STRATHCLYDE

DISCUSSION PAPERS IN ECONOMICS

THE MACROECONOMIC IMPACTS OF A UNIVERSAL BASIC INCOME: AN APPLICATION TO SCOTLAND

BY

KEVIN CONNOLLY, DAVID EISER, ASHWIN KUMAR,
PETER G MCGREGOR AND GRAEME ROY

NO 20-10

DEPARTMENT OF ECONOMICS
UNIVERSITY OF STRATHCLYDE, GLASGOW

The Macroeconomic Impacts of a Universal Basic Income:
An Application to Scotland

August 2020

Kevin Connolly*[1],

David Eiser[1]

Ashwin Kumar[2]

Peter G. McGregor[1]

and

Graeme Roy[1].

1. Fraser of Allander Institute, Department of Economics, University of Strathclyde
2. Manchester Metropolitan University

*****We are grateful to Gioele Figus and Kim Swales for comments on an earlier draft. The study was funded by the Scottish Improvement Service.

Abstract

UBI is defined as a payment made to all citizens in a region/ nation that is unconditional, permanent and substantial. We explore the macroeconomic consequences of such a UBI proposal for a regional economy, introduced on a fiscally neutral basis. We use Scotland, a country where the First Minister has indicated her support for the principle behind the idea, to illustrate the application of our analytical approach. The implementation of such a UBI at scale represents a major societal shift that involves substantial rises in taxation as well as in payments. Much of the existing empirical evidence relates to schemes that are small and in which the beneficiaries bear none of the costs, so its applicability here is questionable. Our approach combines microsimulation, to identify the immediate impact of the UBI on the tax/benefit system and distribution of income, with macroeconomic modelling to identify and analyse the wider economic impact of potential behavioural responses. The macroeconomic impact of the UBI depends critically on workers' and potential migrants' behavioural responses to the increase in taxation as well as to increased benefits. However, it seems clear that any positive stimulus to productivity as a consequence, for example, of reduced precarity and increased training would need to be substantial to offset any adverse impact on the scale of economic activity, unless policymakers succeed in securing a social contract that dampens or eliminates workers' pressure for higher wages in response to a reduction in take home pay.

Keywords: Universal Basic Income; Citizen's Basic Income; Computable General Equilibrium

JEL: D58; H24; J30; R11; R13

1. Introduction

The period since the financial crash of 2007/8 has seen significant structural changes in economies including shifts to a more unequal distribution of income, increasing insecurity of employment and precarity. There is growing concern about the impact of automation (Industry 4.0) and the shift to the green economy changing peoples' relationship with work. This, together with the huge economic impact of the policy response to COVID-19, has seen an increase in support across the political spectrum for new radical plans relating to the link between work, people and the government (Martinelli, 2017).

One key idea that has gained considerable traction is that of Universal Basic Income (UBI). UBI is often defined in terms of a payment made to all citizens in a region/ nation that is unconditional, permanent and substantial. While the idea of UBI is not new, with roots reaching as far back as the middle ages, interest in it has grown significantly over the last few years and been given further impetus by the coronavirus lockdown. A recent survey of 12,000 people in all European Union countries found that 71% of Europeans supported the introduction of a UBI.[1] Support for the UBI naturally focuses on its impact on the distribution of income, but also emphasises a wide range of other benefits including reduced precarity and improved mental health. (Emery et al., 2013).

In fact, UBI-type interventions that have occurred internationally have often been conditional, transitory and/ or small scale in nature. This may in part account for the dearth of analyses of the likely *macroeconomic* impact of a UBI.

The introduction of a UBI has gained traction in a number of European countries. Scotland is at the forefront of possible UBI implementation, with plans to initiate small scale trials of the system, which could lead to a nationwide rollout.[2] Furthermore, the plan is for a UBI that does conform to the characteristics of the archetypal scheme and there appears to be significant support for such a policy from the public and the Scottish Government.[3] The implementation of a UBI at scale would represent a major societal shift that would inevitably impact macroeconomic activity in any country in which it was introduced. The primary purpose of this paper is to provide a systematic analysis of these likely effects. While the specific numerical results to a degree reflect the characteristics of the Scottish

[1] https://www.thetimes.co.uk/article/70-of-europeans-want-the-state-to-pay-a-basic-income-kbgdzz3bv
[2] See Standing (2018) and Emery et al (2013)

[3] https://www.heraldscotland.com/news/18471823.coronavirus---now-two-thirds-scots-support-universal-basic-income-poll-finds/

economy, our approach and analysis have widespread applicability for both regional and national economies, wherever substantial UBI interventions are under consideration. Since a UBI at scale has never been implemented, there is considerable uncertainty surrounding behavioural responses. Accordingly, the novel micro/macro approach that we develop does not attempt to predict specific impacts; rather we seek to identify and analyse the likely mechanisms and effects that can inform policymakers of a range of options and what they could do to facilitate particular outcomes.

Section 2 provides a brief review of the literature on UBI-type schemes, covering various case study, microsimulation and macroeconomic evidence. Section 3 provides an ex ante analysis of the likely macroeconomic impact of a UBI in a regional economy in which wage bargaining and migration responses prove central, since they influence the scale and direction of changes in economic activity and employment in ways that have typically not been captured by previous attempts at evaluation. Section 4 outlines our own modelling approach, which combines microsimulation, to identify the immediate impact of the UBI on the tax/benefit system and distribution, with macroeconomic modelling to help identify and analyse the wider economic impact of a range of potential behavioural responses not previously considered, thereby helping to resolve major lacunae in the existing literature

Section 5 uses the microsimulation results to generate the UBI-induced disturbances to a macroeconomic model of Scotland. We explore a range of possible behavioural responses to the implementation of the UBI and identify the short- and long-run impacts on economic activity, employment and the distribution of income among households. Section 6 is a brief conclusion.

2. Brief overview of the literature

To date, much of the literature has focused on microeconomic case study evidence with two key economic impacts of a UBI emphasised, namely changes to household incomes and labour supplies. In fact, there exist a number of recent, extensive reviews of the literature, so this review can be brief. Gibson et al (2018), which uses scoping methods, Standing (2019) and Fraser of Allander et al (2020, Annex A) review the evidence on the impact of previous UBI-type interventions. While the papers provide details of a wide range of interventions, there are reasons to be cautious in assuming that the findings of this evidence base can be translated to the implementation of an archetypical UBI.

