Countercyclical Unemployment Benefits and Unemployment Fluctuations

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Abstract

This paper introduces a prototypical dynamic general equilibrium model with liquidity-constrained workers and firms and in which public debt facilitates liquidity hoarding by firms and hence hiring in bad times. We use this framework to study the desirability of countercyclical unemployment insurance over the business cycle and, more specifically, its ability to dampen output and unemployment flucutations. To the extent that unemployment benefits raise government outlays and public debt in the short run, it increases the stock of aggregate liquidity that firms may wish to hoard for future hiring needs. This impact of UI benefits on aggregate liquidity relaxes the borrowing constraints faced by firms, thereby effectively raising their labour demand in recessions, relative to an economy without countercylical UI benefits.

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1 Introduction

This paper studies the desirability of countercyclical unemployment insurance (UI) over the business cycle, specifically its ability to dampen output and unemployment fluctuations. To this end, we introduce a prototypical dynamic general equilibrium model with liquidity-constrained workers and firms and in which public debt facilitates liquidity hoarding by firms and hence hiring in bad times. We find, under our preferred calibration, that a moderate degree of UI countercyclicality is effective at stabilising (even though not completely eliminating) unemployment fluctuations.

This result complements the literature on the macro- and microeconomic effects of unemployment insurance, which typically emphasizes the adverse (income) effects of higher unemployment benefits on incentives of job seekers to search and take up new employment opportunities . In addition, unemployment benefits are also thought to reduce the opportunity costs of unemployment, leading to higher wage demands and lower effort of those currently being employed. On the other hand, some researchers have emphasised the match-quality enhancing role of unemployment insurance (Acemoglu and Shimer 2000) and higher welfare when jobseekers are liquidity constrained (Bender et ali 2009). Finally, at the macroeconomic level, stabilization effects can be expected from unemployment insurance, either directly through automatic stabilisers or indirectly as the result of counter-cyclical savings behaviour when credit-constrained households rely on the insurance function of unemployment benefits.

The most commonly used, theoretical framework to analyse the impact of UI on unemployment and unemployment fluctuations has been the Diamond-Mortensen-Pissarides (DMP) "labour search and matching" model. In this framework, higher unemployment benefits tend to raise unemployment in the long-run (i.e., at the steady state) as well as to magnify unemployment fluctuations (i.e., along the business cycle). The key reason for this is the impact of unemployment benefits on the bargaining terms between the parties. In steady state, higher unemployment benefits tend to raise the wage bargained by employees, with the effect of lowering firms' marginal benefits from any additional match and thereby deterring hiring (see, e.g., Pissarides, 2000). Along the business cycle, higher unemployment benefits tend to magnify the volatility of firms' profits associated with any match, with the implication of raising the volatility of vacancy openings, which goes towards raising unemployment fluctuations (Hadgedorn and Manovskii, 2008).

Within the DMP framework, the key (and, most of time, unique) friction under consideration is one in the labour market whereby it takes time for workers and firms to establish succesful matches. Other frictions (e.g., capital market frictions) are usually left aside, even though they have been recognised to be important in affecting aggregates (including employment) over the business cycle. Recognising the importance of such additional frictions may thus drastically alter our understanding of the macroeconomic impact and desirability of unemployment insurance as a tool for macroeconomic stabilisation.

In the present paper, we explore the implications of capital markets frictions for the effect and desirability of unemployment insurance. To make this point entirely clear, we abstract from other frictions and focus on the macroeconomic linkages between UI, public debt, and firms' hiring constraints . In our model, firms (modelled as "entrepreneurs") face borrowing constraints that limits both employment and production. Firms, however, can alleviate the impact of this constraint by engaging in liquidity hoarding ex ante by holding assets that can be readilly sold in order to finance future and uncertain spending needs (as in, e.g., Holmstrom and Tirole, 1998.)[1] For simplicity, we focus on the case where the government is the only supplier of aggregate liquidity while the firms are the only demanders for it.

