function. The second research path, on the other hand, focuses on the difference in shape of the tax revenue curve for the consumption- and the labor income tax (ibid. 2018, 2022). Whereas one can observe the classical Laffer curve (humped-shaped tax revenue curve) for the labor income tax independent of the utility function, one cannot observe the same for the consumption tax revenue curve. By manipulating the multiplicative utility function of King and Rebelo (1999) for an UBI and then applying it to the consumption tax, we thus contribute to the research on the relationship between the consumption tax revenue curve and the utility function.

And third, we are contributing to the body of research on intrinsic motivation, especially in the waged labor context. Along with the transformation of the work environment, a research focus has also moved into the direction of intrinsic motivation in the labor market context. Economists such as Murdock (2002) or Prendergast (2008) increasingly emphasize the importance of intrinsic motivation in highly specialized jobs. Our contribution to this line of literature relates to the incorporation of intrinsic motivation into the utility function. In the context of this paper, we refer to intrinsic motivation whenever an individual finds pleasure in a task or activity for reasons that lie in the activity itself and not in its consequences, thus following Frey's (1994) definition. Or, put it in another way, in a labor market and work system in which only compensation for the disutility of work effort is considered to be relevant intrinsic motivation is “crowded out” because “it does not pay”. With UBI, we argue, this logic will be undermined.

3. Paradigm Shift in Time Sovereignty

Throughout this paper, we argue that a social policy shift from a means-tested social security system to an unconditional basic income implies a paradigm shift in time sovereignty. This paradigm shift is due to the fact that individuals in an UBI system are no longer forced to work and thus become truly time sovereign. That time sovereignty, in turn, then allows individuals to take intrinsic motivation into account in their utility calculus. This is most easily illustrated by the principal agent theory, although it can also be found in many other economic models, such as the Shapiro-Stiglitz efficiency wages model (1984). In the classic understanding of the employer-employee relationship, the employee is only motivated to work by extrinsic incentives and constantly tries to assert his own interests, which are inconsistent with those of the employer. This shift is not just theoretical; it impacts how we design social policies and labor markets. Previous research, such as studies on the Negative Income Tax, has often missed this nuance by focusing solely on labor-time reduction under the old additive framework (Widerquist, 2019, 304 ff.). Not only working conditions but also the design of the welfare state is based on these assumptions. Thus, many social security systems consist of numerous control mechanisms for jobseekers, which are intended to ensure that they get back into employment as quickly as possible. However, UBI advocates assume that individuals aim to be a productive part of society on their own initiative (e.g., Standing 2017, Van Parijs & Vanderborght 2017, Torry, 2019). Thus, the absence of these control and incentive mechanisms is a key component of UBI, as it gives each person absolute freedom over their own time. We thus argue that such a drastic shift in social policy affects the utility calculus of individuals and endogenizes the utility function with respect to it. Therefore, we argue that our approach is a rigorous implementation of UBI logic.

This move away from the additive separability and consumer sovereignty, where economic value is only recognized through market transactions or government provisions, toward recognizing time sovereignty, underscores a broader societal and policy transformation. It questions the effectiveness of traditional social welfare mechanisms built on outdated economic theories that see work primarily as a disutility. Moreover, it challenges the paternalistic structures of capitalism by empowering individuals with full control over their time, thus promoting a more equitable and forward-looking approach to social policy. UBI, by emphasizing multiplicative utility relations, paves the way for rethinking work ethics and social welfare, advocating for a society that values time sovereignty and the diverse contributions of its citizens.

4. The Model

In this section we provide the static baseline model in which we apply the UBI- and the means-tested utility function.

We differentiate between the additive-separable utility function, (1), as representation for means tested social security system,

$$U^{MS}(c,n) = \frac{c^{1-\eta}}{1-\eta} - \kappa\frac{n^{1+\lambda}}{1+\lambda}, \tag{1}$$

and the multiplicative UBI utility function (2), which is given by,

$$U^{UBI}(c,n) = \frac{1}{1-\eta}\{c^{1-\eta}[1-(\kappa-\rho)(1-\eta)n^{1+\lambda}]^{\eta}-1\}$$
$$for\ \eta > 0, \eta \neq 1, (\kappa-\rho) > 0. \tag{2}$$

We argue that the multiplicative utility function captures the utility calculus of an individual socialized in a UBI system for two reasons. First, the multiplicative linkage of work and consumption represents the time sovereignty that individuals gain through a UBI. That is because individuals in a UBI system are no longer obliged to work or to accept any acceptable job (i.e., exit option for the labor market). Rather, they are empowered to derive *positive* utility not only from consumption but also from productivity, respectively work. Second, intrinsic motivation to be productive is a central argument of UBI proponents and hence must be considered in the utility calculus. The intrinsic factor in the utility function is defined as the

intrinsic motivation to work. Here, it is integrated into the function in an additive manner with labor suffering, and primarily affects n. Since it is assumed that it may still be rational for individuals to accept a job in which they suffer, but for which they receive a decent wage (compensating for labor suffering), labor suffering is also integrated into the UBI utility function.

