The macroeconomic effects of a UBI: A review of existing evidence and approaches

Abstract

Research on UBI has blossomed in recent years, with a particular focus on conducting experiments with policies that share features with a UBI, microsimulation analysis and public opinion surveys. However, a common drawback with many of these approaches is the difficulty with examining 'general equilibrium' or 'community' effects. Macroeconomic modelling is one tool used to explore these more difficult questions of what would happen if a UBI was implemented at the national level. In this paper, a review of existing analysis of the macroeconomic effects of a UBI offers an insight into the assumptions, approaches and results of these studies and how these are interlinked. Recommendations are made to increase the diversity of models used and the mechanisms and contexts explored.

Introduction

The idea of providing an unconditional income to every individual in a political community has made an impressive impact on the global policy debate since 2015, when Switzerland held a national referendum on a universal basic income (UBI) and the national government in Finland and several Dutch municipalities announced plans for basic income experiments. While there have been no more referendums, experimentation with UBI – or more accurately experimentation with policies that share common features with a UBI – has continued across the world, with new experiments or pilots seemingly announced every year. Although there are clearly broader political motivations for these projects (Chrisp & De Wispelaere, 2022), much focus remains on what the results from these randomised control trials (RCTs) tell us about the likely effects of a UBI. Alongside microsimulation studies that examine the costs and distributional consequences of different schemes, these field experiments have been at the forefront of new academic research into UBI. Torry (2020) also identifies these as two of the main three areas of research development for the future[1].

However, there are several well-rehearsed problems with these field experiments, including 'Hawthorne' effects[2], the inability to capture long-term effects and the difficulty of rationalising the evidence provided by very different models of basic income tested in heterogenous contexts (Widerquist, 2018). The experiments in OECD countries have not tested a UBI as we would commonly define it and mostly target low-income households, so at best we can infer information about the effects of providing more money or removing various forms of conditionality within the benefit system (Chrisp et al. 2022). Widerquist (2018) also notes the issue of the 'streetlight effect', where experiments neglect the thorniest questions about the impact of a UBI because they are too hard to measure. One set of thorny questions regards community or 'general equilibrium' effects: RCTs analyse the individual-level effects of an intervention but tell us very little about how individuals will interact with each other when *everyone* is receiving a UBI. For example, employers

[1] Analysis of public opinion being the third.
[2] This is the problem that participants in experiments are likely to change their behaviour when they know they are being observed.

may increase wages if workers in general are less inclined to work, more people may withdraw from the labour market if they see neighbours doing so or an increase in income for all low-income households may simply lead to higher prices or rents.

RCTs may, therefore, be ignoring the most important effects of a UBI that render any of the measured individual-level effects imprecise at best. This issue also afflicts static microsimulation analysis given it also assumes no community effects or behavioural responses and thus makes any calculation of costs and distributional consequences incomplete. For example, if a UBI leads to 20% of the labour force moving to non-employment, the costs of the policy will increase considerably. But this in turn may be reduced by an increase in wages and consumption from the intervention. These dynamics are one of the reasons why understanding the community or *macroeconomic* effects of a UBI is so important and a serious gap in existing research.

One way of approaching this question is simulating the impact of a UBI using macroeconomic models. This provides a holistic means of analysing its effects, incorporating both the impact of the benefit and the method of funding, as well as the interaction between individuals (agents), although the absence of real-life examples heightens the extent to which analysis relies on assumptions about the most relevant factors to consider. Nevertheless, the purpose of this paper is to summarise the state of the literature as it stands and to identify the assumptions inherent in the different ways that authors approach the question. It also serves as a call for more interrogation of the macro-effects of a UBI and for macroeconomic modelling to form another branch of the emerging UBI research agenda.

The paper proceeds as follows. First, the paper examines the broader evidence base for the likely effects of a UBI on key variables of interest such as labour supply, wages, inflation and so on. Second, a summary of recent trends in macroeconomic modelling since the financial crisis serves provides an indication of the central debates within the field. Finally, the main existing examples of attempts to model the impact of a UBI using macroeconomic models are discussed and compared.

What are the likely effects of a UBI?

While the history of UBI is rooted in philosophical and normative debates about rights, freedom, reciprocity and equality that at least partially abstract from the *effect* of a UBI (Van Parijs, 1992; White, 2003; Bidadanure, 2019), most arguments for the policy rely on a ‘pragmatic’ view of its capacity to achieve certain outcomes (Barry, 1996). Interestingly though, as the case for a UBI has been made based from a huge variety of perspectives, two (partly connected) issues beset theoretical arguments about the effects of a UBI.

First, even from the perspective of advocates, the expected effect of a UBI can be contradictory. This is most notably the case when distinguishing between ‘productivist’ and ‘post-productivist’ perspectives. On the productivist side, a UBI is expected to reduce marginal effective rates of taxation to incentivise employment (Van Parijs & Vanderborght, 2017), stimulate consumption (and GDP) through a fiscal stimulus and redistribution to households with a greater propensity to consume (Crocker, 2020) and facilitate greater risk-taking, creativity or entrepreneurial activity (Painter and Thoung, 2015). However, from a post-productivist perspective, a UBI is argued to provide an ‘exit option’ to households to withdraw from the labour market and increase their bargaining power (Wright, 2004), facilitate a process of ‘degrowth’ and reduce consumption (Fitzpatrick, 1999) and increase time spent on unpaid or poorly remunerated activities (Offe, 1992). Although these do not need to be entirely contradictory if different individuals are responding in different ways, at an aggregate level there must be either a net positive or net negative impact on outcomes such as employment, consumption and wages.