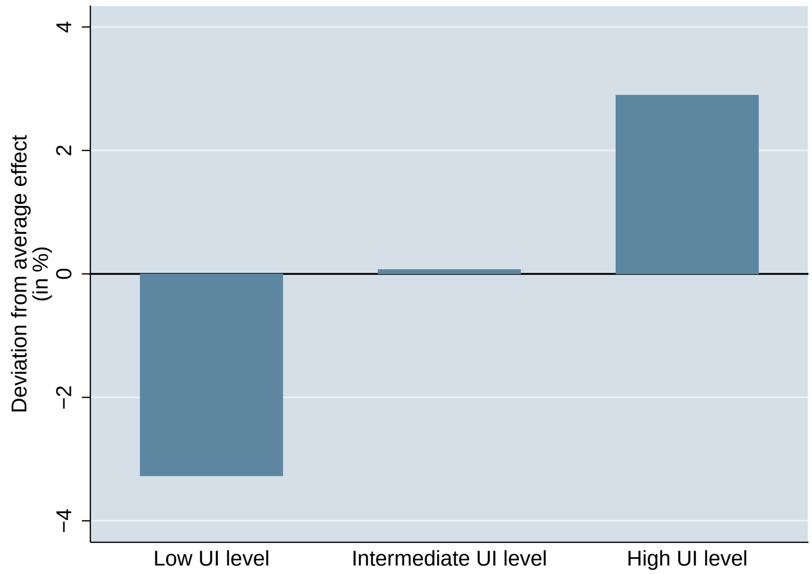
The policy experiment that we focus on is the introduction of countercyclical benefits for unemployed households, that is, one that rises when output falls. With liquidity-constrained firms, countercyclical unemployment benefits raises government outlays during recessions and hence public debt. The implied higher liquidity supply relaxes the borrowing constraint faced by firms, thereby easing hiring and dampending the fall in employment generated by the recession. Moreover, this policy dampens consumption fluctuations via several channels. First, the countercyclicality of unemployment benefits implies that the unemployed enjoy higher income, thereby allowing them to consume more. Second, the dampening effect of the policy on unemployment implies that the unemployed, who enjoy lower income and consumption than the employed, are less numerous, so this composition effect goes towards raising aggregate consumption. Last, it also raises entrepreneurs' consumption (that is, firms' profits). Hence, not only does countercyclical UI stabilise unemployment and output, it also raises aggregate welfare by improving the consumption possibilities of all agents (relative

[1]In our model, liquidity is made up of all assets that allow agents to transfer wealth across ime to meet future and uninsurable spending needs. Earlier model making use of the same liquidity concept include Woodford (1990), Homström and Tirole (1998, 2001), Kehoe and Leving (2001), and Fahri and Tirole (2008).

to the consumption that would prevail without the policy). This non-conventional impact of unemployment benefits is explored within the simplest possible framework, based on Challe and Ragot (2010) (who focus on public spending shocks rather than on unemployment benefits). In the conclusion, we highlight the directions in which this framework could be enriched and extended, notably to incorporate additional frictions and employment policies.

Empirically, this paper tries to put forward a new mechanism to explain recent new evidence on the potentially beneficial role of unemployment benefits for job creation. Indeed, reduced-form regressions estimating the impact of unemployment benefits on jobless rates typically indicate a positive relationship (e.g. Bassanini and Duval, 2006). This link has proved to be fairly robust to the inclusion of various control variables or interaction effects (see Curci, 2011). In contrast, Ernst and Rani (Forthcoming) document that accounting for the endogeneity of unemployment benefits with respect to macroeconomic conditions, an increase in spending on UI comes with higher job creation and lower job destruction rates, i.e. an overall reduction in the measured unemployment rate (see figure 1 below). Recent parametric changes in UI systems in advanced economies stress the importance of taking account of such dynamic modifications in the unemployment benefit system in order to avoid endogeneity biases. Moreover, from a theoretical standpoint, the endogeneity of unemployment benefits with respect to business cycle conditions captures the insurance function of UI systems for liquidity-constrained households, as emphasised in this paper.