The vast majority of the existing evidence base relates to UBI-type interventions that are small in scale, often temporary and are either non-universal or conditional or both. Many such interventions/events would typically not be expected to have significant macroeconomic effects, and indeed involve no

apparent costs to the recipient (often targeted) population. The literature and case study evidence suggest a wide range of potential benefits arising from the introduction of a UBI, including enhanced freedom and security and reduced poverty, inequality and precarity. However, this literature often abstracts from the (typically adverse) effects of having to finance a UBI at least partially through higher taxes. Yet these funding decisions may have significant impacts on wage bargaining and the macroeconomy as we show in the next Section. In practice, responses to financing decisions are likely to prove critical where archetypal UBI schemes are concerned.

Two UBI case studies that seem most closely to approximate the archetypical UBI, in that both have been long-lasting and imply a non-trivial transfer, are the Alaska Permanent Fund and the distribution of Casino profits within the Eastern Cherokee reservation. (See Gibson et al., 2018, Marinescu, 2018, and Standing, 2019). However, the proposed UBI schemes now being actively discussed by policymakers in many countries – including Scotland – differ fundamentally from both these cases in that, while more substantial, there is no external funding available. Accordingly, for most UBI systems the budget will need to balance, and the UBI has to be funded by a combination of reductions in other benefits and tax increases. This is particularly true in the context of regions such as Scotland which have limited borrowing powers. This has a major influence on the likely micro- and macroeconomic impact of the UBI since we would expect behavioural responses to the substantial rises in tax rates that are required to fund it as well as to the UBI payments per se.

In the UK context, there have been a number of detailed microsimulation studies of the likely effects of a UBI implemented on (at least a partially) balanced budget basis. Martinelli (2017) explores a comprehensive range of options for the UK as a whole. Mackenzie et al. (2016) model the effects of the Scottish Greens' proposal to provide a weekly basic income of £50 for children and £100 for adults. Painter et al (2019) also considers a Scottish-specific UBI, finding that, even for small transfers, large changes in tax rates are needed. The results of microsimulation analyses are invaluable in providing a detailed analysis of the immediate effects of the distributional impact of the UBI under various assumptions about financing, but typically do not allow for behavioural responses to what are often substantial changes in tax rates and household incomes.

There are very few studies of the macroeconomic impacts of a UBI, and none that we are aware of are published in refereed journals. Thurlow's (2002) computable general equilibrium (CGE) analysis of a proposed UBI in South Africa focuses on the macroeconomic impacts of the financing of the UBI and finds that even the most favourable option implies a negative impact on GDP and employment. Two recent studies have provided an ex ante assessment of the likely effects of the introduction of a (hypothetical, substantial $6,000 per adult per annum) UBI in the US. Nikiforos et al (2017) report that

the UBI would have a substantial beneficial impact on GDP and employment. The Penn Wharton Budget Model (PWBM, 2018) analysis of exactly the same policy intervention, however, finds evidence of significant and negative impacts on GDP and employment. The different results reflect very different models of supply-side behavioural responses. In particular Nikiforos et al (2017) results are derived from what is effectively a traditional Keynesian macroeconomic model in which the supply side of the economy is entirely passive and economic activity is driven entirely by aggregate demand.

Overall, the case study literature has limited applicability to today's debates upon UBIs – including the Scottish example – and the literature on macroeconomic impacts of a UBI is thin and contested. We clarify and extend this literature by: providing an ex ante analysis of a UBI implemented at scale within a regional economy in which wage bargaining and migration are explicitly incorporated; simulating the policy's impact on the fiscal balance, the level of economic activity and the distribution of income among households, using micro- and macro-simulation models to identify both impact effects and a range of potential behavioural responses not previously considered.

3. The macroeconomic impact of a UBI given an imperfectly competitive labour market

We begin by considering the likely macroeconomic impact of the implementation of a substantial UBI in the absence of any migration in the context of a small, open regional economy (so that all external prices and incomes are exogenous) Since the evidence on the strength of a likely interregional migration response is limited, we compare two limiting cases with a zero and strong migration reaction.[4] Our initial focus is on the impact of the UBI on workers' bargaining responses to changes in the income tax rate required to fund it.[5] We then consider how allowance for interregional migration impacts the analysis.

In the case of an externally-funded UBI the major impact is a stimulus to aggregate demand and the demand for labour, since no tax changes are required.[6,7] The impact on the regional economy depends on the supply side of the labour market. There is overwhelming long-term evidence of the importance

[4] For simplicity we abstract from potential international migration response, which seem likely to be very modest.

[5] While other tax combinations are possible we deal here exclusively with income-tax- financing for simplicity (since this is the principal devolved tax of sufficient scale in Scotland at the current time). Future research should consider alternative means of ensuring a balanced budget, but all will inevitably be associated with substantial economic costs. The financing issue is considered further below.

[6] For simplicity, we assume that the only supply side impacts come through the tax changes implemented to fund it. However, see both the discussion on productivity in the subsequent text and footnote 6 below.

[7] The existence of a sovereign fund could motivate this case at a national or regional level. In the absence of such a fund it is difficult to envisage a motivation at the regional level given how unlikely a nationally funded region-specific UBI is. At the national level the macroeconomic conditions assumed by Modern Monetary Theory could motivate this case.

of wage curves, typically motivated in terms of a system in which labour's bargaining power is inversely related to the unemployment rate. In these circumstances the increase in labour demand would increase both real wages and employment (and the employment rate) and stimulate the aggregate economy. However, upward pressure on prices and wages, and therefore on competitiveness, would result in a degree of crowding out. In all cases it is likely that all household quintiles would experience an increase in incomes, although proportionately by much more among lower income households.

Matters are more complicated if, in the more likely case for most countries/ regions, the UBI has to be financed internally by some combination of a reduction in other benefits and an increase in income taxation. Given the progressive nature of the tax system the change would result in an increase in the incomes of the less well-off, funded in part by a reduction in the net incomes of the better off. While we would still expect a stimulus to demand, it would be much smaller than that expected under external funding.[8] However, the analysis of the likely response of wage bargaining becomes more complex, although in each case we expect a substantial redistribution of income.

The reaction of workers to the introduction of the UBI now becomes critical and we consider a range of cases, since we have no direct empirical evidence on this issue given that there are no examples of such a policy being implemented. Assume a conventional bargaining model in which workers focus exclusively on the net-of-tax real wage. The rise in income tax rates here results in a major upward push on wages (and prices) as workers seek to restore their net of tax real wage. This would result in a major adverse supply shock that would reduce regional competitiveness and generate a reduction in net exports. Receipt of UBI is not conditional on labour market status, so may not be taken into account in bargaining over wages. However, this case does imply that workers effectively seek to increase their real personal disposable incomes by the full amount of UBI payments[9]. We cannot determine whether this adverse supply effect will dominate ex ante, but it seems likely given the anticipated major rise in income tax rates and the probably modest nature of the demand stimulus in which case economic activity and employment would decline.