Second, a UBI can look extremely different depending on the design of the policy and the context, which makes general statements about the impact of UBI difficult to sustain. As Barry (2001, p. 63) points out: “Asking about the pros or cons of basic income as such is rather like asking about the pros and cons of keeping a feline as a pet without distinguishing between a tiger and a tabby". A 'tiger-sized' UBI funded through redistributive income taxation is unlikely to have the same effect as a 'tabby-sized' UBI funded through sovereign money. Similarly, providing a UBI in a country where there is no social security system will be very different to one in which the benefit system has expanded and evolved over more than 70 years.

Although the second issue is harder to resolve conclusively, it is helpful that the level of attention that UBI has attracted in recent years has come with a greater degree of scrutiny as to the empirical evidence on various social and economic outcomes. Outcomes of interest for researchers have included UBI's effects on poverty, consumption, savings, investment, production, employment, wages, women's empowerment, education, healthcare access, health, and civic participation (Gibson et al., 2018; Hasdell, 2020). The data for these analyses have come from existing policies or experiments that resemble UBI (unconditional cash transfers, means-tested income guarantees or earned income tax credits), resource dividends or the receipt of cash from other sources such as lottery winnings.

Among these outcomes of interest, UBI's effect on labour market participation – both at the extensive (the employment rate) and intensive margin (hours worked) – has attracted the most attention and research. Neo-classical economic theory suggests that there will be both an income and a substitution effect from the introduction of a UBI. Models of labour-leisure choice derived from individual utility functions indicate that an increase in disposable income induces an individual to consume more leisure and work less (income effect), while an increase in marginal rates of tax also reduces work hours (substitution effect). However, whether individuals see an increase or decrease in their disposable income, and whether they face higher or lower marginal rates, depends on the specific basic income scheme and what it replaces. Indeed, as stated above, one of the main justifications for a UBI is that it is assumed to lower marginal effective tax rates for benefit recipients relative to existing benefit systems. The size of the effects will also depend on estimated income and substitution elasticities, which are usually derived from existing empirical evidence on the labour supply response to benefit levels, taxes and wages (Blundell and Macurdy, 1999; Hoynes and Rothstein, 2018). This micro-level framework also typically provides the basis of macroeconomic modelling, which we return to in the following two sections.

Experimental data from RCTs and lotteries offers more evidence as to the effect of a UBI on labour supply. Between 1968 and 1980, the US government conducted four negative income tax experiments across different states, while the Canadian government conducted one in Manitoba between 1975 and 1978. In all five experiments, the results showed a reduction in work hours in the treatment group, particularly among mothers (Widerquist, 2005; Calnitsky and Latner, 2017). Evidence from lottery winners further supported this finding (Imbens et al., 2001; Cesarini et al., 2017), although at least one study has found insignificant effects (Marx and Peeters, 2008). Results from the 2017-18 Finnish basic income experiment also showed no overall effect on labour supply of the unemployed target group (Kangas et al., 2019).

However, in these studies, both the theory and evidence focused on individual-level behavioural responses and ignored 'general equilibrium' or community effects that may counter this initial disincentive effect. For example, 'saturation site' basic income experiments that have been conducted in developing countries, such as Nambia and India, have shown that the policy can increase economic activity (Haarmann et al., 2009; Davala et al., 2015). One obvious counteracting mechanism would be that employers increase wages to attract more workers that are otherwise marginally disincentivised from working with UBI facilitating this by providing a stimulus to household consumption.

This is effectively the finding of Jones & Marinescu (2022) in their study of the Alaskan Permanent Fund dividend. As a universal payment provided to every individual resident in Alaska, the dividend arguably comes closest to an existing example of a UBI[3]. They identified no overall effect on employment at the extensive margin, due to a positive general equilibrium effect (i.e. an increase in aggregate demand) cancelling out an initial disincentive to work (negative income effect), although part-time employment (intensive margin) increased by 1.8%. The next closest policy to a UBI implemented at the national level was in Iran where various goods subsidies, notably for fuel, were converted to a cash payment to all households. In an analysis of household panel data, Salehi-Isfahani and Mostafazi-Dehzooei (2018) find no significant negative labour supply effect, either at the intensive or extensive margin, while women and self-employed men appear to work more. One caveat to these examples is the lack of substitution effects: none of the UBI schemes are funded through income taxation and thus do not tell us about how this would affect labour market participation.

Compared to the data on employment effects, analysis of UBI's impact on inflation and wages is limited. Partly this is because these are fundamentally general equilibrium effects: it is not really possible to investigate these effects in an RCT unless it is in a saturation site. The main evidence from the Iranian case, which shows extremely high levels of inflation, is also hard to disentangle the effects of sanctions applied to the Iranian economy at the same time. In Manitoba, Calnitsky (2020) finds an increase in wages at the lower end of the income distribution consistent with these general equilibrium effects.