Figure 1: Unemployment benefits and job creation



Note: The chart shows job creation rates (as deviations from the average effect) at different levels of UI generosity for a panel of 14 OECD countries.

Source: Ernst and Rani (2011).

The present work is related to at least three strands of the literature. Starting with Merz (1995) and Andolfatto (1996), a number of papers have sought to model unemployment fluctuations within dynamic stochastic general equilibrium models plagued by search frictions a la Diamond-Mortensen-Pissarides. This literature has been revived since the contribution of Shimer (2005), who showed that under plausible parameters the model proves unable to explain the magnitude of historical fluctuations in unemployment and vacancies in post-war U.S. data. The parameterisation of unemployment benefits plays a key role in Shimer's analysis, because it defines the threat point for workers and hence determines the equilibrium real wage that prevails under Generalised Nash Bargaining. The relatively low value of unemployment benefits assumed by Shimer (40% of the full wage) turns out to generate too little unemployment volatility relative to the data, essentially because it tends to dampen fluctuations in the share of the match surplus that accrues to the employer. In response to this result, Hadgedorn and Manovskii (2008) have argued that the threat point should not only include explicit unemployment benefits but also the implicit value of leisure. Setting the threat point to a high value generates substantial variations in the firm's share of the match surplus and hence large fluctuations in vacancies and unemployment.[2] The bottom line of this research is that larger unemployment benefits tend to raise steady state unemployment in the deterministic equilibrium, and also to raise unemployment volatility under aggregate shocks. In contrast, the present paper seeks to understand the circumstances under which unemployment benefits have a stabilising (rather than destabilising) effect on unemployment, and does so by focusing on capital markets (rather than labour markets) imperfections.

A second strand of research has focused on the optimal amount and timing of UI payments, that is, the pattern of such payments that strikes the best balance between unemployment insurance (which is desirable under risk aversion and incomplete markets) and incentives (since higher unemployment benefits may deter search effort or raise unemployment risk). Typically, this literature has focused on steady state analysis (see Shavel and Weiss, 1979; Hopenhayn and Nicolini, 1997; and more recently Shimer and Werning, 2008), whilst our analysis takes the path of UI benefits as given and analyses its effect on aggregate employment fluctuations.

Finally, a large number of papers in macro-finance has explored the role of borrowing constraints in affecting firms' behaviour, focusing mostly on investment spending (e.g., Kiyotaki and Moore, 1997; Bernanke and Gertler, 1989). It is also well known that under such constraints private agents may find it worthwhile to store assets in positive net supply ex ante in order to provide for future, uncertain spending needs because they expect borrowing constraints to become binding precisely when such needs arise (e.g., Kehoe and Levine, 2001; Holmstrom and Tirole, 1998). In this context, the supply of "aggregate liquidity" matters in as much as it indexes the ability of agents to self-insure against future shocks. In our model, the only outside asset is public debt (as in, e.g., Woodford, 1990; Floden, 2001), so its availability over time, which is directly affected by the generosity of the UI system, directly affects private decisions.

The paper is organised as follows. The model is described in Section 1, where we characterise the behaviour of private agents (entrepreneurs and workers), as well as that of the

[2] Costain and Reiter (2008) have then criticised Hadgedorn and Manovskii (2008)'s approach on the basis that it implies too large an effect of active employment policies. Indeed, the key mechanism behind the high volatility result of Hadgedorn and Manovskii is the small average quasi-rent enjoyed by the firm on any match, which it turns implies that relatively moderate shocks have a *proportionally* large impact on firm's quasi-rents. If it were the case, relatively cheap employment policies would also have a proportionally large effect on those rents and hence on unemployment.

goverment and also the market clearing conditions of the model. Section 2 summarises the implied aggregate dynamics of the model as well as its steady state. In Section 3, we calibrate the model and show the dynamic responses of aggregates with and without countercyclical unemployment benefits. Section 4 summarises the results and gives some directions for future work.

