A Middle-Class Motivation for Universal Basic Income

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Bachelor Thesis Economics & Business Economics

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Abstract: *I simulate a post Universal Basic Income labour supply model where workers are initially endowed with a wage and labour supply of one unit. I determine how individuals from different income groups alter their labour supply allocation based on their income-elasticity and average tax rate, where the government has tactically reshaped the marginal tax system to maximise social welfare. I observe that the income-elasticity determines whether the substitution or income effect dominates, while the optimal marginal tax system in combination with the unconditional cash transfer favours the median incomes mostly. I verify the model hypotheses with empirical research that suggests that demographic and social aspects strongly influence labour supply allocation in a UBI-setting. Lastly, I determine that a revised marginal tax system will not significantly decrease life-satisfaction in large-scale setting, demonstrating that UBI carries positive externalities in terms of utility.*

The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

I. Introduction

With the introduction of mechanical production by the first wave of industrialisation in the 18th century, the interaction between labour and physical capital has evolved to a subordinate relation where two-thirds of a mature economy's output is the product of physical capital (Solow, 1956). The last three waves of industrialisation have alluded to create these physical systems that have facilitated the rapid economic growth experienced by global economies, where the third wave

has mainly focussed on the development of the information technology (IT) market. We are currently in the fourth wave of industrialisation, which emphasises the integration between physical production and IT so that physical capital will become both the 'hands' and the 'brains' of production (Bloem, et al., 2014). While these labour-saving technological developments could eliminate the necessity of working the long term, the spread of these clever machines is likely to lead to the destruction of many jobs in the transitory phase (Painter & Thoung, 2015). Moreover, entrepreneurship, lower working hours and unemployment are likely to become more common in the future, though we may expect a large wave of underemployment, rather than true unemployment (Baer & Herve, 1966).

Keynes had already identified these upcoming waves of industrialisation and IT-integration during the second wave, which led him to believe that the average working week would reduce to fifteen hours by the end of the 20th century (Keynes, 1930). Of course, we observe quite the contrary, where the median worker supplies roughly forty working hours per week (Eurostat, 2020).

Though this technological progression could have led to a relaxation of the labour force through shorter working hours or less working pressure, it has contrarily facilitated the development of a global economy with infinite growth of production (Glaser, 2014). Furthermore, inequality has been at a considerably high level and is expected to rise even further without interference. Its substantial growth is a natural consequence of the increased role of capital in our global economy (Piketty, 2015). When capital has become the main source of an economy's output and is slowly replacing labour, inequality ought to rise even more during the fourth wave of industrialisation. Many critics have already pointed out that there is no social safety net to safeguard the lower-income classes from the potential destruction of their jobs (Graeber, 2018). Though the prospect about labour demand is uncertain, it is reasonable to believe that the future labour market will put more emphasis on middle-skill jobs. This suggests that society demands a social safety net that is capable of providing those who may see their job vanish with the possibility to retrain, work lower hours, or exit the labour market completely. Moreover, the prophecies of machine-human substitution highlight that the upcoming economic challenge will be one of distribution rather than scarcity (Autor, 2015).

A universal basic income (UBI) has been proposed as the embodiment of this much needed social safety net, in which each member of society would receive an equal cash transfer. The marginal effect of this unconditional source of income would naturally differ based on the initial income and consumer behaviour. A UBI could have many forms and past research has already abstractly evaluated different UBI-setups. Generally, economist (and society) see UBI as a poverty-fighting mechanism rather than a way to free society out of its 40-hour workweek. A returning element is the principle of negative income tax (NIT), where incomes under a certain threshold receive a benefit payment, rather than paying income taxes. This idea has been evaluated versus a

truly unconditional cash transfer to every member in society, in a policy evaluating matter. We see that though both NIT and UBI may lead to the same distributive outcome, they are fundamentally different from a socio-economic and ethical point of view. Mainly, we see that NIT would have a much larger effect on the lower-income labour supply, whereas UBI's consequently distributes income from the most affluent to the middle and lower incomes (Tondani, 2009). Tondani's research does not address the possibility of sorting around the negative income tax threshold, which may lead to even larger labour market frictions as opposed to UBI.

Many forms of UBI with different income thresholds or payments have been piloted (Wikipdia, 2020). I notice that these pilots tempt to deviate from UBI's fundamental proviso, an unconditional cash transfer. UBI-experiments that lived up to this have also seen the most potent results, where both consumption, savings and employment had increased (Haushofer & Shapiro, 2013). Perhaps the unconditionality is the mechanism rather than the benefit. To emphasise, unconditional social security, rather than a cash transfer to some, is what is needed for people to evaluate their status quo working environment. Behavioural economics has taught us that people fundamentally are risk-averse and are therefore unlikely to drastically change their situation in the absence of assurance.

In my research, I will abstractly model UBI. I aim to explain how various social groups will differently respond to an unconditional cash transfer by altering their labour supply, aiming to maximise individual welfare. Furthermore, the model will emphasize the role of the government, that will maximise social prosperity by tactically determining the benefit. The hypothesis produced by the model will be statistically tested. Unfortunately, there has not been any UBI experiments where the treatment group does not solely consist out of low-income individuals, while I propose UBI as a more liberal, middle- and lower-class emancipating mechanism. Therefore, I have decided to use a survey designed by the Dalia Research Centre that includes many European countries and approaches UBI in a more liberal matter. My central research question '*How will different individuals alter their labour supply with the introduction of an unconditional cash transfer?* has the main role of shaping the model, while I will use the government's role to truly evaluate the policy.

II. Theoretical Framework.

UBI has proven to have the ability to facilitate economic growth (Banerjee, Niehaus, & Suri, 2019). Next to the fact that it provides a social stimulus, UBI's effect would also be positive from a purely economic point of view. Firstly, we have the utilitarian argument (Arrow, 1971) that redistribution from the affluent to the lower incomes increases total utility due to the marginally diminishing effect of income on utility. From a more pragmatic view, literature shows that money in the hands of the poor gets spend much more often and thus has much more economic impact

(Pateman, 2004). UBI evolves around the idea that the redistributed funds will enter the economy quickly through the consumption of normal goods, which in term stimulates economic growth and raises rents for the capital owners (Hoynes & Rothstein, 2019). Furthermore, if workers would supply less labour, the marginal product of labour would increase, capital held constant. Take into the account that the acquisition of capital will only become more rapid in the future, and we may observe an enormous productivity boost in terms of labour (Lucarelli & Fumagalli, 2008). Since the marginal productivity fundamentally determines the wage, the recede in labour supply also can slightly boost the wages, so that those who supply labour cetes paribus may even be able to achieve higher incomes.

Unfortunately, UBI is also likely to hold several negative externalities, which has been the main source of its critique. Let's say that by implementing UBI an economy will reduce the size of its bureaucracy since it can eliminate a handful of existing welfare programs (Harvey, 2006). However, this bureaucratic shrink is very unlikely to completely cover the costs of the UBI-program. Therefore, tax collection ought to increase in one way or another. For instance, by increasing the marginal tax rate for the upper classes. The chances of this leading to long term labour market frictions for high-income jobs is small (Widerquist, Noguera, Vanderborght, & Wispelaere, 2013). Moreover, the unconditional cash transfer is likely to lead to some labour market frictions for the middle and lower incomes, where mainly the lowest income jobs would observe a sizeable decline in labour force participation (Clark, 2005). However, I already mentioned the dangers from the fourth industrialisation wave and observe that literature also addresses the existence of a (future) underemployment for middle-skill labour as well (Graeber, 2018). Therefore, it seems that when UBI would lead to a sustainable recede of the low-income labour supply, these short-term labour market frictions could be seen as a positive externality, instead of negative. Perhaps its goal should be to optimise the labour market through proper resource allocation so that the social stability and additional leisure time may allow for more space for entrepreneurial behaviour. Moreover, there is the possibility of these additional leisure hours contributing to economic expansion as stated above. There are two possible scenarios here; firstly, an individual may invest time in self-development by studying, which will consequently increase human capital. Secondly, an individual may invest time in research or starting their own business, which will ergo increase physical capital. Both an increase in human and/or physical capital have a proven positive effect on economic growth by the General Solow Growth Model (1956).

I aim to prove that besides the lowest incomes, the middle incomes will also supply less labour so that only a share of the higher income groups are left with an inelastic labour supply. The model will address labour income as the product of wage and labour supply, where I try to deviate from the Solow Growth Model's assumption that every individual supplies one unit of labour inelastically. The income after taxes and redistribution would be the product of wage and labour

multiplied with one minus the individual tax rate, which is the average of marginal tax rates per income bracket, plus the benefit. Translating income to utility (prosperity), foregoing models discount the income by raising it the power of a fraction, so that the concept of marginal decline in income still holds. By framing the benefit as the prime part of income, its perceived value may be a lot higher than that of additional income. In practice, this means that the marginal effect of additional income, subjective to labour supply and wage is less, so that individuals who are relatively less sensitive to income may supply less labour. I capture this in the form of an elasticity that is between one and zero. Moreover, utility may be increased by additional leisure if we approach leisure as a normal good. We have seen this concept being used in the past, which has led to the current income-leisure curve, where individuals may substitute consumption of other normal goods for the consumption of leisure (Hawrylshyn, 1977). I state that this foregoing model has led us to the inelastic labour supply of one unit and aim to deviate from this by creating a static model.

I approach utility as the sum of income (after taxes and redistribution) and 'additional' leisure, where individuals which are relatively less sensitive to income -thus they carry a small income-elasticity- will substitute income for additional leisure. Since this additional leisure is a fraction denoted by one minus the labour supply, raising it the power of this elasticity will increase the marginal value, rather than discounting it. Note that those with relatively high average tax rates will face an even sharper diminishing, marginal effect on income. This is how I try to capture the labour supply deviation for the middle- and top-incomes. Though those who are extremely sensitive income will still supply labour cetes paribus. This hypothetical elasticity could even be presented as a factor of 'capitalistic culture' so that the model still embraces UBI's liberal objective of allowing people to supply labour and consume as they individually prefer.

Since UBI concerns a pure redistribution, I assume that any current monetary policy is unaffected, so that the interest rate remains unchanged. This allows me to examine the demand side of the macro-economic equilibrium, while firms will supply cetes paribus. Furthermore, I will not propose any mechanism for financing UBI since that is beyond the scope of my research. Though economists argue that the source of the wealth redistribution should be by capital owners since they have primarily created the inequality (Van Parijs, 2000), I do not find this realistic since firms have such monopolistic power that they are unlikely to cooperate. After all the whole idea of UBI is to embrace entrepreneurship and long-term development. It has been concluded that there is an expansionary impact of UBI by delimiting the constraints of the current aggregate demand market (Nikiforos, Steinbaum, & Zezza, 2017). So by promoting economic expansions and efficiency, it seems elusive to obligate firms with financial participation.

Another common and feasible idea is the concept of a carbon emissions tax so that UBI could be financed by both individuals and firms combined (Ortiz, Behrendt, Acuña-Ulate, & Anh,

2018). In practice, this would be a redistribution facilitated by a tax on consumption, which closely resembles a redistribution of labour income. I find this to be one of the more realistic ideas. Therefore, the model strongly emphasis the redistribution of income by exploiting marginal tax, which could abstractly resemble this mechanism of a carbon emissions tax.

The Model

I address the Utility function in a common form so that it is the product of both consumption and leisure:

$$U = f(C, (1 - L))$$

Foregoing models assume an inelastic labour supply of one unit (Solow, 1956). However, the model allows for an elastic labour supply so that an individual supplies either one unit of labour or less. Moreover, consumption is approached as the income after taxes plus the benefit, while I address leisure as the fraction of time spend working versus additional leisure hours so that it becomes one minus the labour supply **L**.