Moreover, it is likely that there will never be a job in which one enjoys all aspects and every day. Thus, in a sense, labor suffering is reduced by intrinsic motivation. The additive function, on the other hand, represents the utility calculus of an individual in a means-tested social security system. Here, utility results from consumption subtracting labor multiplicated by labor suffering. This is in line with the principal agent theory and thus not applicable to a UBI as labor is exclusively associated with suffering, the individual cannot derive any positive utility from working (Murdock, 2002). Hence, this is contradictory to the basic assumptions of UBI (Liebermann, 2012). Note that in Neumärker and Weinel (2022) a detailed discussion of the derivation and justification of this endogenization of the utility function is given.

The constant relative risk aversion is shown by η which, in the static model, can be interpreted as an index of the curvature of the utility function. λ is the inverse of the labor supply elasticity. The labor weight, indicating the disutility of effort, is given by κ, while the intrinsic factor is ρ.

The production function is given by,

$$y = n, \tag{1}$$

where n is the only input. The resource constraint is given by,

$$y = c. \tag{2}$$

The public budget constraint is

$$T = s. \tag{3}$$

The unconditional transfer to households (UBI) as social spending and the only public expenditure is given by s. n is for labor, c for consumption, and T for tax revenue. Since we are particularly interested in the tax revenue of consumption taxation, we exclude any other taxes in our baseline model. Thus, the total tax revenue is

$$T = \tau^c c. \tag{4}$$

The wage and the consumption tax rate are given by w and τ^c. Hence, the household budget constraint is given by,

$$(1 + \tau^c)c \leq wn + s. \tag{5}$$

5. Main Results

This section presents the main results. We first present the theoretical results of the model for a UBI scheme and a means-tested social security scheme. Next, we provide graphs that visualize the key findings and differences.

5.1 The Unconditional Basic Income Scheme

Applying the utility function consistent with the assumptions of the UBI and paying an unconditional transfer s to the representative individual, we obtain the following results in this simple static mode. The consumption labor supply condition is given by,

$$\frac{1}{(1 + \tau^c)} \times w = \eta(\lambda + 1)\left(\frac{c(\kappa - \rho)n^{\lambda}}{1 - (\kappa - \rho)(1 - \eta)n^{\lambda+1}}\right). \tag{6}$$

Since the total tax revenue is given by the tax rate times the consumption, we observe the following total tax revenue,

$$T = \tau^c \times [(\kappa - \rho)(\eta((\tau^c + 1)\lambda + \tau^c) + 1)]^{-1/(1+\lambda)}. \tag{9}$$

The partial derivative of the tax revenue is,

$$\frac{\partial T}{\partial \tau^c} = \frac{\eta\lambda(\tau^c + 1) + 1}{(\eta((\lambda + 1)\tau^c + \lambda) + 1)((\kappa - \rho)(\eta((\lambda + 1)\tau^c + \lambda) + 1))^{1/(\lambda+1)}}. \tag{10}$$

The elasticity of consumption to the consumption tax rate in the case of the UBI utility function is then given by,

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| = \frac{\tau^c}{(1+\tau^c)} \times (\frac{n^{\lambda+1}(\eta-1)(\eta(\lambda+1)-1)(\kappa-\rho)+\lambda}{n^{\lambda+1}(\eta-1)(\kappa-\rho)+1} + \frac{n^{\lambda+1}(\kappa-\rho)(1-n^{\lambda+1}(\kappa-\rho)(\eta-1))^{\eta-1}(1-\eta)\eta(\lambda+1)}{(1-n^{\lambda+1}(\kappa-\rho)(1-\eta))^{\eta}} + 1)^{-1}. \quad (11)$$

It can be shown that the consumption tax revenue curve is monotonically increasing if $\lambda > 0$ and $\tau^c > 0$ (see Appendix A & B and Neumärker & Weinel (2022) for a more detailed explanation on this result).