Empirical evidence regarding the effect of a UBI on women's empowerment, education, health and civic participation is generally positive in the sense that it improves outcomes, but the evidence for this is usually found in low-income countries (Gibson et al. 2018; Banerjee et al. 2019). The findings from studies in high-income countries are more tentative (Chrisp et al. 2022), albeit with more recent evidence that punitive conditionality has detrimental impacts on benefit recipients' health (Pattaro et al., 2022). Nevertheless, clearly a healthier population with more investment in skills and education would also have several positive knock-on effects on macroeconomic outcomes (see e.g. Akee et al., 2010).

However, apart from the Alaskan case and to some extent the Iranian example[4], there are no other 'real-world' empirical cases to analyse for the (macro-level) effects of a UBI. In particular, there is a significant absence of data on the effect of a UBI on outcomes such as inflation, wages and GDP. The evidence from these limited cases also do not tell us what the effect of introducing taxation to fund a UBI would be. In most contexts outside of resource-rich regions, this would be a necessary part of a UBI implementation process. This provides the motivation for the use of existing macroeconomic modelling techniques to estimate the effects of a UBI, using more general indicators of the relationship between key micro- and macro-economic variables. The next section examines some of the recent debates that have dominated the field of macroeconomics in the last 15 or so years to give a sense of how and why the macroeconomic studies of UBI differ.

Recent debates in macro-modelling

Although debates about the best way to conduct macroeconomic modelling have existed for over 75 years (Hall et al., 2013), the financial crisis was something of a watershed moment for economists and macroeconomics specifically. The failure among most mainstream economists to predict the crisis, or at least to identify the trends that were increasing the risk of such an event, raised concerns that the principal macro models were flawed. The main object of scrutiny were Dynamic Stochastic General Equilibrium (DSGE) models, which had become the most prominent models in macroeconomic analysis since the 1980s. The rise of DSGE models was in turn a response to the perceived failure of prior macroeconomic modelling to predict and explain the stagflation of the 1970s, as well as the Lucas critique that the parameters of these models were not structural, i.e. policy invariant. However,

[3] Though there are plenty of advocates who argue it falls far short of a UBI (Zelleke)
[4] And arguably experiments in saturation sites where community effects can be observed

the response to this crisis has not been to reject DSGE models in favour of new approaches even if there is wide acceptance that a more heterogenous set of macro-modelling approaches should be used, particularly if tailored to specific needs.

While there is a myriad of types of DSGE models, they share several key features. Responding to the Lucas critique, DSGE models are formally derived from the micro-foundations of households, firms and governments optimising their behaviour in response to utility functions, maximising profit and balancing the budget respectively. Typically, it is assumed that there is perfect competition in all markets, no informational asymmetry and rational expectations of economic agents, but that certain frictions exist such as distortionary taxes and adjustment costs. As many critiques point out, the central assumptions are 'unappealing' (Blanchard, 2018), not least the assumed infinite foresight of consumers, and not convincing empirically. But defenders of their use assert that no other models alone can do all the jobs required of macro-modelling. Blanchard (2018), for example, identifies 5 types of macro models that can serve different purposes for researchers and practitioners.

For the sake of conciseness and with the primary aim of conceptualising the different ways of modelling a UBI, Wren-Lewis's (2020) stylised categorisation of macro-models along two dimensions, which responds to Blanchard, is useful. Wren-Lewis distinguishes models based on:

1) Theoretical consistency (as opposed to being data-driven)
2) Complexity

DGSE models can be more or less complex, depending on how many frictions, heterogenous agents and other complicating factors are added, but they are very much theoretically consistent as opposed to data-driven. The simplest general equilibrium models are labelled 'foundational models' by both Wren Lewis and Blanchard, which includes the basic overlapping generations model.

On the other end of the spectrum are forecasting models that are data-driven with either no theoretical constraints, in the case of VAR (vector autoregressive) models, or some theoretical considerations that form a part of the modelling, as in the case of SEMs (structural econometric models). The most complex SEM-style approaches are agent-based models, while Wren-Lewis cites the IS-LM model for aggregate supply and demand that undergraduates learn in macroeconomics as a simple 'toy' model equivalent of an SEM.

It is these fundamental distinctions that help to categorise the different approaches reviewed in the next section and to contextualise the outcomes that the macromodelling predicts.

Modelling a UBI: a review

Nine published studies were found that use macroeconomic modelling to estimate the effects of a UBI. The first included was from 2016 and there are two published in 2022. Table 1 shows the main set of characteristics and results of the studies: the UBI schemes used, the modelling framework, labour supply inputs, other inputs and reported outcomes.

The types of models used to analyse the macroeconomic effects of a UBI can be divided into two (or three) broad categories based primarily on the distinction between theoretically consistent and data-driven models. First, the majority of the papers (6/9) use general equilibrium models that are derived from micro-foundations. The parameters of these models are calibrated to match empirical evidence on, for example, substitution effects, savings elasticity or earnings distributions determined by idiosyncratic shocks to productivity. Markets are usually incomplete due to e.g. borrowing constraints but they clear (by definition). Despite these consistencies in the broader framework, there are important differences in the key features of the models that the authors seek to emphasise: Ludivice (2019) includes childcare costs, Daruich & Fernandez (2020) include intergenerational linkages and skill formation, Conesa, Li & Li (2021) include an element of innate ability/productivity and consumption heterogeneity and Jaimovich et al. (2022) include job search frictions and insurance. There are also other smaller differences in the definition of parameters and optimisation functions.