Suppose workers could be persuaded to focus on the real wage net of taxes *and* their own personal UBI receipts. Clearly, this would moderate the scale of the wage-push effect since workers now value their own CBI receipts "as if" they were a part of the wage that they receive. In effect, their personal real disposable income would be maintained and they would be as well off after the implementation of the CBI as before. However, there will still be upward pressure on wages since UBI is payed to all

[8] In fact, in our model there is a modest stimulus to value added in this case, but the demand for labour actually falls slightly, reflecting the greater capital intensity of the consumption of low-income households.
[9] Strictly, the full amount of the excess of UBI benefits over the loss of other benefits and personal allowance.

individuals irrespective of labour market status, and the extent of the rise in income tax reflects this. Accordingly, the scale of the adverse supply effect is reduced relative to the case where workers focus exclusively on their net of tax real wage, but is still present. A continuing dominant adverse supply effect would be associated with a smaller contraction in the macroeconomy compared to the first case.

If workers could be persuaded to take account of their own and their family's UBI receipts during bargaining this would further reduce the upward pressure on wages, but not eliminate it since UBI is paid to all individuals, irrespective of whether they live in a household where there is an individual in employment.

Finally, consider the case where workers fully value all UBI payments, irrespective of who actually receives them. Perhaps a social contract could establish this "social wage" case in which workers are persuaded to value the resultant more equitable distribution of income as much as their net loss of household disposable income. If this case prevailed there would be no wage-push effect at all in response to the implementation of a UBI; workers would feel as well off after the implementation of UBI as before and there would be no adverse supply-side impact. Accordingly, in this case the stimulus to demand implied by the UBI would predominate, and the macro-economy would actually expand.

While it may be reasonable to abstract from international migration flows in analysing balanced budget UBI interventions in national economies, if the policy is being implemented at the level of a small, open region migration responses are potentially much more important. Following Layard et al (2005) and Lecca et al (2014, 2019) we take net migration to continue to flow in response to real wage and unemployment differentials between regions of a national economy, until these differentials are eliminated.

Consider first, the potential macroeconomic outcomes if migrants respond to the same real wage as workers, and that the adverse supply side impact predominates, except in the case of the social wage. If the focus is the net of tax real wage then the fall in the real wage and rise in the unemployment rate that is generated in the "no migration" case discussed above, generates net out-migration, which gradually increases the net of tax wage rate and reduces the unemployment rate to their original levels. However, population, employment and GDP all contract more relative to the macroeconomic impact under no migration. [10]

[10] Wherever the UBI tends to have an expansionary impact on the host economy, as in the externally-funded UBI case, migration flows would generate net in-migration and further expansion.

In fact, allowing for migration exacerbates the adverse macroeconomic impact of the UBI given a predominant adverse supply shock for all bargaining models. Naturally, it remains the case that the scale of this contraction is smaller the greater the extent to which workers and migrants respond to UBI receipts. Where workers take their own personal UBI receipts into account when bargaining, for example, this ultimately restores the real net of tax and personal UBI "wage".

Where both workers and migrants focus on their social wage the *gross* real wage and unemployment rates are ultimately unaffected by UBI implementation. Here the adverse supply effect is again entirely neutralised by wage bargaining responses and the modest demand stimulus predominates, encouraging an economic expansion.

Allowance for migration under symmetric responses of workers and migrants therefore simply reinforces the contraction (expansion) in economic activity given a predominant supply (demand) side impact, except in the social wage case, and emphasises the point that any moderation of the wage push effect is beneficial for macroeconomic outcomes.

However, it would seem irrational for migrants to ignore the impact of the UBI on their own, and indeed their households' disposable income; this should be an element of rational migration decisions. Furthermore, there is a long-standing recognition that migrants might select that combination of public spending and taxation that they prefer (Tiebout, 1956), and so social wage considerations may be more likely to be key for migrants. If migrants do indeed respond to a more encompassing notion of their real take home pay than workers, then the adverse long-run impacts on GDP and employment would be somewhat less than would be the case under symmetry. Furthermore, the impact would no longer "restore" the relevant initial (appropriately benefit-adjusted) real wage: this would now increase less than envisaged in any of the symmetric cases identified above, reducing any adverse impact on the level of economic activity and lowering unemployment rates.[11]

Impacts on productivity

It is often argued, and case studies have tended to provide supporting qualitative evidence (e.g. Gibson et al, 2018), that the provision of a basic income allows individuals to choose to invest more in their human capital through education and training, rather than feeling compelled to take low paid,

[11] There is a literature suggesting that benefits (typically focussed on unemployment benefits) increase union bargaining power and unemployment (e.g. Nickell, 1997). Others have argued that benefits improve the efficiency of search activity and ultimately reduce unemployment (e.g. Biegert, 2017). Overall, there currently seems to be little convincing evidence that benefits as a whole have a major impact on unemployment, although this may reflect the net outcome of these countervailing forces. Accordingly, we do not explore these impacts further here. (See Fraser of Allander et al, 2020, Annex E.)

possibly insecure jobs. Some case studies have also identified mental health benefits, which are likely ultimately to improve productivity through reduced absenteeism, for example. However, given the absence of empirical estimates of the likely scale of these various sources of productivity gain, we simply explore the extent to which productivity would need to increase to achieve certain economic target economic outcomes in the results section below.

4. Modelling approach

Our own approach is distinctive in a number of respects. First, we make use of a microsimulation to provide information on the scale of the fiscal transfers that are required and their distribution across households.[12] Second, we use this information as an input into our macroeconomic model to assess the impact of this policy initiative on the Scottish economy under alternative assumptions about behavioural responses to the substantial changes in benefits and taxes. Finally, we explore the impact of UBI-induced migration flows.

4.1 The microsimulation model and results

We analyse the impact of a Scottish CBI of £73.10 per week to each adult over 25, £57.90 per week to adults between 20-24, £163.00 to pensioners and £84.54 to under 20s, uprated in line with the Consumer Prices Index to 2023/24.[13,14] This is intended to ensure that UBI payments to all individuals broadly match current minimum benefit level payments. The gross cost of this scheme is £26.7 billion, funded by: £4.0 billion savings from benefit reductions[15]; £6.3 billion from state pension reductions and £9.1 billion from eliminating the personal allowance. Income tax rates have to rise to meet the

[12] The microsimulation model also provides us with data that allows us to explore those bargaining specifications that require knowledge of the proportion of households with employees and with families.
[13] In fact, this is the "lower level" UBI payment, which is based on benefit levels. We focus exclusively on this case here since the higher level implied income tax rates that will almost certainly be regarded as unacceptably high – from 58% in the lowest income tax band to 85% in the two highest bands.
[14] The proposed UBI scheme could not be implemented without the collaboration of the UK's HMRC and DWP. See the feasibility report:
https://basicincome.scot/wp-content/uploads/sites/75/2020/06/Draft-Final-CBI-Feasibility_Main-Report-June-2020.pdf
[15] The UBI does not replace those elements of Universal Credit designed to help with housing and childcare costs or the elements that provide additional support for families containing disabled adults or children.

very substantial residual funding requirement of £7.2 billion.[16,17] The scale of the required tax rise combined with other changes represents an unprecedented and radical change that – as intended – implies societal change.