5.2 Means-tested Social Security Scheme

The total tax revenue is again used for an unconditional transfer to households only, that is that $s = T$ holds. The preferences of the representative individual are defined by the additive separable utility function, U^{MS}. That is, following our reasoning, associated with a means-tested welfare system.[2]

Here, the consumption labor supply condition is the following,

$$\frac{1}{(1+\tau^c)} \times w = \kappa n^{\lambda} c^{\eta}. \quad (12)$$

Hence, the total tax revenue is given by

$$T = \tau^c[\kappa(1+\tau^c)]^{-1/(\eta+\lambda)}, \quad (13)$$

and

$$\frac{\partial T}{\partial \tau^c} = \frac{(\lambda+\eta-1)\tau^c+\lambda+\eta}{(\lambda+\eta)(\tau^c+1)(\kappa(\tau^c+1))^{1/(\lambda+\eta)}} \quad (14)$$

is the partial derivative of the tax revenue.

Thus, the elasticity of consumption to the consumption tax rate is as follows,

[2] This is the approach, almost all politicians have in mind when criticizing UBI as provoking laziness, idleness as negative (paid) work incentives and as making social expenditures too expensive, or, not financeable. The second problem is, principally, excluded in our model, as the budget constraint always holds. I.e., integrating a budget constraint eliminates the problem of unaffordability.

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| = \frac{1}{\eta+\lambda} \times \frac{\tau^c}{1+\tau^c}. \tag{15}$$

The consumption tax revenue curve is humped shaped if $\eta + \lambda < 1$ holds. The revenue is maximized at $\tau^c = \frac{\eta+\lambda}{1-\eta-\lambda}$ (Hiraga & Nutahara, 2016) (see Appendix A & C and Neumärker & Weinel (2022) for a more detailed explanation on this result.).

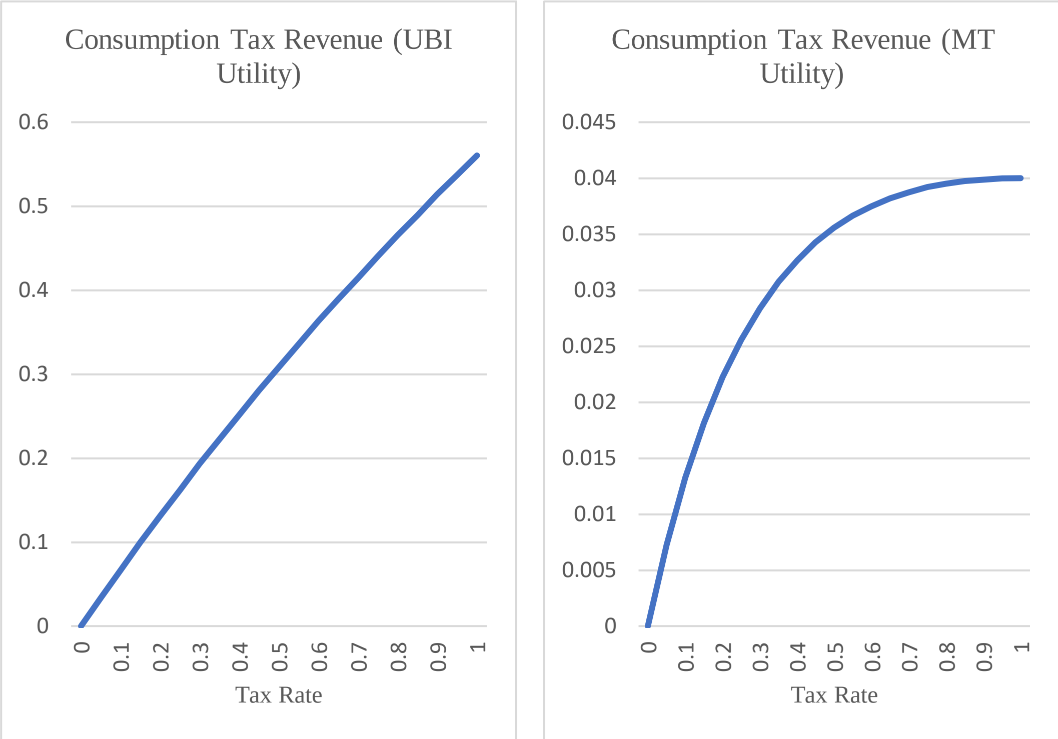
5.3 Numerical Example

To illustrate the results of the model we are providing a numerical example. *Figure 1* shows the consumption tax revenue for the UBI- and the means-tested scheme of the model as a numerical example. Note that for the consumption tax revenue curve to be humped shaped in the case of the additive separable preferences, $\eta + \lambda < 1$ must hold. The relative risk aversion η is set at 0.25. The inverse of the labor supply elasticity is set at 0.25. The labor weight is set at 2.5 and the intrinsic value is set at 1. The empirical plausibility of the parameter values is the concern of the following discussion.