2 The Model

The economy is populated by a mass of infinitely-lived households of size $1+\mu$, where 1 and μ are the measures of "entrepreneurs" and "workers", respectively, as well as a government. All markets (for goods, credit and labour) are competitive, but financial markets are incomplete: on the one hand, workers cannot insure fully share unemployment risk via Arrow-Debreu securities; on the other, all households (workers and entrepreneurs alike) are borrowing-constrained. We first describe the behaviour of entrepreneurs, and then turn to that of workers and the government. Finally, we show how their behaviour interact in general equilibrium by spelling out the market-clearing conditions (in capital, goods, and labour markets) of the model.

2.1 Entrepreneurs

Entrepreneurs may either "run a project" or "supply labour", depending on whether the have a project opportunity or not. Those who supply labour have a probability θ of encountering a project opportunity in the next period, and project opportunitities last for one period. Entrepreneurs maximise

$$E_t \sum_{j=0}^{\infty} \beta^j \left(u \left(c_{t+j}^i \right) - l_{t+j}^i \right), \tag{1}$$

where $\beta \in (0,1)$ is the subjective discount factor and $u(c)$ is a twice continuously differentiable utility function satisfying $u'(c) > 0$, $u'(0) = \infty$, $u''(c) < 0$. Entrepreneurs who run a project have access to a production technology that yields $y_{t+1}^i = z_t l_t^{f,i}$ units of goods at date $t+1$ for $l_t^{f,i}$ units of labour hired at date t. Their budget constraint is:

$$c_t^i + a_t^i + \left(1 - \xi_t^i\right) w_t l_t^{f,i} = a_{t-1}^i R_{t-1} + \xi_t^i w_t l_t^i + \left(1 - \xi_{t-1}^i\right) y_t^i - T_t, \tag{2}$$

where a_t^i denotes end-of-period asset holdings, T_t are (lump sum) taxes, and ξ_t^i and indicator variable such that $\xi_t^i = 1$ if the entrepreneurs supplies labour at date t and $\xi_t^i = 0$ if the entrepreneur runs a project. Note that because of the assumed production lag only entrepreneurs who have run a project in the previous period (that is, those for whom $\xi_{t-1}^i = 0$) enjoy the entrepreneurial income y_t^i. For example, for an entrepreneur who is currently running a project but did not in the previous period we have $(\xi_{t-1}^i, \xi_t^i) = (1, 0)$ and hence:

$$c_t^i + a_t^i + w_t l_t^{f,i} = a_{t-1}^i R_{t-1} - T_t,$$

implying that its total resources are made of beginning-of-period asset wealth $a_{t-1}^i R_{t-1}$ minus taxes, T_t, whilst these resources can be allocated to finance current consumption, c_t^i, the wage bill $w_t l_t^{f,i}$, and possibly newly purchased assets, a_t^i. As we shall see below, however, an entrepreneur who is running a project faces a binding borrowing constraint and hence holds no end-of-period assets, i.e., $a_t^i = 0$. In contrast, for an entrepreneur who is not running a project but did so in the previous period we have $(\xi_{t-1}^i, \xi_t^i) = (0, 1)$ and hence

$$c_t^i + a_t^i = a_{t-1}^i R_{t-1} + w_t l_t^i + y_t^i - T_t.$$

The latter budget constraint reads as follows. Since this entrepreur does not have access to a project (by definition), his total spendings are made of current consumption, c_t^i, and asset accumulation, a_t^i. His total gross income, on the other hand, is made of his labour income $w_t l_t^i$, his production income $y_t^i = z_{t-1} l_{t-1}^{f,i}$ (since, by definition, this entrepreneur was running a project in the previous period), minus taxes, T_t. While in theory this entrepreneur could inherit some wealth from the previous period and hence enjoy beginning-of-period assets $a_{t-1}^i R_{t-1}$, the fact that entrepreneurs running a project face a binding borrowing constraint in equilibrium will imply that $a_{t-1}^i = 0$.