The Fraser of Allender Institute study is distinct in that it uses a Computable General Equilibrium (CGE) model used by Scottish Government, which includes various sectoral-level variables and detailed household types. It is therefore both more complex and more data-driven than the other general equilibrium models. However, it is also internally consistent with basic economic theory of the rational behaviour of economic agents.

The second set of models are data-driven in that they incorporate macro-level and/or sectoral-level variables and the relationships between them econometrically estimated based on historical data. The model used in the Roosevelt Institute study is simpler in that it only includes aggregate or macro-level variables and it is Stock-Flow consistent. The Cambridge Econometrics (E3ME) model is more complex in that it includes sectoral-level variables and household types, while also deriving its parameters econometrically from past data. These models explicitly do not assume a steady-state equilibrium or that the economy is at or near full capacity, which also provides an important distinction with the other models.

As with the difficulty of interpreting results from field experiments in heterogeneous contexts and policy designs, macroeconomic analysis of a UBI also depends on the specific features of a basic income policy. The crucial variables in this regard include the level of the payment and the means of funding it. Across the different studies, the main options for financing include: (1) income/payroll tax (or simply a tax on households); (2) consumption tax; (3) the removal of existing transfers; (4) government debt; (5) exogenous input of new external resources (e.g. sovereign wealth fund); (6) sovereign money (i.e. central bank financing); or (7) some combination of these options. The size of the UBI payment varies from $1000/year to $12,000/year. All nine studies include at least two different schemes or modulations. In the main table all UBI values are recalculated to indicate a yearly amount.

However, on the whole, the macro-model used appears to be more important for determining the estimated outcomes than the type of basic income scheme. For example, in the Roosevelt Institute paper (Nikoforis et al., 2017) and Cambridge Econometrics paper (Komuves et al. 2022), the main macroeconomic outcomes are positive regardless of whether funded by taxes on income, government debt or sovereign money. Meanwhile, the Penn Wharton model (2018) produces negative results across all four UBI schemes regardless of the level and funding mechanism. There is more variation in the general equilibrium models with some schemes increasing economic activity while others decrease GDP and employment, although the reasons for the positive effects of a UBI are not usually in accordance with the primary motivation of most advocates to support UBI as we discuss below. The Fraser of Allender Institute paper indicates mostly negative outcomes unless you assume there are no supply side effects, due to for example external financing. In most of the papers, the size of the payment does not seem to change the direction of the effect unless other aspects of the model or intervention are also changed, although this is rarely pertinent given the increases in UBI do tend to require changes in taxation.

It is helpful that while the models themselves are sophisticated (and both theoretically and empirically founded), the mechanisms by which UBI affect the macroeconomy are relatively straightforward to explain, partly because the intervention itself – giving households more income and increasing taxes elsewhere – is quite straightforward. And despite the parameters being largely based on existing evidence on the relationship between given variables, the assumptions behind which variables should be included in the model and other crucial assumptions often determine the results of the macro modelling.

What are the main drivers of positive outcomes in the models?

In the general equilibrium models, most of the stimulation to economic activity occurs because of the *removal* of existing benefits or taxation and the comparatively low rates of UBI and taxation to replace it. At a certain point, the higher level of UBI and taxation acts as a brake on economic activity and employment, GDP and so on fall. There is also a bit of a contradiction in the general equilibrium models in that welfare ('Consumption equivalent variant') often increases when economic activity is reduced and vice versa. Thus, for the UBI schemes that stimulate growth, this is effectively off the back of making households, and particularly low-income or low-skilled households worse off. On the other hand, the so-called 'optimal' NIT scheme in Lopez-Danieri (2016) from the perspective of maximising welfare reduces GDP by 9.4%, which seems equally unlikely to be a trade-off appealing to policymakers, at least in the short-term. The replacement of income taxes with progressive consumption taxes in the Conesa et al. (2020) paper is also a key driver of the positive outcomes there.

In the Fraser of Allender, Roosevelt Institute and Cambridge Econometrics papers, the main mechanism is the demand-side: increased consumption from an injection and/or redistribution of household income, which stimulates economic activity. In the Fraser of Allender multi-sectoral model, however, the redistributive impact is more ambiguous as changes in the *composition* of consumption can affect the capital- and value-added intensity of consumption beyond simply the marginal propensity to consume across income groups. The high import-intensity (from a value-added perspective) of the consumption of the lowest quintile means that the tax-financed UBI has negligible overall impact on demand. They indicate this by showing the greater stimulative effect a UBI would have if the lowest quintile had the same consumption profile as the second quintile.

The negative mechanisms, on the other hand, mostly come from either an income effect to labour supply or negative effects from the taxation required to fund the UBI, whether labour supply substitution effects (if income tax), reduced private investment (if government debt) and so on. In the Penn Wharton model, higher government debt leads to higher expected future interest rates dampening consumption (and increasing saving). However, if there is a relatively inelastic household response to a change in interest rates, government debt will also 'crowd out' private investment as savings are channelled to the former. This in turn slows economic growth and is why the deficit funded UBI leads to the worst outcomes. However, even the small externally resourced 'Alaska'-like UBI scheme reduces GDP, employment and capital services from the income effect of a new payment. Jaimovich et al. (2022) also cite a negative impact on economic activity from an 'insurance' effect.