In case of the UBI utility function the consumption tax revenue curve is increasing. One can easily see that this holds if $\lambda > 0$ and $\tau^c > 0$ hold. In case of the MT utility function, on the other hand, the consumption tax revenue curve is hump shaped and peaks for these parameter values exactly at $\tau^c = 1$ ($\tau^c = \frac{\eta+\lambda}{1-\eta-\lambda}$). This is in line with the results by Hiraga and Nutahara (ibid.) who find that the consumption tax revenue curve is sensitive to the utility function. However please note that this only holds if $\eta + \lambda < 1$. The consumption tax revenue curve is increasing for $\eta + \lambda > 1$.

There are three main observations in *Figure 1*. First, the tax revenue grows faster at lower tax rates for the MT utility case than for the UBI case. As the curve approaches its peak the growth flattens out. Hence the second observation is the difference in the shape of the curves. While the MT utility function results in a classical tax Laffer curve, the UBI utility function results in an increasing function. This is in line with the results by Trabandt and Uhlig (2011) who show that the consumption tax revenue curve does not peak for the multiplicative utility function by King and Rebelo (2000). The third aspect is the difference in revenue. The tax revenues for the UBI function far exceed those for the MT function for any given tax rate.

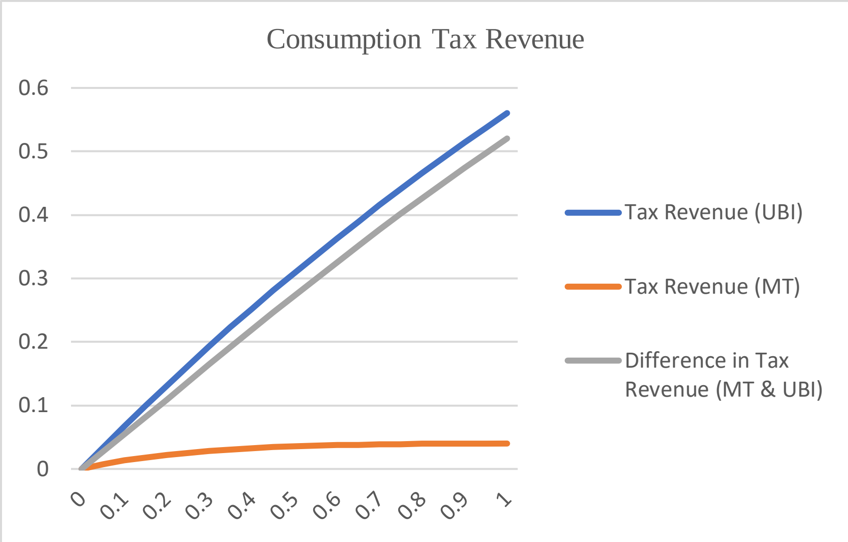
Figure 1: Consumption Tax Revenue Curves of the Numerical Example



Note: MT stands for means-tested social security system and UBI stands for unconditional basic income. The y-lab shows the tax revenue. The x-lab shows the tax rate. Parameter values: $\eta = 0.25$, $\lambda = 0.25$, $\kappa = 2.5$, $\rho = 1$.

Figure 2 shows both consumption tax revenue curves and their difference in revenue. One can see that the difference in revenue is quite large. It is often argued that a certain level of UBI required by its proponents is not feasible because of its financial sustainability. Our results indicate that if one accounts for the behavioral adjustment associated with an UBI the tax revenue far exceeds that of the MT utility function (with an unconditional transfer). It is, however, obvious that these results are not applicable in any real sense. The main result is rather the importance of modeling the right underlying assumptions and the magnitude this can have.