We employed the Institute for Public Policy Research microsimulation model, maintained by Manchester Metropolitan University (Corlett, 2019) to assess the impact of the proposed UBI on income distribution and the fiscal balance.[18] Table 1 summarises the key results of the microsimulation for the purposes of our macroeconomic modelling. Full details of the microsimulation results are provided in Fraser of Allander et al (2020) Section 2. However, it is worth noting that the implementation of the UBI necessitates an increase of eight percentage points on each of the five income bands in Scotland (resulting in a minimum marginal rate of 27% and a maximum rate of double that). Recall that these rates are applied to even the first £1 of income given the elimination of the personal allowance.

Table 1 Income impacts by household (2019 basic prices).

Household Group	Total quintile income (£ million)	Average income	Average change per year	Change (percentage)
HG1	10,166	£9,967	£3,640	36.52%
HG2	14,438	£13,621	£2,860	21.00%
HG3	23,812	£22,465	£1,924	8.56%
HG4	34,129	£31,311	£156	0.50%
HG5	54,860	£54,317	-£5,304	-9.76%

[16] Income tax is the principal devolved tax of sufficient scale – for example, it currently raises around £13 billion as compared to around £2.5 billion from Council Tax. Even if other combinations of tax rises and expenditure cuts could be used they would not change the fundamental trade-off between the benefits of UBI payments and the costs associated with their financing (except in the very special conditions assumed by Modern Monetary Theory).

[17] The balance of £0.1 billion reflects the fact that we used whole percentage point increases in income tax rates and treated positive or negative fiscal effects of less than £250 million as tantamount to a balanced budget outcome given the scale of change being modelled.

.

[18] The model used the Family resource survey with an enhanced Scottish sample, averaged over three years (2015/16, 2016/17, 2017/18)

These average changes in income per year per household are introduced in the AMOS UBI model through transfers from the Scottish Government to household groups. Overall fiscal balance is imposed though adjustments in income tax.

4.2 The macro-simulation model

Here we employ a multi-sectoral general equilibrium macroeconomic model, which provides a detailed description of the economy that captures the key interlinkages between the private sector, households, government, international trade and the labour market. These models allow extensive simulation of the impact of policy changes. They are used widely by governments to assess the merits of alternative policy choices.

In this paper we use a UBI version of the modelling framework AMOS, calibrated on an eighteen sector Social Accounting Matrix for Scotland for 2013. (See Fraser of Allander et al, 2020, Annex C for a fuller discussion of the model and Figus et al (2018)) for a full model listing. In addition to the 18 sectors/commodities, within the model there are three internal institutions - households, firms and governments - and two external, the rest of the UK (RUK) and the rest of the world (ROW). Scotland is considered a small, open economy so that external RUK and ROW prices are taken to be exogenous. Commodity markets are assumed to be competitive. Financial flows are not explicitly modelled, and the interest rate is assumed to be exogenously determined at UK level.

This framework has been used in a number of applications (e.g. Allan et al., 2014; Harrigan et al., 1991) and a variant is used by the Scottish Government for policy analysis. The model allows for a degree of flexibility in the choice of model closures and parameters. The version used in this paper assumes myopic expectations. Fundamentally, the model assumes that producers minimise cost using a nested multilevel production function. The combination of intermediate inputs with RUK and ROW inputs is based on the Armington function (Armington, 1969). Output is produced from a combination of composite intermediates and value added, where labour and capital combine in a constant elasticity of substitution (CES) function to produce value added, allowing for substitution between these factors in response to relative price changes.

There are four components of final demand in the model: household consumption, investment, government expenditure and exports. Household consumption is a linear function of real disposable income. Government expenditure in the model is constant in the model, while exports are determined again based on an Armington function and so are dependent on relative prices.

All simulations are run in a multi-period setting, with the periods interpreted as years as both the SAM and behavioural relationships are benchmarked using annual data. The model is initially assumed to

be in steady-state equilibrium, implying that with no exogenous disturbance, the model simply replicates initial values over all subsequent time periods.

The supply side of the economy determines the use of capital and labour in the model. Capital, in the first period, is fixed but in subsequent periods each sectors sector's capital stock is updated through investment, which responds partially to the gap between the desired and actual (adjusted for depreciation) levels of capital stock – in line with the neoclassical investment formulation (Jorgenson, Dale, 1963).

For this paper AMOS has been adapted to account for the implementation of a UBI. First, the households have been disaggregated into quintiles to allow an analysis of the distributional effects of the policy. Second, within the model we generally assume that the UBI is paid as a transfer from the Scottish Government to Scottish households funded partly by a reduction in some benefits with the balance funded by an increase in income tax. Third, we modify the wage curve/ bargained real wage function and the zero net migration function to reflect the alternative wages that workers and migrants may focus on, with the net of tax real wage and the social wage providing the limiting cases.

Labour force changes in the model are solely attributable to migration; there is no change in natural population. Migration to Scotland is determined by the gap between the Scottish and UK unemployment and real wage rates. The regional economy is assumed to have zero net migration in the base year (2013) and, where we allow for migration, this flows continuously to re-establish initial real wage and unemployment rates. The migration function is given by:

$$m = \sigma - \ 0.08[\ln(u^S) - \ln(u^R)] + 0.06\left[\ln\left(\frac{w^S}{cpi^S}\right) - \ln\left(\frac{w^R}{cpi^R}\right) - \beta\ln[1-\tau]\right] \qquad (1)$$

In equation (1): w^S is the net of tax nominal wage; *m* is net in-migration as a proportion of the Scottish population; u is the unemployment rate; the S and R superscripts stand for Scotland and the Rest of the UK, respectively; and σ is a parameter calibrated to generate zero net migration in the base period. β is the parameter indicating the extent to which households value the benefits of the CBI as against general private consumption. It represents the subjective net valuation by households of the benefits of the increased CBI (including greater equity) weighed against the corresponding increase in their income tax. If β=1 migrants respond to the *gross/ pre-tax* real wage; the rise in tax does not impact their migration decision since they feel as well off after the change as before. They value the benefits of the CBI as much as their loss of real take home pay.