Let the individual's taxable income $\mathbf{y_i}$ be defined as their wage $\mathbf{w_i}$ multiplied with the amount of labour they supply $\mathbf{L_i}$, which is a commonly used form of the labour income function:

$$y_i = w_i \cdot L_i$$

I condition on examining a steady-state society. Therefore, I assume the presence of a marginal tax system so that there exists an idiosyncratic tax rate $\boldsymbol{\tau_i}$, which is determined by the individual's taxable income and increases exponentially in both wage and labour supply:

$$\tau_i = f(w_i, L_i)$$

For simplification purposes, I address the idiosyncratic tax rate as the sum of a partial income between certain thresholds $\boldsymbol{\rho_i}$ multiplied with the respective marginal tax rate $\mathbf{m_i}$. Though the tax bracket thresholds and respective marginal tax rates have already been determined on the national level by the government, the implementation of UBI ought to bear a tax reform that mainly redistributes from the upper incomes. By using this complete, yet changeful approximation there is room to target a specific income group. Here **t** represents the number of tax brackets –in practice four is most common:

$$\tau_i = \sum_{i=1}^{t} \rho_i \cdot m_i$$

Since $\boldsymbol{\rho_i}$ denotes a relative share of income rather than the absolute value, the sum of $\boldsymbol{\rho_i}$ multiplied with its corresponding $\mathbf{m_i}$ represents the average tax rate for the individual (instead of having to divide by tax payable by labour income).

Expanding the labour income formula with the concept of an unconditional cash transfer **B**, which is excluded from any income taxation, an individual's net income $\mathbf{y_{Ti}}$ in this UBI-system may be defined as the residual of their taxable income $w_i \cdot L_i$ plus the benefit **B**:

$$y_{Ti} = B + w_i L_i \cdot (1 - \tau_i)$$

I argue that the shift to a UBI-system will lead to a graduate recede in the total labour supply. Since the benefit allows for a minimum standard in the absence of work, those who decide to supply less labour face the opportunity costs of not earning additional net income, which could expand their consumption possibilities. However, additional income is exponentially discounted by the factor of income-elasticity $\boldsymbol{\epsilon_i}$:

$$U_i = y_{Ti}^{\epsilon_i} + (1 - L_i)^{\epsilon_i}$$

In this system, a worker's utility function $\mathbf{U_i}$ may be written as the sum of their disposable income with the benefit $\mathbf{y_{Ti}}$ and the number of leisure hours captured by the factor $1 - \mathbf{L_i}$. Here, $\boldsymbol{\epsilon_i}$ may represent how sensitive an individual's utility function is to income. Since $\boldsymbol{\epsilon_i}$ is a fraction between zero and one, it weakens the effect of additional income in a diminishing matter. Furthermore, the utility gained from additional leisure is raised to the power of $\boldsymbol{\epsilon_i}$, so that it has an enlarging effect on this the value of this fraction.

The model predicts that workers who are endowed with a relatively high $\boldsymbol{\epsilon_i}$ will supply the maximal amount of labour of 1 unit. They will maximise their utility through both an optimal additional leisure allocation of (near) 0 and aim to influence their disposable income positively though their wage $\mathbf{w_i}$. On the other hand, workers whose utility is less sensitive to income will bear a relatively low $\boldsymbol{\epsilon_i}$, which makes them likely to supply less than one unit of labour, so that in equilibrium their utility is maximised through both disposable income and optimal leisure allocation. Each worker is endowed with a target income, based on status quo working hours and wage. The presence of UBI will lead to many worker's achieving this target income at a slightly lower labour supply below one unit. At this threshold, a worker must decide to voluntary supply more labour to boost their income to a newly desired level (income effect) or enjoy additional leisure time (substitution effect). The concept of an elastic labour supply changes the regular labour-wage rate curve so that there exists a macroeconomic equilibrium where there is less total labour supplied.

Resource Constraint

Since UBI concerns a pure redistribution, I will assume that monetary policy is unaffected. Therefore, the supply-side of the economy, which is largely determined by the interest rate, remains

unchanged. This allows me to focus solely on the demand-side of this closed economy which is simply defined as the sum of consumption **C**, investments **I** and governmental spending **G**:

$$Y = C + I + G$$

With the introduction of UBI, government spending will face a sharp increase, though it will also slightly decrease due to bureaucratic shrinking. To preserve initial equilibrium, the government will need to finance UBI completely out of its income tax revenues so that the sum of all individual incomes multiplied with their respective tax rate is equal to government spending (after reform) plus the total benefit n · B granted to all citizens:

$$G + n \cdot B = \sum_{i=1}^{n} y_i \cdot \tau_i$$

Assumptions

To finalise, I append a handful of assumptions regarding the domains of the variables. Firstly, as mentioned before, income-elasticity $\boldsymbol{\epsilon_i}$ can be any number between 0 and 1. The same goes for the labour supply and the average tax rate. However, the average tax rate cannot surpass the value of the marginal tax rate corresponding to the highest tax bracket so that $\boldsymbol{\tau_i < m_t}$. In theory, $\boldsymbol{\tau_i}$ only approaches $\boldsymbol{m_t}$ when income becomes infinite. Lastly, the benefit ought to have a realistic value relative to labour income. I simply capture this as that the benefit can never become higher than the wage. To emphasise, since I approach the labour supply as a fraction and its maximal value is 1, the maximal labour income is equal to the wage. Therefore, it makes sense that the benefit cannot exceed the wage unless one's wage is extremely low. Since there will exist a minimum wage requirement in any economy with a marginal tax system, $\boldsymbol{B < w_i}$. Because the model is both static and abstract, it has no pragmatic reason to define additional assumptions.

III. Data

While my research mainly focuses on creating and interpreting the model, I try to strengthen the model hypotheses with empirical results. Ideally, there would have been an experiment that observes individuals from different social groups (income, education et cetera) who have been granted an unconditional cash transfer, through time. Hypothetically speaking, the individual would need some time to adapt to this new social structure. It is not realistic to expect people to instantly respond to such a substantial reform. However, the idea is that UBI would allow people to have more room for ideas regarding personal development and endeavour it by freeing them from a potential 'job trap'. As mentioned already, the main field experiments that have been done mainly focus on the behaviour changes from the low-income social groups. Furthermore, the

nature of such an experiment is that it is held locally, at most nationwide. This will result in a strong selection bias when using this data evaluate my more common model. Since the model emphasises the individual preferences by exploiting the concept of an income-elasticity, a local experiment that only focusses on low-income groups carries little conjunction with the model. Next to the fact that this hypothetical income-elasticity may not differ much between the individuals from the same social group, certain social causes such as work-ethic and attitude towards the cultural and bureaucratic sector may differ largely between countries.

I have chosen to evaluate the model by using a continent-wide, cross-sectional survey held in 28 EU member states. This survey puts more emphasis on how individuals from different social groups may respond to a UBI. This has been done by capturing many idiosyncratic aspects such as education level, gender, having children and having a full-time job, versus their knowledge and judgement about the policy. Furthermore, the survey addresses how the individual would alter their labour supply when being granted a UBI. I have transformed this dataset to include dummy variables for different levels of education and familiarity with the policy while having ranked the labour supply responses from zero to eight. For a complete display of the survey, I refer to the Appendix. furthermore, I present my categorisation of labour supply alteration and allocation with justification about the ranking in **Table 1**. Since the survey regards a snapshot of attitudes and response towards UBI, one must deal with the common bias regarding surveys, where individuals may not be able to truly predict their behaviour. However, because the survey is quite detailed, I have only removed the lines from the dataset where individuals had not answered with their education level (-663) or have not chosen one of the eight options regarding labour supply (-1056). This leaves me with a dataset containing 7930 observations, of which 63% are from Germany, Spain, France, Great Britain, and Italy. Moreover, roughly 19% reported to be lowly, mediumly (40%) or highly (38%) educated, while 3% said to be non-educated. Lastly, it is notifiable that when asked if one would vote in favour of UBI, 73% would vote in favour of the policy.

The survey also includes two questions which address the individual's perception towards both positive and negative arguments regards UBI. However, these questions are multiple-choice and thus too abstract to interpret. Next to the fact that is quite subjective −though one could obviously omit out the data of people that have stated to have little to no knowledge about the policy in an earlier question, it has no added value towards the prediction of labour supply.

Besides using the Dalia Research Institute's survey data, I have also created a data set in which I aim to examine the effect of the marginal tax system structure on life satisfaction (read: utility). I have extracted data from the Organisation for Economic Co-operation and Development (OECD) worldwide libraries and merged the data, Firstly, I have used the data regarding life satisfaction that is relatively recent. Since life satisfaction is extremely subjective, I felt that using the national average better fits when comparing marginal tax systems. This data set also includes

numerous social and economic variables such as the median income and employment rates, along with the educational level and more detailed geographical factors such as air pollution and water quality. I only intend to use the labour- and income-related variables. Moreover, I merge this data with another data set that includes variables regarding the marginal tax bracket thresholds and respective tax rates, so that I can examine whether the relative distances have a significant effect on life satisfaction. For simplification purposes, I drop the countries that have more than 5 marginal tax brackets. Afterwards, I am left with 16 countries, of which most are European. Taking into regards that the country of origin has a major influence on life satisfaction, I will use robust standard errors that are clustered at the country level in further analysis.

Table 1. Ranking of response radicalness:

Rank	**Answer**	**Justification**
0	A basic income would not affect my work choices	In this context, I interpret this as that labour supply and allocation is not affected by a UBI.
1	Work as a freelancer	This would mean that the individual continues to do his/her job but with slightly more volatile labour supply. UBI here provides stimulates entrepreneurial behaviour.
2	Look for a different job	Switching jobs is a more radical response where one would alter labour allocation and is likely to supply no labour during the transitionary period.
3	Gain additional skills (educate)	One would exit the job market only temporarily, aiming to develop him- or herself to achieve a higher wage.
4	Spend more time with family	Substitute labour for additional leisure.
5	Do more volunteering work	Substituting labour for work in a non-profit sector, rather than leisure. This has been ranked as a more extreme response to UBI since leisure is thought to be a normal good. With regards to the model, one could say that the wage has become 0 in this case.
6	Work less	Substitute labour for additional leisure. However, without one of the particular purposes mentioned above. This implies a more extreme response towards the labour market.
7	Stop working	Exit the labour market completely.
8	None of the above	These observations have been removed for the sake of statistical interpretation.