The Fraser and Allender model includes a number of other feedback effect mechanisms as part of its analysis of a macro-macro interaction such as bargaining over the net wage in response to increased taxation, which reduces competitiveness and GDP, and outward migration, which further reduces GDP (but less so GDP per capita) in the models. The bargaining response, which produces a negative impact on economic activity, can be mitigated if we assume workers fully value their UBI payments as part of their wage or even more so if they value the UBI redistributed to fellow citizens as part of a social wage. However, of course this means accepting permanently lower real take home wages. This approach in particular is a good example of transparently weighing up multiple possible assumptions and mechanisms by which UBI is likely to affect the macroeconomy.

Study	UBI schemes	Modelling framework	Labour supply inputs	Other inputs	Main outcomes reported
Lopez-Daneri (2016)	*4 schemes* 1. Low $1330/year (2.5% of GDP in transfers) with a 10% tax/withdrawal rate 2. Medium $2660/year (5% of GDP in transfers) with a 13% tax/withdrawal rate 3. 'Optimal NIT' $5800/year (11% of GDP in transfers) with a 22% tax/withdrawal rate 4. 'Popular NIT' $4745/year (9% of GDP in transfers) with a 19% tax/withdrawal rate All replacing existing transfers and prior federal income tax	General equilibrium model - Life-cycle economy (overlapping generations) - Idiosyncratic shocks to productivity - Incomplete markets	Endogenously determined - Frisch elasticity (intertemporal substitution) = 1 - Disutility of labour calibrated so that average working time = 1/3	Model calibration includes: - Demographics (agents born at 25, survival probability, 1.09% population growth from US data) - Discount factor 0.9825 to target a capital-output ratio of 2.93 (US average 1960-2007) - Capital share 0.35, growth rate 2.22% (US average 1960-2007) - Depreciation rate 4% to match investment-output ratio as 21.38% - Calibrate taxes and transfers for income quintiles using Congressional Budget Office data for 2000 - Earnings determined by age (Current Population Survey) and idiosyncratic permanent, temporary and persistent shocks	<u>Low NIT</u> GDP +18.1%; capital stock +44.6% increase; labour supply +5.9%; labour hours +7%; savings rate +22.5%; welfare transfers +113.1%; 'Consumption equivalent variation' (i.e. welfare) -2%
					<u>Medium NIT</u> GDP +10.9%; capital stock +25.5%; labor supply +3.8%; labour hours +3.2%; savings rate +13.1%; welfare transfers +126.3%; 'Consumption equivalent variation' -0.2%
					<u>'Optimal' NIT</u> GDP -9.4%; capital stock -21.5%; labour supply -2.2%; labour hours -6.8%; savings rate -13.3%; welfare transfers -397.8%; 'Consumption equivalent variation' +2.1%
					<u>'Popular' NIT</u> GDP -2%; capital stock -5.8%; labour supply +0.1%; labour hours -3.3%; savings rate +3.8%; welfare transfers +307.3%; 'Consumption equivalent variation' +1.7%
Roosevelt Institute (Nikiforos, Steinbaum & Zezza, 2017)	*6 schemes* 1. High $12,000/year to all adults 2. Medium $6,000/year to all adults 3. Child $3,000/year for children <16 (1.1% GDP) Each scheme is funded by either (a) government debt or (b) taxes on households	Levy Institute Macro-Econometric Model - Aggregates only - Keynesian - Stock-Flow consistent - Household & corporate sector debt - No aggregate production function	Assumption that there are no micro-level income or substitution effects on labour supply	Redistribution leads to increase in aggregate household consumption due to higher marginal propensity to consume of lower income quintiles. Inputted off-model as household sector is treated as a whole	<u>High UBI</u> (all effects level off after eight years) GDP +13.1% (deficit financing) & +2.62% (tax-funded); price level +3.77% (deficit) & +0.56% (tax); nominal wages +5.23% (deficit) & +0.51% (tax); government deficit +9.11% (deficit) & -1.39 (tax); employment rate +2.11% (deficit) & +0.31% (tax)
					<u>Medium UBI</u> (all effects level off after eight years) GDP +6.79% (deficit) & +1.65% (tax); price level +2.02% (deficit) & +0.37% (tax); nominal wages +2.8% (deficit) & +0.37% (tax); government deficit +4.61% (deficit) & -0.78% (tax); employment +1.12% (deficit) & +0.21% (tax)
					<u>Child UBI</u> (all effects level off after eight years) GDP +0.84% (deficit) & +0.27% (tax); price level +0.26% (deficit) & +0.06% (tax); nominal wages +0.35% (deficit) & +0.06% (tax); government deficit +0.52% (deficit) & -0.08% (tax); employment +0.12% (deficit) & +0.04% (tax)