The bargained real wage curve is:

$$\ln\left[\frac{w^S}{cpi^S}\right] \ = \ c - 0.113\ln[u^S] + \alpha\beta\ln[1-\tau] \qquad (2)$$

The parameter α represents the extent to which any private valuation of the CBI and any amenity effect associated with greater equity generated by the CBI is reflected in the wage bargain and *c* is a calibrated parameter. In the conventional bargaining model above both α and β equal zero so that the last term on the RHS of (2) is zero. In this case bargaining and migration are motivated by the real *net-of-tax* consumption wage (which is the wage on the LHS above). However, in the Social Wage case $\beta=\alpha=1$, so that (2) implies that workers bargain over the pre-tax real wage: the tax hike has no impact on the bargained wage; workers feel as well off after the introduction of the CBI as before. Intermediate cases where workers bargain over the wage adjusted for their personal or family CBI receipts are reflected in values of $0< \beta=\alpha <1$.

5. The macroeconomic results

We begin by assuming that there is no migration response. From the analysis of Section 3 we expect the implementation of an archetypical UBI in Scotland to generate simultaneous demand and supply side shocks. However, the first column of Table 2 reports the results of the (hypothetical) case where the UBI is externally funded. As anticipated, the impact is a substantial rise in consumption of 8.6%, and a 3.5% stimulus to GDP, with all household quintiles benefiting. The greater stimulus to investment than employment reflects the greater capital intensity of lower income household groups. Second and subsequent columns all report the impact of introducing a balanced budget UBI. The second column, however, isolates the demand side impact of the income-tax-financed UBI by fixing the nominal wage, thereby precluding any "wage push" response. There are some surprising aspects of the results. First, the overall stimulus to GDP is extremely modest (0.1%) despite the scale of the redistribution, reflecting the fact that the impacts of the increasing consumption of lower income households (the first three quintiles) are largely offset by the reduction in consumption of higher income households. Indeed, aggregate consumption is unaffected – the GDP stimulus is primarily due to an increase in investment (and capital stock, of 0.5%). Second, employment actually falls slightly (by 0.1%) despite the increase in GDP.[19] These results reflect the greater capital intensity of low-income households' consumption. Third, the real (and nominal) take home wage falls significantly, by 13.1% due to the substantial rise in income tax combined with a fixed nominal wage.

[19] If the lowest income quintile takes on the same consumption pattern as the next lowest, the GDP effect increases to 0.4% and the employment impact becomes positive (0.1%). If the tax revenue was used to finance a general increase in current government spending rather than to effect transfers to low income households GDP would increase by 2.8% and employment by 4.0%, reflecting the low import intensity and high labour intensity of government expenditure.

The next four columns of Table 2 report the long-run macroeconomic impacts of the UBI under alternative assumptions about workers' responses to the rise in income tax that funds its implementation. (The final column relates to the alternative policy of improved child benefits.) These results confirm the qualitative analysis of Section 3 and illustrate the sensitivity of the scale of the macroeconomic impact to workers' responses to the substantial rise in income taxation.

Table 2. The long-run macroeconomic impacts of implementing the UBI across various bargaining models (with no migration)

Results (percentage change from base)	Externally funded	Fixed Nominal wage	Conventional Bargaining	Bargaining adj. for worker's CBI	Bargaining adj. for family's CBI	Social wage
Economic activity (GDP)	3.5	0.1	-8.8	-4.4	-1.7	0.2
Employment	3.0	-0.1	-9.7	-5.0	-2.1	-0.1
Exports	0.0	0.0	-10.5	-5.3	-2.1	0.1
Investment	4.0	0.5	-7.9	-3.7	-1.2	0.5
Unemployment rate	-2.8	0.1	9.1	4.7	1.9	0.0
Nominal gross wage	0.0	0.0	13.2	6.3	2.4	-0.1
Real take home wage	0.0	-13.1	-9.9	-11.5	-12.4	-13.1
CPI	0.0	0.0	4.0	1.9	0.8	-0.1
Consumption of lowest quintile	31.5	30.8	26.7	28.7	30.0	30.8
Consumption of highest quintile	2.1	-12.5	-18.4	-15.4	-13.6	-12.4

It is apparent from Table 2 that in there is a predominant adverse supply shift in all the bargaining models: the impact of the upward push on wages for competitiveness and GDP dominates the small positive stimulus to goods demand, so that there is a contraction in economic activity (and of course employment always falls further than in the fixed nominal wage case).[20] However, as our earlier analysis implies, the scale of this contraction varies significantly depending upon the response of wage bargaining to the substantial rise in income tax.

Under conventional bargaining workers seek to resist any reduction in their net-of-tax real wage, and while they do not succeed in doing this – the real net of tax wage falls by 9.9% in the long run (although

[20] With a predominant adverse supply shift the nominal gross wage rises in all the bargaining models, but falls in the social wage case. Of course the real take home wage falls in all cases.

this is substantially less than the 13.1% fall in the fixed nominal wage simulation) – their attempt to do so (as reflected in the 13.2% rise in the gross nominal wage) ultimately results in a substantial rise in the unemployment rate by over nine percentage points and a fall in GDP and employment of 8.8% and 9.7% respectively (second column of Table 2). The consumption of the lowest quintile increases by 26.7% while that of the highest income group falls by 18.4%.

Conventional bargaining implies that workers fail to fully value their own UBI payments and, in effect, attempt to increase their personal disposable income. If, instead, workers were persuaded fully to value their own UBI payments in wage bargaining (column 3), the upward pressure on wages is moderated – the gross nominal wage rises by only 6.3% and real take home pay now falls by 11.5% - as is the scale of the adverse supply effect. Ultimately GDP falls by 4.4% and employment by 5.0%. The contraction is further moderated if wage bargainers fully value their entire family's receipts of the CBI (column 4), in which case gross nominal wages rise by 2.4% and the real take home wage falls by 12.4%, with much smaller falls in GDP and employment of 1.7% and 2.1% respectively.

The results of the social wage simulation are very similar to the fixed nominal wage case, but not identical. In fact in the social wage case the nominal gross wage actually falls slightly. As implied by our earlier analysis bargaining focuses on the gross wage in this case, but it is subject to downward pressure because of the slight contraction in labour demand that we observed for the fixed nominal wage case. Accordingly, the positive aggregate demand effect is enhanced in this case by the supply side response, with GDP increasing by 0.2%. Even so, employment continues to fall slightly, by 0.1%, because of the shift in the composition of consumption away from comparatively labour intensive goods. However, note that in this case the real take home wage falls by 13.1%.