IV. Results

The model may be solved by assuming individuals allocate their labour supply optimally to maximise utility. I take the first-order condition with regards to labour:

$$\delta U/_{\delta L_i}\,(B + w_i L_i \cdot (1 - \tau_i))^{\epsilon_i} + (1 - L_i)^{\epsilon_i} \equiv 0$$

(1)

I conclude that the derivative of this function is non-elementary, meaning that I cannot re-write the first-order condition into a form so that it solely expresses the exogenous variables as a function of L_i by using algebraic methods. I have tried to overcome this by using a non-elementary method. Firstly, I re-write the derivate to the following form:

$$\frac{B + (1 - \tau_i) w_i L_i}{1 - L_i} - \frac{{\epsilon_i}^{1-\epsilon_i}}{(\epsilon_i (1 - \tau_i) w_i)^{1-\epsilon_i}} = 0$$

Secondly, I create a new function f that denotes a given optimum with regards to labour supply allocation, so that:

$$f(L_i, B, \tau_i, w_i, \epsilon_i) = \frac{B + (1 - \tau_i) w_i L_i}{1 - L_i} - \frac{{\epsilon_i}^{1-\epsilon_i}}{(\epsilon_i (1 - \tau_i) w_i)^{1-\epsilon_i}}$$

(2)

I am still able to perform vector analysis by using the method of mathematical bisection. By using the bisection method, I examine the behaviour of the optimal labour supply allocation for given combinations of exogenous variables, conform the model. The bisection method allows me to narrow down these interior solutions. I explain the concept of the bisection method in the Appendix. Moreover, I have also evaluated different qualifications of the model to examine whether I could overcome the algebraic problem in the first place. One honourable mention is by modifying the utility function so that it becomes:

$$U_i = B + w_i L_i \cdot (1 - \tau_i) + (1 - L_i)^{\epsilon_i}$$

For this variant, a share of the diminishing effect on income is taken away by removing the elasticity from the income part. Income's marginal effects remain diminishing by the existence of the marginal tax rate and the magnifying effect of the income-elasticity on leisure. It is noteworthy that the benefit would not affect the optimum in this setting:

$$L_i = 1 - \ ((1 - \tau_i) w_i)^{1-\epsilon_i} \cdot {\epsilon_i}^{\epsilon_i - 1}$$

(3)

This makes sense when one takes the product rule into regard. Furthermore, it noticeable that the optimal labour supply allocation would have a positive relationship with the tax rate. It seems that by extracting the income-elasticity from the income part, the substitution effect would

dominate the income effect. To emphasize: next to the fact that this version hints at a negative relationship between the optimal labour supply and the wage w_i, the relationship between τ_i and L_i would presumably be positive conform this version of the model. That would mean that labour supply would rapidly go up as the average tax rate increases. However, this is quite counterintuitive when one takes the marginal effect of labour on the average tax rate τ_i into regard. Since the average tax rate is a continues, concave function of both wage and labour supply, there should exist a marginal effect of labour supply on the average tax rate. I have proven this dynamic in the Appendix, where I also show how the marginal effect of labour supply becomes stronger for higher incomes:

$$^{\delta\tau_i}/_{\delta L_i}\, high > {}^{\delta\tau_i}/_{\delta L_i}\, mid > {}^{\delta\tau_i}/_{\delta L_i}\, low$$

(4)

This leaves me with the conclusion that the functional form the model ought to include a marginally diminishing effect on the income **after** taxes and redistribution. As stated before, I use the method of mathematical bisection to constitute vector-interpretations.

I plot the function $f(L_i, B, \tau_i, w_i, \epsilon_i)$ in a mathematical computer assistant and calculate for which value of L_i the function intersects with the horizontal axis, for a given set of the exogenous variables B, τ_i, w_i and ϵ_i. I have created a dataset consisting out of 100 observations regarding different combinations of B, τ_i, w_i and ϵ_i. Here, the assumptions provide a logical spectrum for each of the variables. For the sake of completeness, I have also included more extreme values for both the benefit and the wage. This dataset may be found in the Appendix.

By using a common OLS-estimator, I have regressed the optimal labour supply allocation on the benefit, average tax rate, wage, and income-elasticity. This allows me to mathematically justify the model's behaviour. I have run the following regression where I used robust standard errors clustered at the singular optimum level:

$$L_{optimal} = \alpha + \beta_1(benefit) + \beta_2(elasiticty) + \beta_3(tax\ rate) + \beta_4(wage) + \varepsilon_i$$

(5)

Since only the vector analysis is relevant here, we do not attach any interpretational meaning to the constant here, though it is significant. In fact, the constant captures the selection bias that is present in the data set. While I have partially used randomisation to construct the variance in the exogenous variable list, the more extreme values have been created by hand. Therefore, one could say that selection bias is present since I have influenced how the exogenous variables differ for some optima. However, since the regression only produces significant results, I conclude that it is meaningful the interpret the parameter here. Taking this into regard, the selection bias is captured by the constant, which has no logical interpretation in this setting.

By interpreting the parameters for each variable, I determine that the benefit and average tax rate decrease the optimal labour supply allocation, while both the wage and income-elasticity contractility increase the labour supply. I note that the income-elasticity has the strongest effect here, which makes sense. Though solely examining the individual parameters does not carry much interpretation value – it would only make sense to compare its relative strength relative to another parameter, we observe that the difference between individuals whose elasticity is near zero versus individuals endowed with an elasticity near one, is an optimal allocation of labour supply of roughly one unit. This is in line with the proposed behaviour dynamics of the model where workers endowed with an elasticity of near one would still supply one unit of labour inelastically.

I have provided scatterplots with a line fit and confidence interval in the Appendix. For the sake of completeness, a scatterplot on optimal labour allocation versus utility and a fitted versus residual plot have also been displayed.

Lastly, I have experimented with the data by removing some of the extreme values I added for B and w_i. After doing this, I am left with 94 observations. Rerunning the same regression, I find that the predictive power has increased since the R-squared increases from 0.56 to 0.71. This increases the parameters noticeably, though the interpretation of the elasticity makes less sense since it has become larger than one −although it might be 0.999 conform the 95% confidence interval. I note that the constant has halved and has become insignificant. However, since that naturally adds to the predictive power of the variables and the constant has no interpretational value, it should be perceived as an advantage, rather than a drawback. Since the parameters seem to have all roughly increased evenly, and only their relative power has interpretational value, there is no need to revaluate the interactions.

Model outcomes

Now that the microeconomic share of the model has been concluded, I will continue to examine the policy form the government's perspective. Firstly, I rephrase the resource constraint so it becomes a function that expresses the benefit in government spending, population size n, and the sum of all collected income taxes, where I substitute $w_i L_i$ for the labour income:

$$B = \frac{\sum_{i=1}^{n} w_i L_i \cdot \tau_i - G}{n}$$

I continue by substituting this expression into the previously introduced utility function. I assume that the government would tactically determine the benefit and tax rate so that utility is maximised. Since the benefit is in term a function of the tax rate, I take the derivative with regards to τ_i and use the first-order condition to solve:

$$\delta U / \delta \tau_i = \epsilon_i \left(\frac{\sum_{i=1}^{n} w_i L_i}{n} - w_i L_i\right) \left[\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n} + w_i L_i (1 - \tau_i)\right]^{\epsilon_i - 1} \equiv 0$$

(6)

Conform the first-order condition, either $\frac{\sum_{i=1}^{n} w_i L_i}{n} - w_i L_i$ or $\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n} + w_i L_i (1 - \tau_i)$ should be equal to 0 in the optimum, given that n ≠ 0. Looking at the first phrase, $\sum_{i=1}^{n} w_i L_i$ is actually equal to the total GDP since it is the sum of all individual incomes before taxes. When divided by the population, $\frac{\sum_{i=1}^{n} w_i L_i}{n}$ naturally translates to the GDP per capita. It becomes clear that for individuals whose income y_i is roughly equal to the GDP per capita, utility is maximised in terms of tax rate allocation by the government. Hence, the unconditional cash transfer variant of UBI inclines to favour the median incomes mostly. Furthermore, it implies that the more one deviates from the median income, the stronger the marginal effects of tax on utility would become. Taking into regard the effect of the second part of the derivative, I conclude that the marginal effect is amplified for higher incomes.

The other side of the equation $\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n} + w_i L_i (1 - \tau_i)$ cannot become 0 since the existence of the benefit B ($=\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n}$) implies that there is positive income by definition, even if either the wage of labour supply would be 0. This equation is limited by the boundaries of the average tax rate τ_i, which in term can hypothetically only approach the value of the highest tax bracket m_i as income approaches infinity.

To complete the model, I ought to examine the dynamics of the income-elasticity more thoroughly. Since ϵ_i denotes one's propensity to substitute labour income for additional leisure, it would intuitively be defined as $\epsilon_i = \frac{\%\Delta L_i}{\%\Delta U}$. I have already expressed that there exists a marginal effect of labour on the average tax rate which becomes stronger for higher incomes. Let us say there exists a random individual whose income is higher than the lowest tax bracket threshold so that $0 < \rho_1 < 1$. Furthermore, this person supplies one unit of labour inelastically in status quo society but carries an income-elasticity below one so that $0 < \epsilon_i < 1$. Under ordinary conditions −no extreme values for the wage or average tax rate that is, this individual will supply less labour after the introduction of the policy. A graphical representation of this outcome is displayed in **figure 1.** The recede of labour supply is determined by the size of the benefit relative to his or her income in combination with the income-elasticity. Due to the marginal effect of labour supply on the tax rate, which intrinsically has a negative effect on utility, overall utility will increase even more for this given individual, though the marginal effect is, of course, limited by the income-elasticity. **Figure 2** displays how the distribution changes the status quo marginal tax system, while **figure 3** displays the optimal average tax rate and thus the optimal benefit, given that the government assumes individuals are fully informed and allocate conform their idiosyncratic optimum. I have created this graph by substituting the optimal labour supply allocation formula in the government's utility

Figure 1:

Augmented Labour Supply

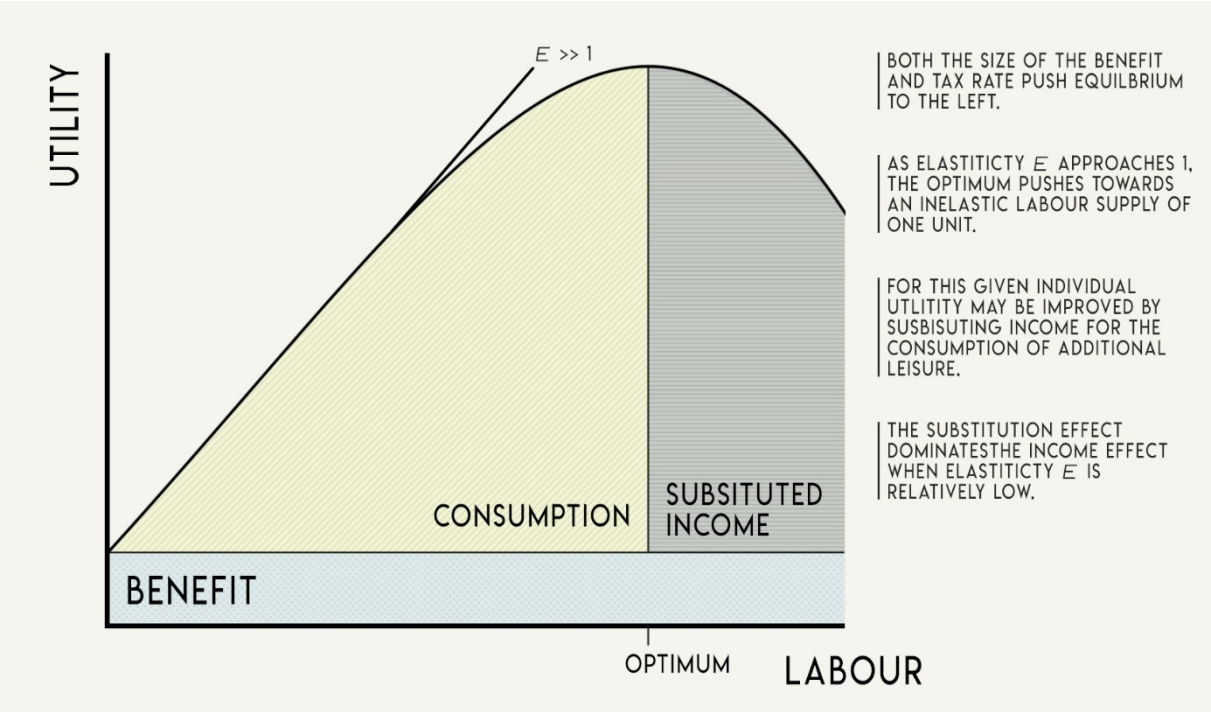


Figure 2:

Redistributive Implication

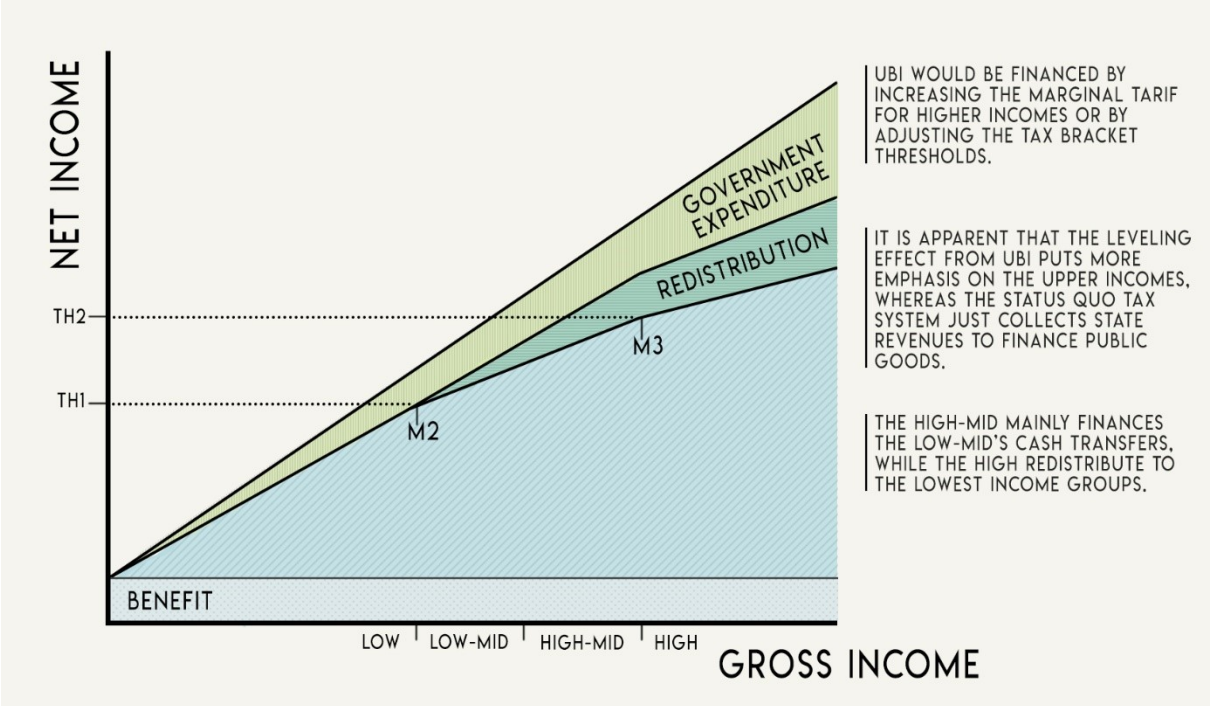


Figure 3:

The Optimal Tax Rate and Benefit

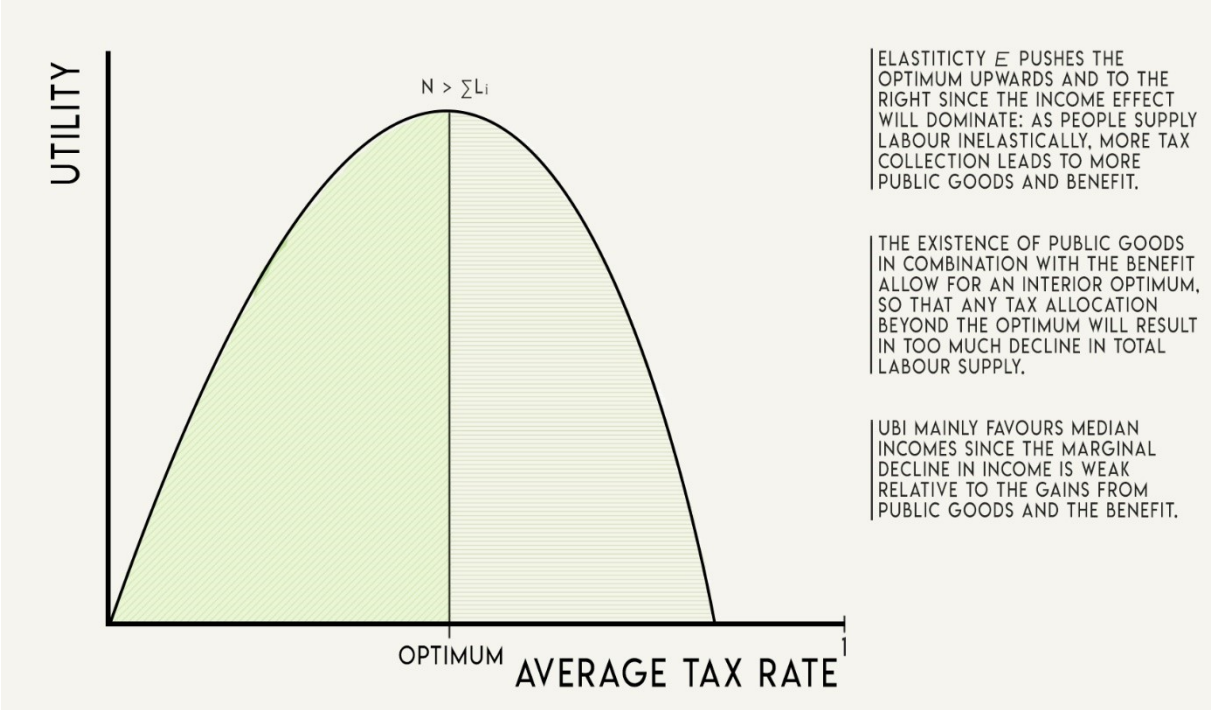
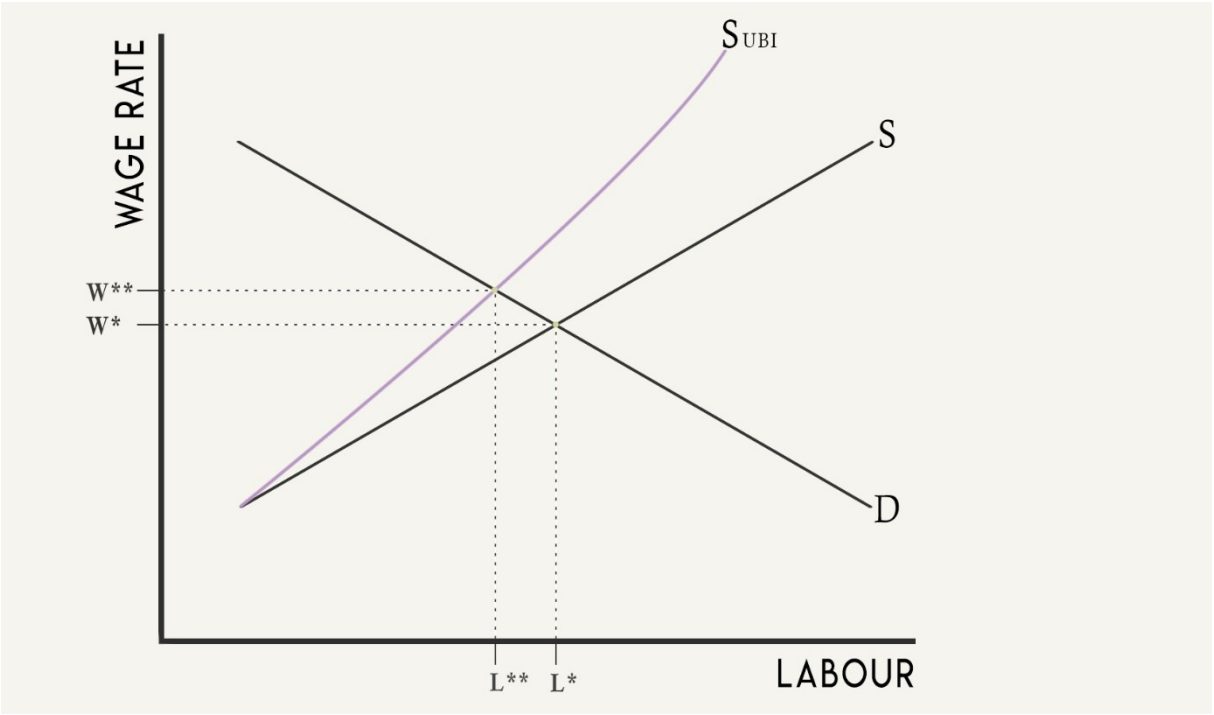


Figure 4:

Elastic Labour Supply Curve



equation. Here I use the OLS-estimates from the bisection method, which serves as an adequate approximation in this context:

$$L_{optimal} = 0.104 - 0.0376(benefit) + 1.148(elasiticty) - 0.74(tax\ rate) + 0.0429(wage)$$

I also hypothesize that since the introduction of the benefit is proven to alter labour supply, an elastic labour supply curve emerges, which consequently results in an optimum with smaller total labour supply. However, with higher wages for those who do supply labour. See **figure 4**. Though further examination of this principle is beyond the scope of this paper, this theorem is completely in line with already mentioned productivity boost that is likely to be a consequence of UBI.

To summarise, the model produces a hand full of hypotheses that will be validated in the subsequent analysis. Firstly, the model hypothesises that total the population will respond to UBI by supplying less labour in total, which can be quite easily verified by the distribution of responses to the survey. Secondly, I expect that demographic factors such as living in an urban area, rather than rural, will have a strong effect on labour supply allocation as they strongly affect the income-elasticity. Thirdly, the model hypothesises that education will have a marginally decreasing effect on the labour supply allocation as the higher educated are likely to have a higher wage. Lastly, the model forecasts welfare improvement through tactical benefit allocation from the government. As the revision of marginal tax brackets and respective rates needed to finance the cash transfers may carry negative external effects on utility, which may counter the positive effect on welfare, I will examine whether these tax allocation influences utility significantly.

Analysis

It has become clear that UBI in the form of an unconditional cash transfer mainly targets the middle class in terms of allocative optimisation. To verify the model hypothesis, I will use the statistical analysis from a large data set. Ideally, I would be able to observe subject's labour supply through time when they have been granted a cash transfer, preferably unconditional. However, by definition, current welfare policies only target the lowest income class and thus this population would not pose as a good representative to validate the model. Instead, I use a survey from the Dalia Research Institute where subjects are asked to predict their response towards labour when a UBI would be introduced. Furthermore, the survey includes a handful of demographic variables which I will exploit in the regression. For the complete ranking of augmentation of labour supply, I refer to the data section. Since this variable would denote one's propensity to substitute labour for additional leisure, it serves as an accurate approximation of the income-elasticity in a UBI-setting. I try to exploit this by examining whether demographic characteristics influence the labour supply response in a way that aligns with the model. For this, a cross-sectional regression will suit since I

do not aim to obtain true causal interpretation; I am solely interested in the effect of demographics on one's propensity to substitute labour. Since culture may have an evident effect on the labour supply, I run the following regression, where I used robust standard errors clustered at the country level:

$$L.supply\ augmentation = \alpha + \beta_1(Age) + \beta_2(Urban) + \beta_3(Male) + \beta_4(Education) + \varepsilon_{country}$$

I observe that both age and educational level seem to have a significant, negative effect on the radicalness of response. To emphasise, since age is a numerical variable, as age increases people will respond to UBI less radically. For education I observe that the higher one is educated, the less radical their response to UBI will be in terms of labour supply. Contrarily, living in an urban area would make one's response more radical. Gender seems to have no significant effect on the labour supply augmentation. A full overview may be found in the Appendix. To amplify the effect of education, I run another regression where I use different dummy variables to indicate the three levels of education, meaning that if a subject answered to have no completed education, all dummy variables take the value of 0. Furthermore, I expand the model with an interaction effect between being male and living in an urban area to examine if the model changes by much:

$$L.s.a. = \alpha + \beta_1(Age) + \beta_2(Male) + \beta_3(Urban) + \beta_4(Male \cdot Urban) + \beta_5(Educ\_low) + \beta_6(Educ\_mid) + \beta_7(Educ\_high) + \varepsilon_{country}$$

It seems that the negative effect of education becomes stronger as the level increases, which may be explained by the fact that the wage is likely to be higher and thus opportunity costs of leisure are larger, which is in line with the model hypothesis. Furthermore, it is noticeable that both being male or living in an urban area have a positive and significant effect. However, when both, the interaction becomes negative and remains significant. This interaction does not give much insight about the effect but does attain statistically international value to the sex of the subject when combined with their area of living, which may be interesting to further examine in future research. Furthermore, variables such as having children and working full time seem to have no significant effect on the prediction of labour supply. I remark that these are income-driven rather than intrinsically and/or demographically driven and therefore they ought to affect the income-elasticity in a true UBI-setting, but perhaps not in this interpretation of the income-elasticity.