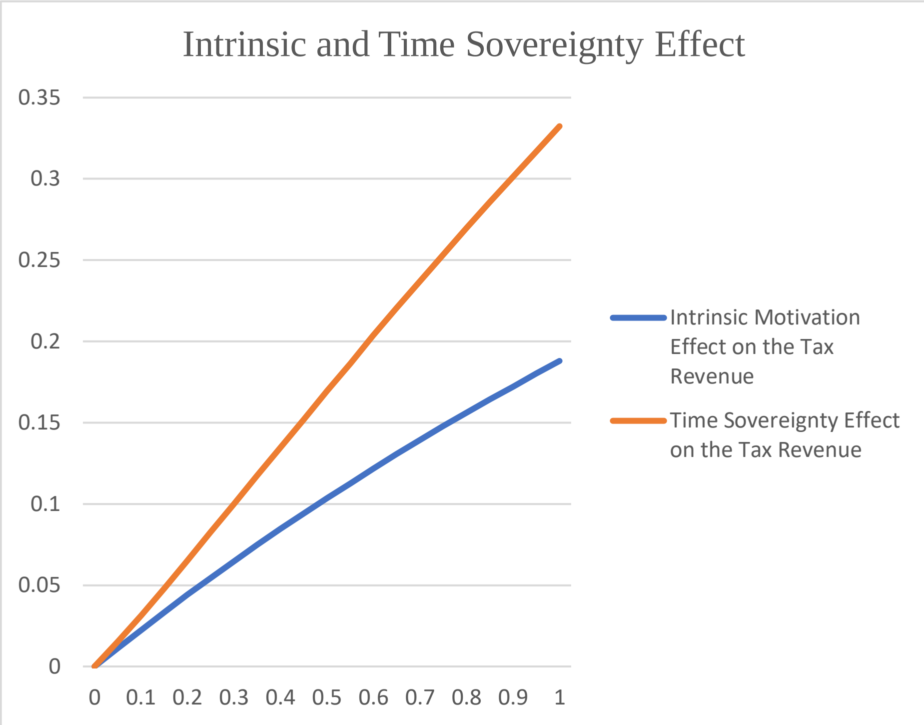
Figure 2: Consumption Tax Revenue Curves (Different Utility Functions)



Note: MT stands for means-tested social security system and UBI stands for unconditional basic income. The y-lab shows the tax revenue. The x-lab shows the tax rate. Parameter values: $\eta = 0.25,\ \lambda = 0.25,\ \kappa = 2.5,\ \rho = 1$.

Figure 3 illustrates the effect of the intrinsic factor and the time sovereignty on consumption tax revenue. The intrinsic factor, ρ, in the utility function is defined as the intrinsic motivation to work. The intrinsic motivation effect on the tax revenue, however, is the difference in consumption tax revenue that arises through the consideration of the intrinsic factor. Therefore, it is not the difference that arises between the MT- and the UBI utility function but the difference between the multiplicative utility function with ρ and without ρ. The time sovereignty effect, on the other hand, is the difference in tax revenue that arises between the multiplicative utility function (without ρ) and the additive separable utility function. In order to isolate the effect from the intrinsic motivation effect ρ is not considered. Time sovereignty is defined as a *true* freedom of time, i.e., no obligation to work. It is indicated by the multiplicative linkage between consumption and work in the utility function. One can see that, independent of the tax rate, the time sovereignty effect is bigger in magnitude on the tax revenue than the intrinsic motivation effect. This is in line with many UBI proponents who argue against the story of the "lazy individual". In this static model economy with a representative individual, one tax (consumption tax), and one unconditional transfer, the impact of the modeling of the utility function on the tax revenue is crucial. Moreover, these results indicate that while intrinsic motivation is an important driver in the utility function it is not the only one nor the most important one.

Figure 3: Intrinsic and Time Sovereignty Effect



Note: MT stands for means-tested social security system and UBI stands for unconditional basic income. The y-lab shows the tax revenue. The x-lab shows the tax rate. Parameter values: $\eta = 0.25,\ \lambda = 0.25,\ \kappa = 2.5,\ \rho = 1$.

6. Discussion

The following discussion is concerned with the implications and the plausibility of the parameter values of the numerical example as well as contextualizing of the results.