The results reported above are achieved only gradually over time. In the short run capital stocks are fixed and it takes time for these to adjust to their new desired levels. As profitability declines capital stocks are gradually reduced. Figure 2 shows the gradual adjustment of GDP to its new long-run level for each of the bargaining models. Figure 3 show the adjustment path of the real take home wage that are a major driver of the overall results. Of course, this is the wage that motivates behaviour only in the conventional bargaining model. In the social wage model it is the real gross wage that motivates wage bargains. The absence of a contraction in economic activity in this case reflects the fact that workers are content to accept a cut in their real take home pay of over 13%, given all the benefits of the CBI. The other models are intermediate cases.

Figure 2. Adjustment path of GDP under alternative models.

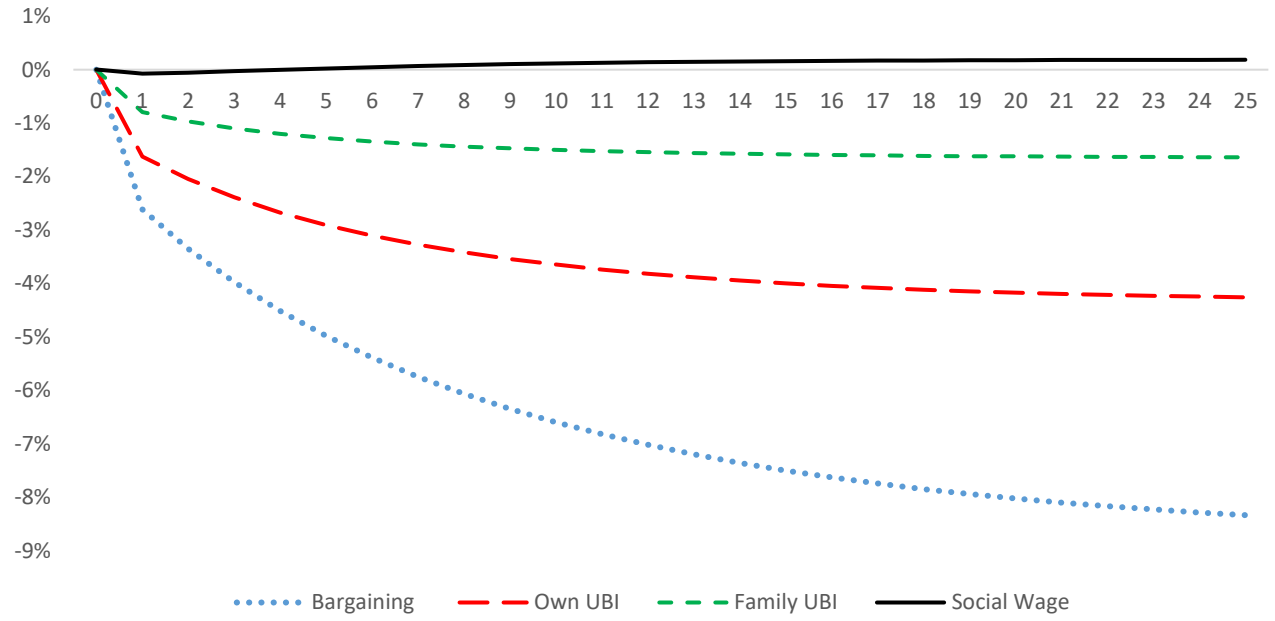
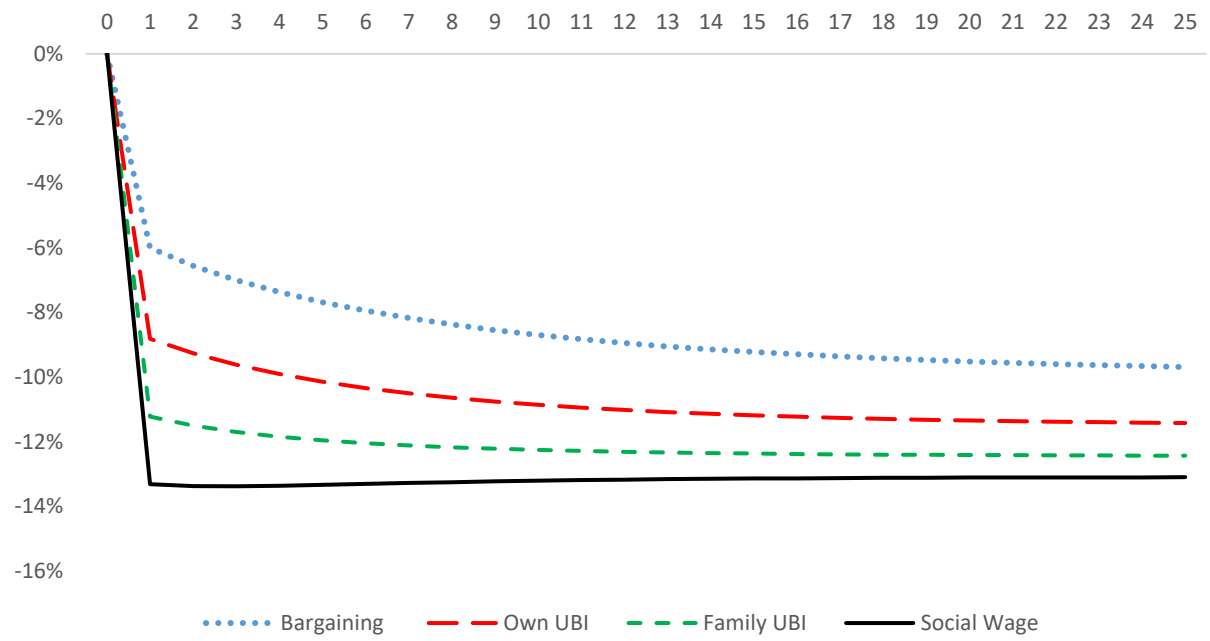


Figure 3. Adjustment path of net of tax real wage under alternative models.



Source: Authors' results

We noted in our ex ante analysis that allowance for migration would tend to exacerbate the scale of any contractionary impact in the labour market on the host regional economy, and the results reported in Table 3 confirm this. In all of the results in Table 2, the unemployment rate rises providing a strong incentive for outmigration that continues until unemployment rates are restored to their original levels, given our assumption of symmetric responses between migrants and workers.[21] Real wages increase as a consequence of this outmigration as, therefore, does the scale of the adverse supply shock.