Penn Wharton (PWBM, 2018)	*4 schemes* 1. 'Alaska' $1,100/year to all adults funded by external resources (ala Alaska Permanent Fund) 2. $6,000/year to all adults Funded by either (a) government debt (b) payroll tax (c) external resources	Penn Wharton Budget Model - Dynamic general equilibrium model - Overlapping generations - Incomplete markets - Idiosyncratic productivity shocks - Households vary by age, income, technology, skills and wealth	Endogenously determined – Not explicitly stated but the model has alternative labour supply elasticity parameters choices of, 0.25, 0.50, 0.75, and 1.0	Saving elasticity centred at 0.65; also has alternative parameter choices of 0.25, 0.50, 0.75, and 1.0.	'Alaska' GDP -0.8% in 2027 & 2032; hours worked -1.3% in 2027 & 2032; total household compensation -0.8% in 2027 & 2032; capital services -0.7% in 2027 & -0.9% in 2032 $6k deficit-funded GDP -6.1% in 2027 & -9.3% in 2032; hours worked -5.6% in 2027 & -6.7% in 2032; capital services -11% in 2027 & -18% in 2032; debt +63.5% in 2027 & +81.1% in 2032; total revenue -8% in 2027 & -11.7% in 2032 $6k payroll tax GDP -1.7% in 2027 & 2032; hours worked -3.2% in 2027 & 2032; capital services -1.3% in 2027 & 2032; debt -0.1% in 2027 & -1% in 2032; total revenue +56.1% in 2027 & +55.4% in 2032 $6k external resources GDP -3.4% in 2027 & -3.7% in 2032; hours worked -5.8% in 2027 & -5.9% in 2032; capital services -3.1% & -3.9%; debt +5.7% in 2027 & +7.5% in 2032; total revenue -6.1% in 2027 & -6.4% in 2032
Luduvice (2019)	*2 schemes* 1. Replace all Income Security with a UBI and fund any subsequent deficit with consumption taxes 2. 'Yang' $12,000/year to all households funded by 22pp increase in tax on consumption	General equilibrium model - Overlapping generations - Incomplete markets - Human capital accumulation - Childcare costs	Endogenously determined - Frisch elasticity (intertemporal substitution) = 1 - Disutility of labour and commuting costs calibrated so that average working time = 1/3 & employment rate = 70%	Model calibration includes: - Discount factor 0.981 to target a capital-output ratio of 2.9 - 1.1% population growth - 30% of pop. with children - Childcare costs 11% of average income - Capital share 0.35 - Earnings Gini 0.44 - Human capital depreciation 1.5%, capital depreciation 7.8% (calibrated so that steady-state real interest rate is 4%) - Social Security tax = 10.61% so replacement rate is 36%	UBI replacement GDP +5.2%; physical capital +10.7%; labour +2.3%; consumption +3.2%; human capital -0.1%; labour hours +1.3pp; employment rate -0.7pp; wage rate +0.032pp; interest rate -0.006pp; earnings Gini +0.04pp; wealth Gini +0.08pp; CEV (welfare) steady state -0.14% (low ability -0.178%; high ability +0.039%) Yang UBI GDP -13.1%; physical capital -8.3%; labour -16.6%; consumption -11.3%; human capital -7.1%; labour hours -9.2pp; employment rate -22.1pp; wage rate +0.038pp; interest rate -0.007pp; earnings Gini +0.11pp; wealth Gini +0.10pp; CEV steady-state +0.08% (low ability +0.08%; high ability +0.002%)

Fraser of Allander Institute (2020)	'Low-level' UBI £4396.08/year for 0-19 year olds; £3,010.80/year for 20-24 year olds; £3801.20/year for 25-State Pension age; £8,476/year for pensioners, replacing benefits other than housing and childcare related, removal of tax allowance and +8pp on every tax band Either (a) Externally funded or deficit financed (b) Balanced budget	Computable General Equilibrium (CGE) model - Multi-sectoral - Forward looking - Imperfect competition	Average elasticity used to estimate substitution effect on extension margin = 0.098 (varies by earnings, age, gender and household type); Average elasticity used to estimate substitution effect on intensive margin = 0.16 (varies by gender and household type and if in top 5% of earners) Elasticity used to estimate income effects = -0.09 (varies by household type) [Lower and higher elasticity options available for all]	Calibrated using a Social Accounting Matrix (SAM) based on Scottish Government Input-Output tables	Externally funded (demand-side only) GDP +1.05 (short-run) & +3.46% (long-run); consumption +6.78% (short) & +8.61% (long); investment +5.62% (short) & +4% (long); exports -2.69% (short) & 0% (long); imports +4.87% (short) & +4.85 (long); nominal gross wage +0 (short and long); real take home wage -1.38% (short) & 0 (long); inflation +1.4% (short) & 0 (long); unemployment rate -1.39pp (short) & -2.84pp (long); employment +1.48% (short) & 3.03% (long)
					Balanced budget (demand and labour supply shock – wage elastic aggregate labour supply curve) GDP -1.3% (short) & -2.53% (long); consumption -0.14% (short) & -1.36% (long); investment -3.48% (short) & -2.01% (long); exports -1.78% (short) & -3.13% (long); imports -0.12% (short) & -0.52% (long); nominal gross wage +4.74% (short) & +3.65% (long); real take home wage -9.75% (short) & -12.14% (long); inflation +0.8% (short) & 1.14% (long); unemployment rate -1.91% (short) & -1.3% (long); employment -2.39% (short) & 3.02% (long)
					Balanced budget (macro-macro – conventional bargaining and no migration) GDP -2.61% (short) & -8.79% (long); consumption +0.4% (short) & -4.65% (long); investment -7.57% (short) & -7.86% (long); exports -3.43% (short) & -10.52% (long); imports -0.18% (short) & -1.77% (long); nominal gross wage +10.17% (short) & 13.22% (long); real take home wage -6.01% (short) & -9.93% (long); inflation +1.62% (short) & +4% (long); unemployment rate +4.38pp (short) & +9.14pp (long); employment -4.66% (short) & -9.73% (long)
					Balanced budget (macro-macro – full valuation and migration) GDP -1.63% (short) & -15.16% (long); GDP per capita -1.63% (short) & -5% (long); consumption +0.21% (short) & -8.11% (long); investment -4.51% (short) & -13.79% (long); exports -2.2% (short) & -17.98% (long); imports -0.14% (short) & -3.1% (long); nominal gross wage +6.08% (short) & +24.5% (long); real take home wage -8.82% (short) & -7.69% (long); inflation +1% (short) & +7.16% (long); unemployment rate +2.79pp (short) & 0pp (long); employment -2.97% (short) & -16.39% (long)