The parameter values of the numerical example are not given by specific values from the literature. There are three reasons for that. First, the literature lacks these estimates for an UBI system. Even though the literature on UBI is growing significantly, there has never been a full scale UBI system in place which makes it very difficult to predict how the labor supply would react. Second, while we would have been able to use estimates of the risk aversion, labor supply elasticity and disutility of work from one study (e.g., Trabandt & Uhlig, 2011), we still would have been obligated to use an estimation of the intrinsic value from a different study. Given that the literature lacks estimations of intrinsic motivation for the labor force, we would be forced to use values that are not in line with the other parameter values. The reasons for this are differences in the underlying data sets, economic-, and econometric -assumptions. Nevertheless, in our previous paper (Neumärker & Weinel, 2022) one can find a numerical example with parameter estimates from the literature.

The third reason is the estimation of intrinsic motivation to work itself. While there is a large body of literature on intrinsic motivation, it focuses mainly on specific categories of work. Yet even if we find an estimate of intrinsic motivation for the labor force, it is likely to be inadequate for our purposes because it was obtained in a specific social security system. In this context, the relationship between extrinsic and intrinsic motivation is particularly problematic. Frey (1997) for example argues that extrinsic incentives can lead to a crowding out of intrinsic motivation. It is therefore expected that the value of intrinsic motivation in a UBI system differs from that in a means-tested system.

These concerns led us to choose hypothetical parameter values that are, however, not unreasonable. We set both, the relative risk aversion, and the inverse of the labor supply elasticity, relatively small. This is because they must meet the assumption $\eta + \lambda < 1$ for the means-tested utility function to be humped shaped. As the inverse of the labor supply elasticity is set at 0.25, the actual labor supply elasticity is 4. The calibration of the labor supply elasticity or Frisch elasticity is, generally, relatively volatile (Peterman, 2016). While it is usually higher in macroeconomics than in microeconomics, 4 is a quite high value even for macroeconomics. Nevertheless, King and Rebelo (1999) also calibrated it as such in their RBC model. Since the multiplicative utility function originates from this work, it seems justified to choose the value accordingly for the purpose of the numerical example. The constant relative risk aversion is set to be 0.25. Since this is a static model without frictions, the risk behavior is irrelevant. However, η can be understood as an index for the curvature of the utility function (Hiraga & Nutahara, 2019, Meyer & Meyer, 2005). The disutility of labor is set to be 2.5. Compared to Trabandt and Uhlig (2011), who take a disutility of labor of 3.46 for the benchmark for a balanced growth of labor of 25 percentage of the total time, and Hiraga and Nutahara (2022), who set the disutility of labor equal to one in their numerical example, in our example the chosen value is in a window between these two. Nevertheless, please note that we still account the intrinsic value and thus obtain a lower overall value for $(\kappa - \rho)$ of the UBI utility function compared to the two other papers. The intrinsic value is assumed to be one. As we have already indicated before, the measurement of intrinsic motivation is somewhat difficult. However, there are two reasons why we have chosen to use this value in the context of this paper. For one, to avoid that the disutility of labor and the intrinsic value cancel each other out in the calculation. Secondly, the term (κ-ρ) is to be kept positive. Consequently, the intrinsic value must be smaller than the disutility of labor. Within these two limits, however, it could have taken any value.

The results of this study, and in particular those of the numerical example, do not have any direct political implications. However, there are economic-theoretical implications. Conversely, the proposition regarding the utility function implies that any calculation concerning the UBI is based on false assumptions, if it does not take behavioral changes into account. Thus, it is particularly interesting that, in the numerical example, we observe significant differences in tax revenues between the schemes that take behavioral adjustment into account and the ones that do not. Moreover, we see that time sovereignty is more important in the utility calculus than the intrinsic factor. This could be interpreted as a clear argument in favor of an UBI, since it is possible to promote a higher integration of intrinsic motivation in the existing system through various measures, but the same cannot be said about time sovereignty.

7. Conclusion

This paper investigates the implications of the UBI for the utility function and consumption tax revenues. We assume an endogenous utility function with respect to social policy. We argue that the additive utility function expresses the utility calculus of an individual in a means-tested social security system, while the multiplicative utility function represents the utility calculus of an individual in an UBI system. In a simple static model with a representative individual, the consumption tax revenue curve of the two systems differs. While the consumption tax revenue curve rises for the UBI system, it shows the classic Laffer-hill for the means-tested social security system. Moreover, a clear difference in tax revenue can be observed. In the context of this paper, however, the focus is on the effect of time sovereignty and intrinsic motivation, both taken into account in the UBI utility function, on the consumption tax revenue curve. Time sovereignty is accounted for by the multiplicative link between work and consumption in the utility function. Intrinsic motivation to work, on the other hand, is represented by ρ in the utility function. Both aspects are shown to have a significant impact on tax revenues. However, the time sovereignty that individuals gain through an UBI exerts a greater influence on tax revenue. It seems remarkable that the rigorous incorporation of UBI assumptions into the utility function not only works, but also has a positive effect on consumption tax revenues that exceeds those of means-tested social security systems.