[21] It is as if labour is perfectly mobile across long-run equilibria. In practice various transactions costs may inhibit the scale of the migration response, although the qualitative changes would be very similar to those reported.

Table 3. The long-run macroeconomic impacts of implementing the UBI across various bargaining models with migration

Results (percentage change from base)	Fixed Nominal wage	Conventional Bargaining	Bargaining adj. for worker's CBI	Bargaining adj. for family's CBI	Social wage
Economic activity (GDP)	0.1	-37.2	-15.2	-5.8	0.1
Employment	-0.1	-38.1	-16.4	-6.5	-0.1
Exports	0.0	-43.3	-18.0	-6.9	0.0
Investment	0.5	-34.2	-13.8	-5.0	0.5
Unemployment rate	0.1	0.0	0.0	0.0	0.0
Nominal gross wage	0.0	83.0	24.5	8.4	0.0
Real take home wage	-13.1	0.0	-7.7	-11.0	-13.1
CPI	0.0	20.7	7.2	2.6	0.0
Population	-0.5	-24.8	-10.7	-4.2	-0.1
Consumption of lowest quintile	30.8	-1.2	23.7	28.1	30.8
Consumption of highest quintile	-12.5	-39.2	-22.8	-16.3	-12.5

In fact, the scale of the additional adverse supply shock in the conventional bargaining case is such that the model fails to find a solution, since in this case migration would need to continue until the real take home wage rate was also restored to its initial level (and recall that it falls by 9.9% in the absence of migration). Even where bargaining and migration fully value individual workers' UBI receipts there is a major further contraction of the economy induced by outmigration: nominal wages increase by 24.5% and real take home wages are driven up relative to the no-migration case (but they still fall by 7.7%) to the point where GDP falls by 15.2% and employment by 16.4%.

Allowance for continuing flow migration would mean that even where bargaining and migration fully value families' CBI receipts, there would again be a significant additional adverse supply shock relative to the case where there is no migration, with GDP falling by 5.8% and employment by 6.5% (and real wages now falling by 11.0%).

When we allow for migration motivated by a social wage, the macroeconomic impacts of the tax-financed UBI become only slightly less favourable than reported in the penultimate column of Table 2 since there is only a small fall in gross wages and rise in unemployment in this case. Accordingly, while

there is still an incentive for outmigration, only a 0.1% loss of population is required to restore the real *gross* wage and unemployment rates to their original levels, and we obtain the results reported in the fifth column of Table 3. GDP rises by only slightly less (0.1% as compared to 0.2%) and employment only falls by 0.2%. In this case workers and migrants are willing to absorb a cut in real take home pay of 13.1% –because of the benefit to their families' incomes and the value they attach to being part of a society with lower poverty and a more equal distribution of income.

Overall, the qualitative pattern of results corresponds to our ex ante analysis, and the UBI always succeeds in effecting a substantial redistribution of income in favour of lower income groups. We find that the stimulus to demand is negligible: the macroeconomic impacts of the redistribution are slightly positive for GDP, but slightly negative for employment. Not surprisingly then, we find that the adverse supply impact typically arising from wage-push effects dominates the weak stimulus to demand – an impact that is reinforced once we allow for migration responses. However, the strength of the adverse supply effect depends critically on the responses of workers and migrants to the significant rise in income tax rates. If workers and migrants are motivated solely by their real take home pay then there are likely to be substantial negative macroeconomic impacts; if transactors are instead driven by a social wage, the impact on macroeconomic activity is likely to be negligible (but positive for GDP).[22]

Other supply-side impacts of UBI

We noted in our literature review section that other supply side impacts have been identified in the literature. The contested impact of benefits on the unemployment rate (and on wage bargaining) led us to the view that the overall net effect is probably negligible and so we do not explore this further here.[23] On the other hand many of the case studies of CBI-type interventions provide qualitative evidence of various improvements in quality of life through, for example, reduced precarity, improved mental health, great capacity for entrepreneurship and for further investment in human capital. These changes would also likely lead ultimately to enhanced labour productivity and improved public finances. However, as previously noted this evidence typically relates to examples where the UBI is either externally financed or where the scale and locus of the intervention is such that its implementation appears costless to UBI recipients. When implementation is, as in this case,

[22] Advocates of modern monetary theory might argue that our emphasis on a funding constraint is misplaced: monetary expansion (under a flexible exchange rate) could be used to fund a UBI provided the economy is at less than full employment. However, Scotland does not have its own currency. Furthermore, the theory appears to be predicated upon a very Keynesian vision of an entirely passive supply side with interest rates at a lower bound. In these circumstances, however, it would be "as if" the UBI was externally funded over a range, its impact would be unambiguously expansionary and all household groups would benefit. (Fraser of Allander Institute et al, 2020, Section 4.)

[23] See Fraser of Allander et al (2020), Annex E.

accompanied by substantial tax rises at least a subset of these impacts are subject to countervailing forces.

Nevertheless, it is interesting to explore what scale of labour productivity stimuli would be required to offset any adverse macroeconomic consequences of an income-tax-financed UBI. For example, it would take a 3.8% rise in labour productivity to offset the 4.4% decline in GDP associated with the case where workers take account of their own CBI payments (and there is no migration). Of course, in the context of the social wage such a stimulus to productivity would significantly enhance the slight expansion in economic activity that this case already implies. Again, the required scale of any productivity enhancement is governed by behavioural responses to the UBI and the associated tax changes.

6. Conclusions

This introduction of a UBI at scale would represent a radical policy innovation, but it is one for which public support in Scotland and Europe is, partly in response to the severe economic impacts of policy responses to COVID-19, now substantial. However, the macroeconomic impacts of a UBI have rarely been analysed. Many past studies of UBI-type policies have considered comparatively small-scale, targeted interventions that are unlikely to have significant macroeconomic effects and in which recipients of the new benefit effectively bear none of its costs. Our focus here, in contrast, is on the implementation of a substantial, permanent, and unconditional UBI paid to citizens of the host region, that is fiscally neutral - funded by a significant rise in income tax. Macroeconomic impacts are therefore very likely to occur and to reflect behavioural responses to the rise in taxes as well as to the receipt of benefits. Questionnaire evidence revealing very positive public attitudes to a UBI typically do not include any indication of the rise in taxation that would be required to fund it.

We find that, across all of the scenarios that we explore, the introduction of a UBI has a major redistributive impact, with the incomes and consumption of high-income households falling and those of low-income households rising. In this sense, achievement of one of the major objectives of the introduction of the UBI seems assured.