I observe that when the labour supply augmentation is not 0, the values are distributed normally across the different responses. The histogram may be found in the Appendix. This means that for the people who would change their labour supply by the introduction of UBI, their responses are normally distributed, where most would simply spend more time their families. I aim to exploit this by using a probit regression. I create a new dummy variable that takes the value 1 if the subject responds to the UBI and 0 if the subject would not. To emphasise, when the value of

the labour supply augmentation is more than 0, this subject proves to have an inelastic labour supply, hence, this serves as a proper identification. Since I have already encountered the occurrence of both the income and substitution effect, I have chosen to cluster standard errors at the level of working fulltime:

$$\Pr(dum\_augment = 1) = \alpha + \beta_1(Age) + \beta_2(Male) + \beta_3(Urban) + \beta_4(Educ_{low}) + \beta_5(Educ\_mid) + \beta_6(Educ\_high) + \varepsilon_{fulltime}$$

The results align with previous findings and may also be found in the Appendix. Since the constant is significant and it is meaningful to interpret it in a probit-setting, I conclude that the chances of an individual carrying an elastic labour supply are a 100% and becomes less as both age and educational degree rise. Living in an urban area again increases the chances, while sex seems to have no significant effect. I conclude that all the model hypotheses have been verified, and conclude that the income effect dominates for the highly educated.

Tax Bracket Analysis

At last, I try to examine if there exists an effect of the marginal tax system arrangement on life satisfaction (utility), along with a hand full of other variables. Since life satisfaction is extremely subjective, I have chosen to compare it on a national level. I extracted data that consists of average life satisfaction ratings in combination with labour market characteristics such as the median income, the employment rate and leisure hours for many OECD-countries. For the sake of completeness, I also created a variable that denotes how much of the population supplies more than 50 working hours on a weekly basis. I merge this dataset with a dataset about the arrangement of the marginal tax system that includes the marginal rates and tax bracket thresholds. I take the natural logarithm of relative distances between tax brackets and create new variables. I note that the majority of the countries has 5 or fewer brackets, so I drop the observations where the number of tax brackets is above 5 for simplification purposes. The idea is that the re-arrangement of tax bracket thresholds and/or marginal rates that is required to finance UBI may influence utility negatively on a nationwide level. Therefore, I aim to research if this arrangement currently has a distinct effect on life satisfaction. To examine the effect, I run the following regression, where I use robust standard error clustered at the country level:

$$Utility = \alpha + \beta_1(Median\_income) + \beta_2(Employement\_rate) + \beta_3(Labourhours\_over50) + \beta_4(Leisure\_hours) + \beta_5(TH1\_0) + \beta_6(TH2\_TH1) + \beta_7(TH3\_TH2) + \beta_8(TH4\_TH3) + \varepsilon_{country}$$

The results unfortunately do not reveal much. After re-running and slightly adjusting the model I conclude that only the median income has a significant, positive effect at a p-level of 0.05. Though dataset only consists out of 16 observations, the R-squared is quite high at 89%. The results, in combination with a regression where I also included the marginal tax rates, may be found in the

Appendix. Since the marginal tax rates and brackets appear to have no significant effect on life-satisfaction, this suggests that a re-arrangement of the thresholds or marginal rates will not counter the positive effect on life satisfaction of the basic income. Therefore, my proposed version of UBI still seems to carry more positive than negative externalities.

V. Discussion

I anticipate on large selection bias in both datasets as there ought to be many more factors than the present variables that influence both labour supply projection in a UBI-setting and utility which are not observed. However, since I do not aim to examine the true causal effect, this selection bias doesn't pose a problem with regards to the findings of this research. The more problematic bias would be that the answers of the survey may be too subjective. Firstly, it addresses UBI in a hypothetical setting so that the subjects have to forecast their behavioural response, which is much less reliable than a field experiment. Secondly, the survey does not contain any information about the subject's initial consumption set or income, which limits the ability to distinguish between the substitution or income effect. The first regression puts more emphasis on the radicalness of the subject's response. Since that may be subjective to the status quo labour market, I clustered the residuals at the country level, which strengthened my findings. I try to distinguish the income effect from the substitution effect by clustering the residuals at the level of working full time in the probit regression. The second analysis, in theory, determines the chances of the substitution effect dominating the income effect. I observe that it is very likely that people would alter their labour supply allocation when UBI would be introduced and that these chances decrease as education becomes higher. As the model would capture the behavioural effect through the income-elasticity, while the higher educated will most likely also carry a higher wage, these findings seem to be in line with the model hypotheses.

Though the model is not complete in its current form as the first part could only be solved by non-elementary mathematics, it does provide an adequate projection of how the unconditionality of the benefit has a stronger effect than normal income. The income-elasticity may be quite hypothetical but, in practice, one would expect the unconditional part of the labour income to have a strong effect on both consumption and labour supply allocation −quantity or sector that is. I have already argued that the benefit, therefore, needs to be within the consumption part of the formula in order for the model to make sense, taking the marginal effect of both the benefit and the tax rate into the regard. If otherwise, the model would not ascertain the substitution effect towards the introduction of the benefit.

The data shows that UBI will lead to a recede in total labour supply, as the model predicts. However, the model does not put much emphasis on supplying labour in another sector, for instance by switching jobs or perform voluntary work. Here, the wage captures some of this effect and behavioural responses such as; temporarily supplying less labour to re-educate (that will ergo lead to a higher wage in the future) or supplying labour more volatilely for a higher wage as an entrepreneur can still fit into the model. Moreover, when one would switch jobs due to the benefit, the second part of the equation is left untouched as the substitution happens within the consumption part of utility. The common efficiency wage model (Shapiro & Stiglitz, 1984) would primarily capture this effect by exploiting the effort a worker has to put into working. In the foregoing example, the benefit would lead to the substitution of wage for effort. I have deliberately neglected the effort component from the model as I hypothesise that these overarching macro-economic models such as the No Shirking Model (Shapiro & Stiglitz, 1984) and Solow Growth Model (1953) have led to the status quo labour market that I aim to deviate from. However, I note that withdrawing the effort component from the model for simplification purposes may have reduced its pragmatic purpose of explaining all possible worker behaviour.

In the case of switching to (some) voluntary work, the substitution effect can be determined by usage of the income-elasticity –people with this specific response to UBI are likely to carry a low income-elasticity, so that the labour part of utility is boosted by much. However, since these people's additional leisure adds value to society in a matter that is not captured by their utility function, the model is not able to capture this effect. I conclude that when one would want to examine both the leisure substitution in combination with a possibly new labour market allocation, any static model is not satisfactory. As I have explained before, the optimal policy evaluation would require both a panel data set and a dynamic model. Unfortunately, this contradicts my fundamental idea that the positive externalities of the labour market optimisation would be completely captured by already existing models such as the Solow Growth Model.

Perhaps some of these problems could be overcome by approaching the labour income as family income. This would not take away the strong marginal effect of the benefit, while I can imagine that labour supply augmentation is decided on the family level, rather than the individual. The idea of the income-elasticity is still feasible here since they would be clustered then based on sociographic characteristics anyway, meaning that is very likely that two parents more or less carry the same income-elasticity on a macro scale. However, this contradicts the underlying intention of measuring this income-elasticity on the individual level, which can be done in an experimental setup, to evaluate whether UBI would carry positive externalities for a given country/economy. For this concept, the income-elasticity ought to be determined at the individual level. My model aims to provide a conceptual conjecture that can aid further research about this topic, as I believe that UBI is a match with developed countries instead of underdeveloped ones.

As the model revolves around the idea of making UBI a pure income redistribution by keeping supply market equilibrium, UBI shall be financed by exploiting the marginal tax rates. Taking this into regards, I use the government's role to express the benefit as a function mainly determined by the average tax rate. I observe that when the government would tactically determine the optimal tax rate that maximises utility through both consumption (benefit + labour income) and additional leisure, the median incomes are mostly well-off. This embraces the idea that the unconditionality of a UBI would favour the middle-incomes. We deviate from an equilibrium that mainly favours the lower-income groups by adding the possibility of additional leisure and/or flexible labour allocation. The second data set gives extensive insight as the statistical analysis shows that both the marginal tax rate or distance between the tax brackets does not influence utility significantly, which suggests that the marginal tax reform in combination with UBI would still bear positive externalities in terms of total utility. I do acknowledge that there is selection bias present as well but since the data set holds many factors that also influence wellbeing, and adding these to the regression didn't amplify the results by much, I conclude that the negative effect truly is absent in a large scale framework.

VI. Final Remarks

I have constructed a hypothetical policy model that puts much emphasis on the possible leisure-work substitution for middle-incomes in a steady-state society with UBI. The bottom line of the theorem is that the production and money market are left untouched so that UBI is a pure income redistribution. I determine that individuals will allocate in their respective optimum, which is mainly influenced by their income-elasticity. If the substitution effect dominates, people will supply less labour for the consumption of additional leisure. Contrarily, when the income effect dominates, people will either supply labour cetes paribus or temporarily exit the job market for entrepreneurial or re-educative purposes, to boost their wage in the future. Behaviour such as job switching or working voluntarily cannot be explained by the model completely. Therefore I conclude that a more sufficient model should be dynamic rather than static. However, the mathematical analysis does show that the unconditionality of the benefit bears unique dynamics: when the government will exploit the marginal tax rates and brackets to tactically determine the benefit and average tax rate, we see that the median incomes are most well-off. This is completely in line with the research theorem that UBI should mainly serve the middle and lower classes, rather than solely being a poverty-fighting mechanism.

The statistical analysis verifies the model hypotheses that total labour supply will decrease when UBI would be introduced and that demographic and social factors have a large influence on the labour supply allocation in a UBI-system. I observe that the strongest effect is that of education,

as the response to labour supply becomes marginally less radical the higher educated one is. Furthermore, I ascertain both the existence of the income and substitution effect and see that the radicalness of the substitution effect is normally distributed. To see if UBI's utility gains will not be countered by utility losses by the marginal tax system reform, I perform additional statistical analysis with regards to the marginal tax rates and respective thresholds to see if they influence life-satisfaction (utility) significantly and observe that they do not. Therefore, I conclude that this UBI-variant with an unconditional cash transfer bears potential positive externalities in terms of social welfare, while the long-term economic benefits have been proven by previous research and will be captured by already existing macroeconomic models.

Lastly, I want to address that future research is still required for true policy evaluation, though this research expands the ongoing exploration of the topic by examining the role of utility. While the economic benefits of UBI have extensively been researched by authors such as Banerjee et al. and Van Parijs et al., my theorem, in combination with the previous literature of Glaser and Graeber regarding future labour market optimisation, serves as a foundation for verifying the assumed behaviour of people in a UBI-system in advanced economies. I have already mentioned how my model could be expanded or adapted to better fulfil this need. However, I consider the most valuable next step to be a more detailed, experimental setup where the consumption and labour supply patterns of people from different income groups from a steady-state economy are to be observed through time. By doing this, one could also verify whether my proposed mechanism of financing UBI purely out of income or consumption taxes is feasible to begin with, while also adequately determining the income-elasticity on the individual or socially clustered level.

Sources

Arrow, K. J. (1971). A utilitarian approach to the concept of equality in public expenditures. *The Quarterly Journal of Economics*, 409-415.

Autor, D. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *Journal of Economic Perspectives*, 3-30.