Based on our results, we can already derive some important implications. First, it should be noted that the assumptions of UBI are not consistent with the classical assumptions of economics. Consequently, the strict application of the classical additive utility function in this context will always lead to (following this argumentation) wrong results. Accounting for these assumptions in the utility function, on the other hand, leads to fundamentally different results with respect to consumption tax revenues. The financing of an UBI is repeatedly pointed out as a counterargument. Our model shows that sustainable financing could be possible, or at least, easier. Nevertheless, it should be noted that this is the beginning of the research work. We will expand the model further in the next steps by introducing different tax regimes, heterogeneous agents and adding quasi-dynamic constraints of the "new ordoliberalism", namely, renegotiation-proofness of a constitutional UBI contract.[3]

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Appendix

A.

To derive the consumption tax revenue in the model, we apply the conditions by Hiraga and Nutahara (2016, 2018, 2019 a & b, 2021).

The household's consumption-labor choice is given by

$$-\frac{U_n}{U_c} = RPL. \tag{16}$$

The relative price of leisure, RPL, is

$$RPL \equiv \frac{1}{(1+\tau^c)} \times w. \tag{17}$$

The equilibrium elasticity of consumption with respect to the consumption tax (τ^c) is

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| = \left|\frac{dRPL/RPL}{d\tau^c/\tau^c}\right| \times (-\frac{cU_{cc}}{U_c} + \frac{nU_{nn}}{U_n} + \frac{cU_{cn}}{U_n} - \frac{nU_{cn}}{U_c})^{-1}, \tag{18}$$

where the elasticity of the relative price of leisure, RPL, with respect to τ^c is given by

$$\left|\frac{dRPL/RPL}{d\tau^c/\tau^c}\right| = \frac{\tau^c}{1+\tau^c}. \tag{19}$$

Hiraga and Nutahara (2018) have also shown that a necessary condition for the consumption Laffer curve to be humped shaped is that,

$$\frac{dc/c}{d\tau^c/\tau^c} < -1 \tag{20}$$

holds.

B.

Multiplicative Utility Function

In the case of the UBI utility function, (16) leads to the following,

$$\frac{1}{(1+\tau^c)} \times w = \eta(\lambda+1)\left(\frac{c(\kappa-\rho)n^{\lambda}}{1-(\kappa-\rho)(1-\eta)n^{\lambda+1}}\right). \tag{21}$$

Given that c is equal to n in this model, we get the following result when rearranging the equation with respect to c,

$$c = [(\kappa-\rho)(\eta((\tau^c+1)\lambda+\tau^c)+1)]^{-1/(1+\lambda)}. \tag{22}$$

The total tax revenue is given by,

$$T = \tau^c \times [(\kappa-\rho)(\eta((\tau^c+1)\lambda+\tau^c)+1)]^{-1/(1+\lambda)}. \tag{23}$$

The derivative of the tax revenue is

$$\frac{\partial T}{\partial \tau^c} = \frac{\eta\lambda(\tau^c+1)+1}{(\eta((\lambda+1)\tau^c+\lambda)+1)((\kappa-\rho)(\eta((\lambda+1)\tau^c+\lambda)+1))^{1/(\lambda+1)}}. \tag{24}$$

To derive the elasticity of consumption with respect to the consumption tax, we obtain the following intermediate result.

$$-\frac{cU_{cc}}{U_c} = \eta,$$

$$\frac{nU_{nn}}{U_n} = \frac{n^{\lambda+1}(\eta-1)(\eta(\lambda+1)-1)(\kappa-\rho)+\lambda}{n^{\lambda+1}(\eta-1)(\kappa-\rho)+1},$$

$$\frac{cU_{cn}}{U_n} = 1-\eta,$$

$$-\frac{nU_{cn}}{U_c} = \frac{n^{\lambda+1}(\kappa-\rho)(1-n^{\lambda+1}(\kappa-\rho)(\eta-1))^{\eta-1}(1-\eta)\eta(\lambda+1)}{(1-n^{\lambda+1}(\kappa-\rho)(1-\eta))^{\eta}}.$$