Daruich & Fernandez (2020)	*3 schemes* $11,000/year to every adult household (in 2000 dollars) [assumed equivalent to $5,500 for every adult] Funded by: (a) progressive income taxation (unchanged) (b) flat rate income taxation (c) consumption taxes	General equilibrium model - Overlapping generations - Imperfect capital markets - Investment in skill formation - Altruism towards child	Frisch elasticity = 1/3	Panel Study of Income Dynamics, Child Development Supplement and National Longitudinal Survey of Youth data used to parameterise investment returns from education, intergenerational skill transmission Discount rate = 0.98 Capital share = 1/3 Capital depreciation = 6.5% Capital income tax = 0.27 Consumption tax = 0.07	<u>Progressive income tax (unchanged)</u> GDP -12.9%; capital -20.2%; labour -9%; college share -12.4%; productivity -1.9% (high-school) & -3.7% (college); hours -7.2 (high-school) & -2.8% (college) <u>Flat rate income tax</u> [Full results are not displayed] College share -2.4% <u>Consumption tax</u> [No results are displayed] Welfare gains for younger cohorts at the expense of older cohorts
Conesa, Li and Li (2020)	1. '1x' $2,488/year for all households replacing all existing transfers Funded by: (a) capital income taxes (b) labour income taxes (c) progressive consumption and income taxes (d) progressive consumption taxes only 2. '10x' $24,880/year for all households replacing all existing transfers Funded by: (a) income taxes and progressive consumption taxes (b) progressive consumption taxes only	General equilibrium model - Overlapping generations - Innate productivity - Idiosyncratic shocks - Basic and other consumption	Endogenously determined - 0.75 = Frisch elasticity of labour supply - Disutility of labour = 11.339 parameterised such that average hours worked = 1/3	Model calibration includes: - 1.2% population growth rate - 36% capital share - 6.9% capital depreciation	<u>'1x' UBI & capital taxes</u> GDP +0.11%; capital -0.08%; hours +5.28% (total) & +6.69% (low skilled) & +1.41% (high skilled); employment +0.22%; basic consumption +0.08% (total) & -0.15% (low) & +0.47% (high); other consumption +0.14% (total) & -0.3% (low) & +0.77% (high); income Gini +0.027pp; earnings Gini -0.015pp; welfare -9.42% (total) & -10.85 (low) & -3.55 (high) <u>'1x' UBI & income taxes</u> GDP +0.05%; capital -0.011%; hours +5.12% (total) & +6.51% (low skilled) & +1.27% (high skilled); employment +0.08%; basic consumption +0.17% (total) & -0.05% (low) & +0.56% (high); other consumption +0.32% (total) & -0.11% (low) & +0.92% (high); income Gini +0.027pp; earnings Gini -0.015pp; welfare -9.08% (total) & -10.51 (low) & -3.23 (high) <u>'1x' UBI & progressive consumption & income taxes</u> GDP -0.44%; capital -0.22%; hours +3.38% (total) & +4.4% (low skilled) & +0.58% (high skilled); employment -0.57%; basic consumption +15.45% (total) & +14.07% (low) & +17.9% (high); other consumption -8.69% (total) & -8.86% (low) & -8.453% (high); income Gini +0.03pp; earnings Gini -0.011pp; welfare -8.29% (total) & -9.33 (low) & -4.15 (high) <u>'1x' UBI & progressive consumption taxes only</u> GDP +11.63%; capital +38.86%; hours +3.49% (total) & +5% (low skilled) & -0.69% (high skilled); employment -1.26%; basic consumption +15.75% (total) & +13.91% (low) & +19% (high); other consumption -4.49% (total) & -5.3% (low) & -3.33% (high); income Gini +0.041pp; earnings Gini -0.15pp; welfare -5.9% (total) & -7.7 (low) & +1.58 (high)