Baer, W., & Herve, M. E. (1966). Employment and industrialization in developing countries. *The Quarterly Journal of Economics*, 88-107.

Banerjee, A., Niehaus, P., & Suri, T. (2019). Universal basic income in the developing world. *Annual Review of Economics*, 959-983.

Bloem, J., Van Doorn, M., Duivestein, S., Excoffier, D., Maas, R., & & Van Ommeren, E. (2014). *THE FOURTH INDUSTRIAL REVOLUTION.* Groningen: Sogeti VINT.

Clark, C. M. (2005). The Economics of Poverty in the United States of America. *Oikonomia: Journal of Ethics & Social Sciences*, 6-19.

Eurostat. (2020, april 21). *Average number of usual weekly hours of work in main job, by sex, professional status, full-time/part-time and economic activity.* Retrieved from Eurostat: http://appsso.eurostat.ec.europa.eu/nui/show.do

Glaser, E. (2014). Beyond bullshit jobs. *Soundings*, 82-94.

Graeber, D. (2018). *Bullshit Jobs.* Paris: Les Liens qui Libèrent (LLL).

Harvey, P. (2006). The Relative Cost of a Universal Basic Income and a Negative Income Tax. *BASIC INCOME STUDIES*, 1-24.

Haushofer, J., & Shapiro, J. (2013). Kenya, Household Response to Income Changes: Evidence from an Unconditional Cash Transfer Program in. *Massachusetts Institute of Technology*, 1-57.

Hawrylshyn, O. (1977). Towards a definition of non-market activities. *Review of income and Wealth*, 79-96.

Hoynes, H., & Rothstein, J. (2019). Universal basic income in the United States and advanced countries. *Annual Review of Economics*, 929-958.

Keynes, J. M. (1930, October 11). Possibilities for our Grandchildren. *The Nation & Athenaeum*, pp. 36-37.

Lucarelli, S., & Fumagalli, A. (2008). Basic income and productivity in cognitive capitalism. *Review of social economy*, 71-92.

Nikiforos, M., Steinbaum, M., & Zezza, G. (2017). *Modeling the Macroeconomic Effects of a Universal Basic Income.* New York: Roosevelt Institute.

Ortiz, I., Behrendt, C., Acuña-Ulate, A., & Anh, N. Q. (2018). *Universal Basic Income proposals in light of ILO standards: Key issues and global costing.* Geneva: Social Protection Department.

Painter, A., & Thoung, C. (2015). *Creative citizen, creative state: the principled and pragmatic case for a Universal Basic Income.* London: RSA.

Pateman, C. (2004). Democratizing citizenship: some advantages of a basic income. *Politics & society*, 89-105.

Piketty, T. (2015). About Capital in the Twenty-First Century. *American Economic Review*, 48-53.

Shapiro, C., & Stiglitz, J. E. (1984). Equilibrium unemployment as a worker discipline device. *The American Economic Review*, 433-444.

Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics*, 65-94.

Tondani, D. (2009). Universal Basic Income and Negative Income Tax: Two different ways. *The Journal of Socio-Economics*, 246–255.

Van Parijs, P. (2000). A basic income for all. *Boston Review*, 4-8.

Widerquist, K., Noguera, J. A., Vanderborght, Y., & Wispelaere, J. D. (2013). *Basic Income.* Chichester: Wiley.

Wikipdia. (2020, may 18). *Basic Income Pilots*. Retrieved from Wikipedia: https://en.wikipedia.org/wiki/Basic_income_pilots

Data

Retrieved from Dalia Research Centre:

https://www.kaggle.com/daliaresearch/basic-income-survey-european-dataset

Retrieved from Eurostat:

https://ec.europa.eu/eurostat/data/database

APPENDIX:

(1). I take the first-order derivative of the utility function with regards to L_i and set it equal to zero: ${}^{\delta U}/_{\delta L_i}(B + w_i L_i \cdot (1 - \tau_i))^{\epsilon_i} + (1 - L_i)^{\epsilon_i} \equiv 0$. By taking the inner derivates and using the product rule we end up with ${}^{\delta U}/_{\delta L_i} = \epsilon_i(1 - \tau_i)w_i((B + (1 - \tau_i)w_i L_i)^{\epsilon_i - 1} - \epsilon_i(1 - L_i)^{\epsilon_i - 1} \equiv 0$, which intuitively re-writes to $(\epsilon_i(1 - \tau_i)w_i)^{\frac{1}{\epsilon_i - 1}}((B + (1 - \tau_i)w_i L_i) = \epsilon_i^{\frac{1}{\epsilon_i - 1}}(1 - L_i)$. Note that ϵ_i's domain is between 0 and 1. Hence, $\frac{1}{\epsilon_i - 1}$ is equal to $1 - \epsilon_i$. Therefore, we may re-write as $(\epsilon_i(1 - \tau_i)w_i)^{1 - \epsilon_i}((B + (1 - \tau_i)w_i L_i) = \epsilon_i^{1 - \epsilon_i}(1 - L_i)$ to isolate the effect of income-elasticity.

(2). I have concluded that the formula cannot be simplified to a form that solely expresses the exogenous variables as a function of L_i. Therefore, I simplify to the most elemental form achievable and denote this to be a new function $f(L_i, B, \tau_i, w_i, \epsilon_i)$: $f = \frac{B + (1 - \tau_i)w_i L_i}{1 - L_i} - \frac{\epsilon_i^{1 - \epsilon_i}}{(\epsilon_i(1 - \tau_i)w_i)^{1 - \epsilon_i}}$.

(3). One of the many different forms of the model that I have evaluated is by writing the utility function as $U_i = B + w_i L_i \cdot (1 - \tau_i) + (1 - L_i)^{\epsilon_i}$. Its derivative with regards to L_i is ${}^{\delta U}/_{\delta L_i} = (1 - \tau_i)w_i - \epsilon_i (1 - L_i)^{\epsilon_i - 1}$. Using the first-order condition and comparable algebra as above I am able to formulate the following function for optimal labour supply allocation: $L_i = 1 - \frac{((1 - \tau_i)w_i)^{1 - \epsilon_i}}{\epsilon_i^{1 - \epsilon_i}}$, so that we ultimately end up with $L_i = 1 - ((1 - \tau_i)w_i)^{1 - \epsilon_i} \cdot \epsilon_i^{\epsilon_i - 1}$.

(4). In a marginal tax system, one may define the taxes payable as a step function of marginal tax rates, income, and tax bracket thresholds. Here TH_i denotes the threshold of a certain tax bracket, while m_i is the corresponding tax rate. To illustrate its dynamics, I use a system with three tax brackets:

$$tax\ payable = \begin{cases} m_1 \cdot y_i & if\ 0 < y_i < \mathrm{TH1} \\ m_1 \cdot \mathrm{TH1} + m_2 \cdot (y_i - \mathrm{TH1}) & if\ \mathrm{TH1} \leq y_i < \mathrm{TH2} \\ m_1 \cdot \mathrm{TH1} + m_2 \cdot \mathrm{TH2} + m_3 \cdot (y_i - \mathrm{TH2}) & if\ \mathrm{TH2} \leq y_i \end{cases}$$

This step function is infinitely expandable, just like the formula for the average tax rate used in the model. To examine the marginal effect of labour on the average tax rate I substitute y_i for $w_i \cdot L_i$ and take the derivative with regards to L_i. Since the above step function is taxes payable in absolute values, it is to be divided by the pre-tax income y_i in order to become the average tax rate τ_i. The derivative of a step function is the sum of its inner derivatives between thresholds multiplied with the final minus initial value of y. However, for the sake of merely examining the marginal effect of labour supply on the average tax rate, it does not have any added value to formulate the entire derivate of the step function. Preferably, I just look at the effects for different income groups; being low, mid, and high.

For low incomes −only subjected to the lowest tax bracket, that is− the average tax rate is defined as $\tau_i = \frac{m_1 \cdot w_i L_i}{w_i L_i}$. Its derivative with regards to L_i is obtained by using the quotient rule; $\delta\tau_i/\delta L_i = \frac{m_1 w_i \cdot (w_i L_i) - m_1 w_i L_i \cdot w_i}{(w_i L_i)^2}$, which simply re-writes to $\frac{m_1 {w_i}^2 L_i - m_1 {w_i}^2 L_i}{(w_i L_i)^2} = 0$. For the sake of completeness, I note that this is only true if neither the wage or labour supply is 0, so that $(w_i L_i)^2 \neq 0$ (which makes sense since one would not pay income taxes then). I conclude that there is no marginally increasing effect concerning the average tax rate by altering labour supply when income is only in the lowest bracket and does not surpass it by supplying more labour.

The medium incomes average tax rate may be defined as $\tau_i = \frac{m_1 \cdot \mathrm{TH1} + m_2 \cdot (w_i L_i - \mathrm{TH1})}{w_i L_i}$. Its derivative $\delta\tau_i/\delta L_i = \frac{m_2 w_i \cdot (w_i L_i) - w_i (m_1 \cdot \mathrm{TH1} + m_2 \cdot (w_i L_i - \mathrm{TH1}))}{(w_i L_i)^2}$ simply re-writes to $\frac{m_2 {w_i}^2 L_i - (m_1 \mathrm{TH1} w_i + m_2 {w_i}^2 L_i - m_2 w_i \mathrm{TH1}}{(w_i L_i)^2}$. By removing the cancelling terms, I end up with $\frac{(m_2 - m_1)\mathrm{TH1}}{{w_i L_i}^2}$.

The highest incomes average tax rate is $\tau_i = \frac{m_1 \cdot \mathrm{TH1} + m_2 \cdot \mathrm{TH2} + m_3 \cdot (w_i L_i - \mathrm{TH2})}{w_i L_i}$. Its derivative is $\delta\tau_i/\delta L_i = \frac{m_3 {w_i}^2 L_i - w_i (m_1 \cdot \mathrm{TH1} + m_2 \cdot \mathrm{TH2} + m_3 \cdot (w_i L_i - \mathrm{TH2}))}{(w_i L_i)^2}$. Again by removing the cancelling terms I ultimately end up with $\frac{-m_1 \mathrm{TH1} + (m_3 - m_2)\mathrm{TH2}}{{w_i L_i}^2}$. I compare the marginal effects for the medium and higher incomes by rewriting both nominators. I removed $-m_1 \mathrm{TH1}$ from both sides of the equations and conclude that $m_2 \mathrm{TH1}$ is smaller than $(m_3 - m_2)\mathrm{TH2}$ by definition since $m_3 > m_2 > m_1$ and

$\mathrm{TH2} > \mathrm{TH1}$. To summarise, considering that $-m_1\mathrm{TH1} + (m_3 - m_2)\mathrm{TH2}$ is larger than $(m_2 - m_1)\mathrm{TH1}$ and both the latter and the former are larger than zero, the marginal effect of labour supply on the average tax rate is stronger for higher incomes.

(5). The bisection method allows me to narrow down the optimum for a given set of exogenous variables by using the averages of different values of $\mathrm{L_i}$ for which the function $f(L_i, B, \tau_i, w_i, \epsilon_i)$ approaches 0. To illustrate, say we take the hypothetical function $f(x) = x^2 - 6x + 4$. By taking two variables within x's domain, for instance, 1 and 6, we find that $f(1) = 1^2 - 6(1) + 4 = -1\ (negative)$ and $f(6) = 6^2 - 6(6) + 4 = 4\ (positive)$. This suggests that our optimum is somewhere in-between 1 and 6. Let x_i denote the used variables so that $x_1 = 1$ and $x_2 = 6$. We continue to define another value of x_i so that $x_3 = \frac{x_1 + x_2}{2}$. Since $f(3.5) = 3.5^2 - 6(3.5) + 4 = -4.75\ (negative)$, we take that the $x_{optimal}$ is anywhere between 3.5 and 6.