However, this redistribution does drive substantial macroeconomic effects. We find that the income-tax-financed UBI has a rather modest overall impact on demand: the stimulus from the increase in the consumption of lower income households is nearly matched by the contractionary impact of the fall in higher income households' expenditure. Furthermore, the redistribution is accompanied by a substantial cut (of over 13%) in the real take-home wage, reflecting the scale of the tax rises required to finance the UBI. Crucial to the final impact of the UBI therefore is the nature and extent of both workers' and migrants' responses to this fall in the net of tax real wage.

In the conventional bargaining model workers' focus on the net of tax real wage so that they respond to the CBI by attempting to restore the initial value of this wage. We find that the resultant "wage push" effect dominates the modest demand stimulus associated with the UBI and generates a substantial contraction in GDP and employment. In a regional context the negative effects would be further reinforced by potential net outflows of migrants, which would reduce labour supply and lead to a further contraction in economic activity.[24]

If, alternatively, workers (and migrants) fully valued their own UBI payments the wage push effect is moderated: workers "only" seek to restore their personal disposable incomes. The effect would be further limited if workers were to fully value their families' receipts of CBI in the bargaining process. However, there nevertheless remains a trade-off between a more equal distribution of income on the one hand and economic activity/ growth on the other.

In the limiting "social wage" case it is as if workers (and migrants) value UBI payments irrespective of to whom they are paid. In this case workers value the reduction in poverty and inequality and are prepared to help pay for that through higher taxes. Workers (and migrants) are content to accept the substantial reduction in their real take home wage in return for their own and their families' CBI receipts and reduced inequality and poverty. In this case the wage push effect is nullified and the modest demand effect stimulates economic activity slightly. The trade-off between equity and growth is no longer significant; there is the potential for a policy "double dividend" of greater equity and economic activity.[25] Future research should explore the extent to which the trade-off between equity and growth is sensitive to the composition of taxes used to ensure a balanced budget implementation of a UBI.[26]

A range of UBI-type studies finds qualitative evidence of other beneficial, supply-side effects that could impact the economy, for example, through reduced precarity, improved mental health, and the possibility of freeing people to improve their human capital or engage in entrepreneurial activity. This could lead to a long-term stimulus to productivity and potential savings for public sector budgets. However, there is currently little or no indication of the likely scale of such effects and, in general, there is even ambiguity about the direction of some effects when taxes have to rise to finance the UBI. Further research into the scale (and direction) of these potential transmission mechanisms would be required to facilitate a comprehensive assessment of the overall macroeconomic impacts of a UBI.

[24] Matters may be made worse still by the progressivity of the income tax system; the incentives for higher wage earners to outmigration may be significantly greater than for lower wage earners.

[25] This potential would almost certainly be realised under the macroeconomic circumstances presumed by Modern Monetary Theory.

[26] While our analysis is developed for a regional economy that is part of a much bigger national economy, much of it is also applicable to nations that are considering the introduction of a fiscally-neutral UBI.

However, it seems likely that these effects would need to be substantial to minimise the extent of any adverse impact on the size of the host economy, unless policymakers succeed in securing a social contract that dampens or eliminates "wage push" responses to the introduction of a UBI.[27]

[27] Of course, some may consider a smaller economy a reasonable price to pay for a fairer economy, but this presumably would depend on the scale of (comparative) shrinkage. There may also be some benefits in terms of reduced carbon emissions, although low income households' consumption is typically quite emissions-intensive, which may limit any gains.

References

Allan G, Lecca P, McGregor P, et al. (2014) The economic and environmental impact of a carbon tax for Scotland: A computable general equilibrium analysis. *Ecological Economics* 100: 40–50.

Armington P (1969) A theory of demand for products distinguished by place of production. *IMF economic review* 16(1): 159–178.

Corlett A (2019) *The shifting shape of UK tax Charting the changing size and shape of the UK tax system*. Available at: https://www.resolutionfoundation.org/app/uploads/2019/11/The-shifting-shape-of-UK-tax.pdf.

Emery JCH, Fleisch C and Mcintyre L (2013) How a Guaranteed Annual Income Could Put Food Banks Out of Business. *The School of Public Policy Publications* 6(37): 1–21. DOI: 10.11575/sppp.v6i0.42452.

Figus G, Lisenkova K, McGregor P, et al. (2018) The long-term economic implications of Brexit for Scotland: An interregional analysis. *Papers in Regional Science* 97(1): 91–115. DOI: 10.1111/pirs.12349.

Gibson M, Hearty W and Craig P (2018) Potential effects of universal basic income: a scoping review of evidence on impacts and study characteristics. *The Lancet* 392(September): S36. DOI: 10.1016/s0140-6736(18)32083-x.

Harrigan F, McGregor PG, Dourmashkin N, et al. (1991) AMOS. A macro-micro model of Scotland. *Economic Modelling* 8(4): 424–479. DOI: 10.1016/0264-9993(91)90028-M.

Jorgenson, Dale W (1963) Capital Theory and Investment Behavior. *American Economic Association* 53(2): 247–259.

Mackenzie J, Mathers S, Mawdsley G, et al. (2016) *Basic Income Guarantee*. DOI: 10.1057/9781137471338_1.

Marinescu IE (2018) No strings attached: The behavioral effects of U.S unconditional cash transfer program. *Nber Working Paper Series* 24337: 1–20. Available at: http://www.nber.org/papers/w24337.

Martinelli L (2017) *Assessing the Case for a Universal Basic Income in the UK*. *IPR policy brief*. Available at: http://www.bath.ac.uk/publications/assessing-the-case-for-a-universal-basic-income-in-the-uk/attachments/basic_income_policy_brief.pdf.

Nikiforos M, Steinbaum M and Gernnaro Z (2017) *Macroeconomic effects of a universal basic*

income. Available at: https://rooseveltinstitute.org/wp-content/uploads/2017/08/Modeling-the-Macroeconomic-Effects-of-a-Universal-Basic-Income.pdf.

Painter A, Cooke J, Burbidge I, et al. (2019) *A Basic Income for Scotland*. Available at: https://www.thersa.org/globalassets/pdfs/rsa-a-basic-income-for-scotland.pdf.

PWBM (2018) *Options for Universal Basic Income : Dynamic Modeling*. Available at: http://budgetmodel.wharton.upenn.edu/issues/2018/3/29/options-for-universal-basic-income-dynamic-modeling.

Thurlow J (2002) Can South Africa become Africa's first welfare State. *TMD dicussion paper* (101). Available at: https://www.mdpi.com/2071-1050/12/1/45/htm.

Tiebout, C. (1956). "A Pure Theory of Local Expenditure", *Journal of Political Economy*, vol. 64, pp. 416-214