Due to condition (18) this yields the following results,

$$\frac{dc/c}{d\tau^c/\tau^c} = \frac{\tau^c}{(1+\tau^c)} \times \Bigg(\frac{n^{\lambda+1}(\eta-1)(\eta(\lambda+1)-1)(\kappa-\rho)+\lambda}{n^{\lambda+1}(\eta-1)(\kappa-\rho)+1} + \frac{n^{\lambda+1}(\kappa-\rho)(1-n^{\lambda+1}(\kappa-\rho)(\eta-1))^{\eta-1}(1-\eta)\eta(\lambda+1)}{(1-n^{\lambda+1}(\kappa-\rho)(1-\eta))^{\eta}} + 1\Bigg)^{-1}. \tag{25}$$

Hence, the elasticity of consumption to the consumption tax rate is given by

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| = \frac{\tau^c}{(1+\tau^c)} \times (\frac{n^{\lambda+1}(\eta-1)(\eta(\lambda+1)-1)(\kappa-\rho)+\lambda}{n^{\lambda+1}(\eta-1)(\kappa-\rho)+1} + \frac{n^{\lambda+1}(\kappa-\rho)(1-n^{\lambda+1}(\kappa-\rho)(\eta-1))^{\eta-1}(1-\eta)\eta(\lambda+1)}{(1-n^{\lambda+1}(\kappa-\rho)(1-\eta))^{\eta}} + 1)^{-1} \tag{26}$$

for $\lambda > 0$ and $\tau^c > 0$.

If $\tau^c = 0$, then $\left|\frac{dc/c}{d\tau^c/\tau^c}\right| = 0$. If τ^c is increasing, then $\left|\frac{dc/c}{d\tau^c/\tau^c}\right|$ increases.

C.

Additive separable Utility function

In the case of the additive separable utility function (i.e., means-tested social security system) we observe the following results.

The consumption labor supply condition is given by

$$\frac{1}{(1+\tau^c)} \times w = \kappa n^{\lambda} c^{\eta}. \tag{27}$$

Solving this condition for *c* yields to

$$c = [\kappa(1+\tau^c)]^{-1/(\eta+\lambda)}. \tag{28}$$

The total tax revenue is

$$T = \tau^c[\kappa(1+\tau^c)]^{-1/(\eta+\lambda)} \tag{29}$$

and the partial derivative is given by,

$$\frac{\partial T}{\partial \tau^c} = \frac{(\lambda+\eta-1)\tau^c + \lambda + \eta}{(\lambda+\eta)(\tau^c+1)(\kappa(\tau^c+1))^{1/(\lambda+\eta)}}. \tag{30}$$

For elasticity of consumption to the consumption tax rate we derive the following intermediate result,

$$-\frac{cU_{cc}}{U_c} = \eta, \qquad \frac{nU_{nn}}{U_n} = \lambda, \qquad \frac{cU_{cn}}{U_n} = 0, \qquad -\frac{nU_{cn}}{U_c} = 0.$$

It follows, that the elasticity of consumption to the consumption tax rate is,

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| = \frac{1}{(\eta+\lambda)} \times \frac{\tau^c}{(1+\tau^c)}.$$

If $\eta + \lambda \neq 1$, then

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| - 1 = \left(\frac{1-\eta-\lambda}{\eta+\lambda}\right)\left(\frac{1}{1+\tau^c}\right)\left(\tau^c - \frac{\eta+\lambda}{1-\eta-\lambda}\right)$$

Assume $\eta + \lambda > 1$, then $\left|\frac{dc/c}{d\tau^c/\tau^c}\right| \leq 1$.

Assume $\eta + \lambda < 1$ and $\tau^c \leq \frac{\eta+\lambda}{1-\eta-\lambda}$, then $\left|\frac{dc/c}{d\tau^c/\tau^c}\right| \leq 1$.

If $\tau^c > \frac{\eta+\lambda}{1-\eta-\lambda}$, then $\left|\frac{dc/c}{d\tau^c/\tau^c}\right| > 1$.

If $\eta + \lambda = 1$, then

$$\left|\frac{dc/c}{d\tau^c/\tau^c}\right| - 1 = \frac{1}{(\eta+\lambda)} \times \frac{1}{(1+\tau^c)}\big((1-\eta-\lambda)\tau^c - (\eta+\lambda)\big) < 0$$

See also Hiraga and Nutahara (2016) for a detailed supporting explanation of this result.

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