(6). I take the derivate of the utility function with regards to τ_i: ${\delta U}/{\delta \tau_i}\left(\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n} + w_i L_i \cdot (1 - \tau_i)\right)^{\epsilon_i} + (1 - L_i)^{\epsilon_i} \equiv 0$, and solve by using the first-order condition. The first-order condition is ${\delta U}/{\delta \tau_i} = \epsilon_i\left(\frac{\sum_{i=1}^{n} w_i L_i}{n} - w_i L_i\right)\left[\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n} + w_i L_i (1 - \tau_i)\right]^{\epsilon_i - 1} \equiv 0$. The derivative of a summation is simply its inner derivative in sigma-notation, hence ${\delta}/{\delta \tau_i} \sum_{i=1}^{n} w_i L_i \tau_i = \sum_{i=1}^{n} w_i L_i$. Conform the first-order condition, either $\frac{\sum_{i=1}^{n} w_i L_i}{n} - w_i L_i$ or $\frac{\sum_{i=1}^{n} w_i L_i \tau_i - G}{n} + w_i L_i (1 - \tau_i)$ is equal to 0 in the optimum, given that the population is not 0. A marginal tax system with three brackets naturally produces four distinguishable income categories. Since ρ_i denotes the part of income subjected a certain tax bracket, the internal ranking allows to separate between these different groups:

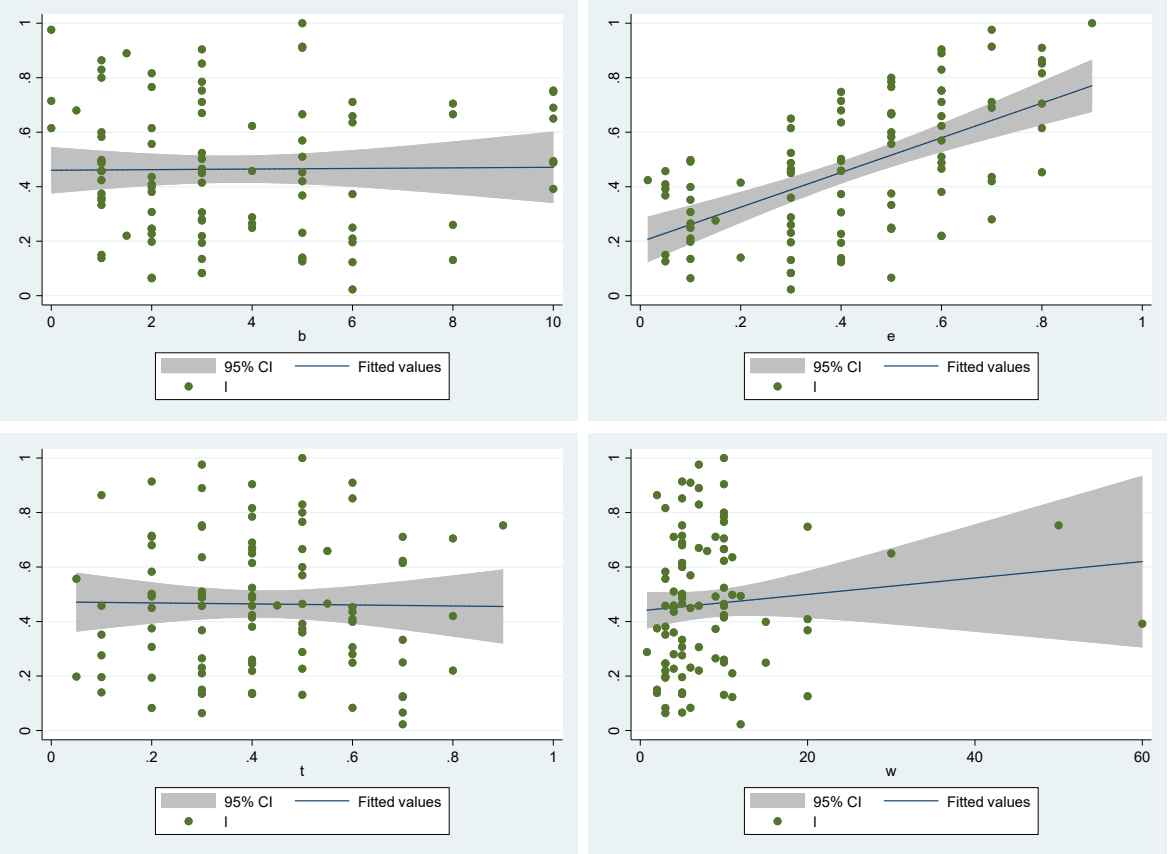
Internal ranking	**Income group**
$\rho_1 > \rho_2 > \rho_3$	Low
$\rho_2 > \rho_1 > \rho_3$	Low-Mid Income
$\rho_2 > \rho_3 > \rho_1$	High-Mid Income
$\rho_3 > \rho_2 > \rho_1$	High Income

OLS – Bisection Method:

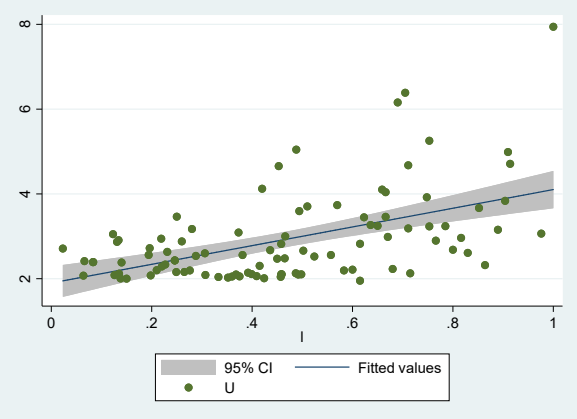
	(1)	(2)
	l	l
b	-0.0269***	-0.0376***
	(-3.61)	(-5.51)
e	0.957***	1.148***
	(12.82)	(14.98)
t	-0.537***	-0.740***
	(-5.13)	(-7.42)
w	0.0174***	0.0429***
	(3.82)	(7.78)
_cons	0.240***	0.104*
	(5.43)	(2.23)
N	100	94

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

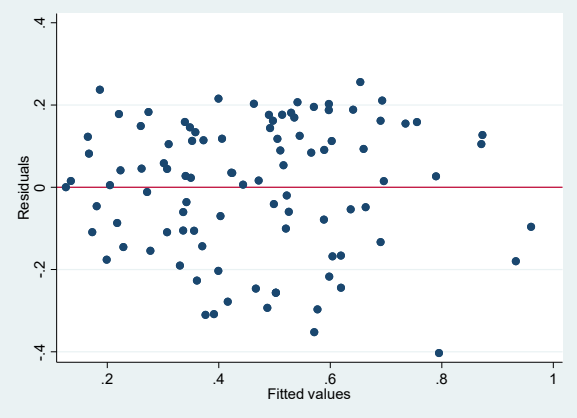
Scatterplots for B, e, t, and w versus L in the Optimum, respectively:



Scatterplots for L versus U in the Optimum:



Fitted Values versus Residual Plot:



Data set – Bisection Method:

ID	b	e	t	w	l	U	ID	b	e	t	w	l	U
1	1	0.5	0.5	5	0.6	2.214	**51**	1	0.1	0.1	3	0.352	2.02663
2	1	0.5	0.5	10	0.8	2.683	**52**	1	0.3	0.1	3	0.458	2.1053
3	2	0.5	0.5	10	0.766	2.898	**53**	3	0.3	0.2	3	0.083	2.3918
4	5	0.5	0.5	10	0.666	3.46	**54**	3	0.3	0.2	6	0.45	2.4719
5	5	0.9	0.5	10	0.999998	7.943	**55**	3	0.3	0.6	6	0.0836	2.3918
6	5	0.7	0.8	10	0.42	4.122	**56**	5	0.8	0.6	6	0.9097	4.9884
7	3	0.5	0.4	10	0.785	3.24	**57**	5	0.8	0.6	4	0.453	4.6556
8	3	0.2	0.4	10	0.415	2.304	**58**	2	0.8	0.4	3	0.8163	2.96299
9	3	0.5	0.4	7	0.6703	2.986	**59**	2	0.5	0.4	3	0.246	2.4313
10	0	0.7	0.3	7	0.976	3.064	**60**	2	0.5	0.05	3	0.557	2.5596
11	0	0.3	0.4	5	0.615	1.953	**61**	2	0.1	0.05	3	0.198	2.0769
12	1	0.3	0.4	5	0.487	2.129	**62**	2	0.1	0.3	3	0.064	2.0722
13	1	0.5	0.7	5	0.333	2.0412	**63**	1	0.05	0.3	10	0.457	2.04431
14	2	0.5	0.7	5	0.066	2.415	**64**	1	0.05	0.3	2	0.15	2.0015
15	2	0.8	0.7	5	0.615	2.824	**65**	3	0.15	0.1	5	0.276	2.1948
16	2	0.6	0.4	3	0.381	2.5589	**66**	5	0.2	0.1	5	0.14	2.383
17	3	0.6	0.4	3	0.219	2.944	**67**	5	0.4	0.4	5	0.134	2.908
18	1	0.8	0.1	2	0.864	2.321	**68**	4	0.4	0.4	7	0.458	2.8199
19	1	0.5	0.2	2	0.375	2.0555	**69**	3	0.4	0.6	7	0.306	2.5996
20	1	0.5	0.2	3	0.583	2.195	**70**	1	0.3	0.5	4	0.36	2.0514
21	2	0.5	0.4	3	0.246	2.431	**71**	3	0.3	0.5	10	0.465	2.48047
22	3	0.4	0.2	3	0.194	2.561	**72**	8	0.3	0.5	10	0.131	2.8694
23	1	0.4	0.4	2	0.138	2.006	**73**	8	0.8	0.8	10	0.705	6.3865
24	1	0.4	0.45	4	0.459	2.104	**74**	20	0.8	0.7	10	0.906	12.315
25	2	0.4	0.5	4	0.227	2.334	**75**	20	0.4	0.4	20	0.572	4.4418
26	2	0.7	0.6	4	0.436	2.673	**76**	10	0.4	0.3	20	0.748	3.9217
27	3	0.7	0.6	4	0.2802	3.173	**77**	5	0.05	0.3	20	0.368	2.1
28	3	0.6	0.2	4	0.711	3.187	**78**	5	0.05	0.7	20	0.126	2.0847
29	5	0.6	0.3	4	0.51	3.7056	**79**	2	0.05	0.6	20	0.409	2.0607
30	10	0.6	0.3	5	0.488	5.045	**80**	2	0.1	0.6	15	0.399	2.1099
31	6	0.3	0.1	5	0.196	2.7203	**81**	4	0.1	0.6	15	0.249	2.1575
32	6	0.3	0.7	12	0.023	2.7119	**82**	1	0.1	0.3	11	0.498	2.1041
33	6	0.4	0.5	9	0.373	3.0897	**83**	6	0.1	0.3	11	0.21	2.2018
34	0	0.4	0.2	5	0.715	2.1277	**84**	6	0.4	0.3	11	0.636	3.267
35	0.5	0.4	0.2	5	0.68	2.2304	**85**	6	0.4	0.7	11	0.123	3.0509
36	3	0.4	0.2	5	0.502	2.662	**86**	6	0.7	0.7	9	0.711	4.676
37	3	0.8	0.6	5	0.852	3.6681	**87**	6	0.5	0.7	10	0.25	3.464
38	4	0.6	0.7	10	0.623	3.4485	**88**	8	0.5	0.4	10	0.666	4.0415
39	1	0.6	0.5	7	0.8296	2.6099	**89**	8	0.3	0.4	10	0.26	2.88
40	1.5	0.6	0.8	7	0.2202	2.28816	**90**	3	0.3	0.4	10	0.524	2.524
41	1.5	0.6	0.3	7	0.8897	3.155	**91**	3	0.6	0.4	10	0.904	3.8369
42	5	0.3	0.3	6	0.231	2.6334	**92**	3	0.6	0.3	5	0.753	3.2342
43	5	0.6	0.5	6	0.5696	3.7362	**93**	3	0.6	0.55	5	0.466	3
44	14	0.4	0.7	100	0.862	4.82	**94**	6	0.6	0.55	8	0.659	4.103
45	10	0.6	0.9	50	0.753	5.2546	**95**	4	0.3	0.5	0.8	0.288	2.538
46	10	0.3	0.4	30	0.65	3.247	**96**	1	0.015	0.4	10	0.424	2.0109
47	10	0.7	0.4	5	0.69	6.1579	**97**	1	0.1	0.2	9	0.492	2.0979
48	5	0.7	0.2	5	0.914	4.7098	**98**	4	0.1	0.3	9	0.265	2.1592
49	2	0.1	0.2	5	0.307	2.0883	**99**	10	0.4	0.4	12	0.494	3.595
50	3	0.1	0.3	5	0.135	2.1182	**100**	10	0.05	0.5	60	0.392	2.1419