					<u>'10x' UBI & progressive consumption & income taxes (middle)</u> GDP -9.4%; capital -5.5%; hours -18% (total) & -20.7% (low skilled) & -10.6% (high skilled); basic consumption -7.1% (total) & -5.1% (low) & -10.6% (high); other consumption -17.3% (total) & -14.6% (low) & -21.2% (high); income Gini +0.065pp; earnings Gini +0.032pp; welfare -0.89% (total) & +3.42 (low) & -14.41 (high)
					<u>'10x' UBI & progressive consumption only</u> GDP +2.9%; capital +29.8%; hours -13.8% (total) & -15.5% (low skilled) & -9.2% (high skilled); basic consumption -0.9% (total) & +0.05% (low) & -2.5% (high); other consumption -13% (total) & -11.4% (low) & -15.1% (high); income Gini +0.074pp; earnings Gini +0.018pp; welfare +5.96% (total) & +8.2 (low) & -1.74 (high)
Jaimovich, Saporta-Eksten, Setty, Yaniv Yedid-Levi (2022)	*4 schemes* $6,000/year to all individuals (10% UBI) funded by (a) taxes on households constant progressivity (b) as above more progressive (c) external financing (d) replace benefits (and tax households)	General equilibrium model - Heterogenous agent - Search-and-matching - Incomplete markets	Endogenously determined	Labour force participation rate = 0.9 Job finding rate = 0.362 Negative income tax rates mimic features of the EITC as the benchmark model Replacement rate of 40% for unemployment insurance system	<u>Taxes on households (constant)</u> GDP -18%; capital -28%; employment rate -14% (-12pp); unemployment rate +2%; Gini -17%, CEV (welfare) -5%
					<u>Taxes on households (most progressive)</u> GDP -15%; capital -27%; employment rate -8%; unemployment rate +0.5%; Gini -20%, CEV +3%
					<u>External financing</u> GDP -5.6%; capital -10%; employment rate -4%; unemployment rate 0%
					<u>Replace benefits</u> GDP -5%; capital -12%; employment rate -0.5%; unemployment rate +1.7%, Gini -14%; CEV +10%

Cambridge Econometrics (Komuves, Thoung, Zagdanski, 2022)	*2 schemes* 1. Income tax and benefit withdrawal-funded UBI - £2609/year for 0-15 year olds; £4174/year for 16-64 year olds and £9392/year for 65+ 2. Debt-free sovereign money (DFSM) funded UBI of £1224/year	E3ME model - Post-Keynesian - Sectoral - Linkages to energy and environment	Tax-funded UBI static disincentive (substitution and income effect) overall is input as -2% at intensive margin and -1% at extensive (on average) DFSM-funded UBI static disincentive (income effect only) overall is input as -0.4% at the intensive and extensive margin	Net transfers calculated by decile with the lowest receiving the highest amounts relative to their income and the highest income decile losing income overall. The tax-funded UBI is covered from an increase in income taxes and employee's social security contributions (50/50). For the UBI funded using DFSM there are no changes to tax and benefits	<u>Tax-funded UBI:</u> 0.4% increase in GDP in 15 years (0.6% increase in consumption, 0.2% fall in net exports) 2.3% increase in employment in 15y 0.01% increase in price level in 15y 1% of GDP reduction in public debt stock in 15y <u>DFSM-funded UBI:</u> 2.5% increase in GDP in 15y (2.9% increase in consumption, 0.4% fall in net exports) 2% increase in employment in 15y 0% increase in price level in 15y 9% of GDP reduction in public debt stock in 15y

Discussion – where next?

This leaves us with the question of what future research should focus on when considering macroeconomic modelling. First, the heterogeneity of approaches should be welcomed. The more diverse the set of macro-models used to estimate the effect of a UBI, the more we will be able to explore the different assumptions and mechanisms by which the introduction of such a policy is likely to affect macroeconomic variables such as GDP, inflation and employment.

Given the critique of mainstream models for failing to adequately account for the financial sector or household and corporate debt, this would seem a particularly fruitful avenue to explore other mechanisms by which a UBI would impact upon macroeconomic variables. Assuming government debt simply increases interest rates and therefore savings seems inadequate given the experience of the last 15 years. Equally though, the recent emergence of higher inflation across OECD economies also raises questions about whether a UBI funded through sovereign money really would have no impact on inflation as implied by the Cambridge Econometrics paper. Sense-checking these assumptions and exploring how the results would change depending on different assumptions would be a fruitful avenue for future research.

The Fraser of Allander Institute and Cambridge Econometrics papers are particularly useful in modelling realistic UBI policy options. While there is a use in testing extreme examples to sense-check assumptions about the effects of a UBI, to most accurately evaluate the likely impact of a UBI it would help to inform the public debate if the results from UBI schemes that could feasibly be implemented. Microsimulation has been an important tool for identifying the winners and losers of the introduction of a UBI, and showing that even for some changes that reduce poverty, many low-income households face losses of over 20% of their income if other benefits are removed. Many of the general equilibrium models assume the replacement of all existing benefits with a UBI, which would cause unacceptable hardship on some losers from the reform suggesting this is very unlikely politically.

There are a number of other possible mechanisms by which UBI can be assumed to affect the macroeconomy that could also be explored. The link between UBI, health and longer-term outcomes has not explicitly modelled up to now (Johnson et al., 2021). Similarly, analysis of the expected impact of a UBI on carbon emissions and climate change mediated through its impact on redistribution, consumption and economic activity could be the subject of more research.

Finally, all the papers discussed here focus on either the US and UK economy. Although this may be a selection bias, due to language preferences of the author, greater variation in the parameters applied based on national economies would be welcome. In particular, there is a gap in our understanding of how a UBI intervention might affect low- and medium-income countries.

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