Regression Models – Labour Supply Response

	(1) labour	(2) labour	(3) labour
age	-0.0191***	-0.0188***	-0.0190***
	(-8.99)	(-9.03)	(-9.11)
male	0.0845		
	(1.46)		
urban	0.184**	0.187**	
	(3.07)	(3.16)	
educ	-0.165***		
	(-5.60)		
edu_low		-0.519**	-0.522**
		(-3.01)	(-3.04)
edu_med		-0.667***	-0.666***
		(-3.93)	(-3.98)
edu_high		-0.779***	-0.780***
		(-4.71)	(-4.80)
1.male			0.267**
			(3.45)
1.urban			0.312***
			(6.13)
1.male#1.u~n			-0.254**
			(-3.58)
_cons	3.205***	3.547***	3.421***
	(31.07)	(18.14)	(19.47)
N	7930	7930	7930

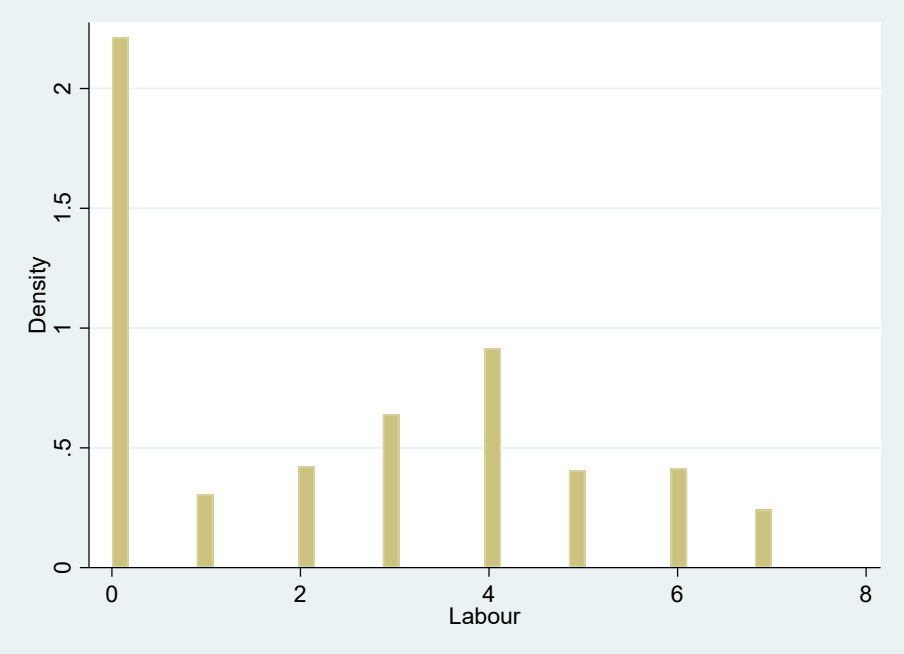
t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Probit Model

	(1)
	augl.sup
age	-0.0137***
	(-13.22)
edu_low	-0.248***
	(-11.12)
edu_med	-0.355***
	(-20.96)
edu_high	-0.405***
	(-5.72)
urban	0.112***
	(4.90)
male	0.0338
	(1.23)
_cons	1.015***
	(9.86)
N	7930

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

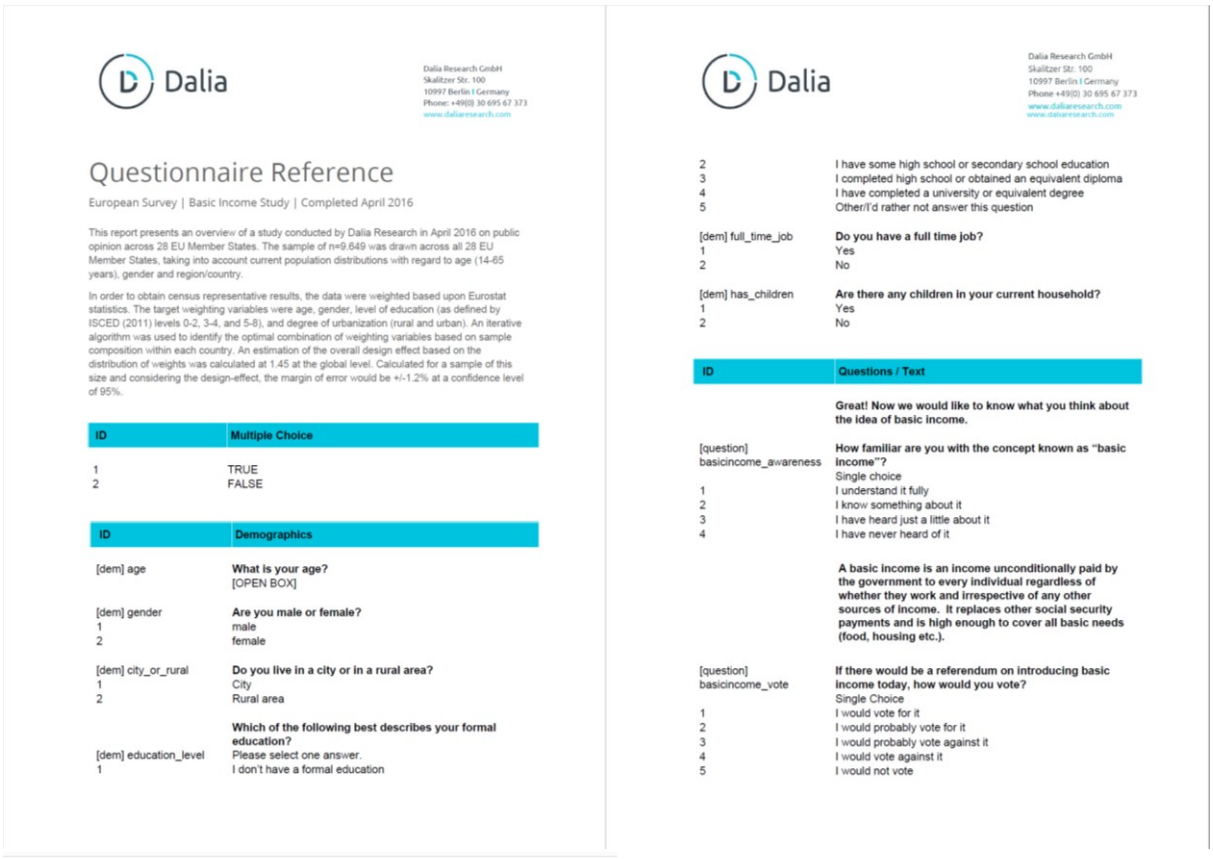
Histogram Labour Supply Response



Regression Model - Life Satisfaction

	(1) utility	(2) utility
th1_0	0.632	0.0472
	(1.98)	(1.82)
th2_th1	0.133	-0.0395
	(0.31)	(-1.65)
th3_th2	-0.233	0.120
	(-0.71)	(0.42)
th4_th3	0.0483	-0.125
	(1.30)	(-0.43)
m1	-0.00571	
	(-0.11)	
m2	-0.125	
	(-1.75)	
m3	0.205	
	(1.59)	
m4	-0.113	
	(-1.36)	
med_inc		0.000147***
		(4.99)
labour_ins~y		0.0214
		(1.24)
emp_rate		0.00378
		(0.13)
l_over50		-0.0448
		(-1.66)
leisure		-0.410*
		(-2.38)
_cons	1.655	8.682*
	(0.82)	(2.15)
N	13	15

UBI Survey – Dalia Research Centre:



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Questionnaire Reference

European Survey | Basic Income Study | Completed April 2016

This report presents an overview of a study conducted by Dalia Research in April 2016 on public opinion across 28 EU Member States. The sample of n=9.649 was drawn across all 28 EU Member States, taking into account current population distributions with regard to age (14-65 years), gender and region/country.

In order to obtain census representative results, the data were weighted based upon Eurostat statistics. The target weighting variables were age, gender, level of education (as defined by ISCED (2011) levels 0-2, 3-4, and 5-8), and degree of urbanization (rural and urban). An iterative algorithm was used to identify the optimal combination of weighting variables based on sample composition within each country. An estimation of the overall design effect based on the distribution of weights was calculated at 1.45 at the global level. Calculated for a sample of this size and considering the design-effect, the margin of error would be +/-1.2% at a confidence level of 95%.

ID	Multiple Choice
1	TRUE
2	FALSE

ID	Demographics
[dem] age	**What is your age?** [OPEN BOX]
[dem] gender	**Are you male or female?**
1	male
2	female
[dem] city_or_rural	**Do you live in a city or in a rural area?**
1	City
2	Rural area
[dem] education_level	**Which of the following best describes your formal education?** Please select one answer.
1	I don't have a formal education
2	I have some high school or secondary school education
3	I completed high school or obtained an equivalent diploma
4	I have completed a university or equivalent degree
5	Other/I'd rather not answer this question
[dem] full_time_job	**Do you have a full time job?**
1	Yes
2	No
[dem] has_children	**Are there any children in your current household?**
1	Yes
2	No

ID	Questions / Text
	Great! Now we would like to know what you think about the idea of basic income.
[question] basicincome_awareness	**How familiar are you with the concept known as "basic income"?** Single choice
1	I understand it fully
2	I know something about it
3	I have heard just a little about it
4	I have never heard of it
	A basic income is an income unconditionally paid by the government to every individual regardless of whether they work and irrespective of any other sources of income. It replaces other social security payments and is high enough to cover all basic needs (food, housing etc.).
[question] basicincome_vote	**If there would be a referendum on introducing basic income today, how would you vote?** Single Choice
1	I would vote for it
2	I would probably vote for it
3	I would probably vote against it
4	I would vote against it
5	I would not vote
5	Running costs
[question] basicincome_effect	**What could be the most likely effect of basic income on your work choices? I would...** Single Choice
1	...stop working
2	...work less
3	...do more volunteering work
4	...spend more time with my family
5	...look for a different job
6	...work as a freelancer
7	...gain additional skills
8	A basic income would not affect my work choices
9	None of the above
[question] basicincome_argumentsfor	**Which of the following arguments FOR the basic income do you find convincing? Choose all that apply.** Multiple Choice (Randomized answer option and question order)
1	It reduces anxiety about financing basic needs
2	It creates more equality of opportunity
3	It encourages financial independence and self-responsibility
4	It increases solidarity, because it is funded by everyone.
5	It reduces bureaucracy and administrative expenses
6	It increases appreciation for household work and volunteering
7	None of the above
[question] question.2016wave4_basicincome_argumentsagainst	**Which of the following arguments AGAINST the basic income do you find convincing? Choose all that apply.** Multiple Choice
1	It is impossible to finance
2	It might encourage people to stop working
3	Foreigners might come to my country and take advantage of the benefit
4	It is against the principle of linking merit and reward
5	Only the people who need it most should get something from the state
6	It increases dependence on the state
7	None of the above