Finally, the budget constraint of an entrepreneur who is currently supplying labour and did so in the previous period is such that $(\xi_{t-1}^i, \xi_t^i) = (1, 1)$. Hence his budget constraint is:

$$c_t^i + a_t^i = a_{t-1}^i R_{t-1} + w_t l_t^i - T_t.$$

Let us now turn to the optimal choices of entrepreneurs. Consider first the labour-supply choice of an entrepreneur not currently running a project. From (1) and (2), the latter chooses the level of labour supply l_t^i that satisfies:

$$w_t u' \left(a_{t-1}^i R_{t-1} + w_t l_t^i + y_t^i - T_t - a_t^i \right) = 1. \tag{3}$$

On the other hand, employed households stay employed in the next period with probability θ and become entrepreneurs with complementary probability. The optimal asset demand of an employed household i, a_t^i, must thus satisfy:

$$u'\left(a_{t-1}^i R_{t-1} + w_t l_t^i + y_t^i - T_t - a_t^i\right) \geq \theta\beta R_t E_t u'\left(a_t^i R_t + w_{t+1} l_{t+1}^i - T_{t+1} - a_{t+1}^i\right) \\ + (1-\theta)\,\beta R_t E_t u'(a_t^i R_t - T_{t+1} - a_{t+1}^i - w_{t+1} l_{t+1}^{f,i}), \quad (4)$$

with this expression holding with strict inequality if the borrowing constraint is binding (i.e., $a_t^i = 0$), but holding with equality otherwise (i.e., $a_t^i > 0$).

Let us now turn to entrepreneurs currently running a project. Their running of a project prevents them from earning any wage income, so for them $w_t l_t^i = 0$. Since they were supplying labour in the previous period they earn no production output, i.e., $y_t^i = 0$. Then, from (1) and (2), their optimal choices of labour demand, $l_t^{f,i}$, and asset demand, a_t^i, must satisfy, respectively,

$$u'(a_{t-1}^i R_{t-1} - T_t - a_t^i - w_t l_t^{f,i}) = \beta w_t^{-1} E_t u'(a_t^i R_t + w_{t+1} l_{t+1}^i + z_t l_t^{f,i} - T_{t+1} - a_{t+1}^i), \quad (5)$$

$$u'(a_{t-1}^i R_{t-1} - T_t - a_t^i - w_t l_t^{f,i}) \geq \beta R_t E_t u'(a_t^i R_t + w_{t+1} l_{t+1}^i + z_t l_t^{f,i} - T_{t+1} - a_{t+1}^i), \quad (6)$$

with the latter inequality holding strictly if the entrepreneur is borrowing-constrained and with equality otherwise.

An equilibrium with a limited number of household type/asset states can be constructed by conjecturing that entrepreneurs who supply labour are never constrained (i.e., they wish to save rather than borrow, so (4) holds with equality) while entrepreneurs currently running a project always are (i.e., they would like to expand employment and production through borrowing but cannot do so, implying that (6) holds with strict inequality). More specifically, there are exactly three types of entrepreneurs, which are: i) f-entrepreneurs, who currently run a project, are currently borrowing-constrained and were employed (and hence unconstrained) in the previous period; ii) ee-entrepreneurs, who are currently employed after having been employed in the previous period; and iii) fe-entrepreneurs, who are currently employed after having been entrepreneurs in the previous period. Employed entrepreneurs (ee and fe) are not borrowing-constrained and all choose the same consumption and asset holding levels, denoted by c_t^e and a_t. We denote by c_t^f and l_t^f the consumption and labour demands of entrepreneurs currently running a project, respectively. The budget constraints of each type of entrepreneurs are now:

$$ee : c_t^e + a_t = a_{t-1}R_{t-1} + w_t l_t^{ee} - T_t, \tag{7}$$

$$fe : c_t^e + a_t = w_t l_t^{fe} + z_{t-1} l_{t-1}^f - T_t, \tag{8}$$

$$f : c_t^f + w_t l_t^f = a_{t-1}R_{t-1} - T_t. \tag{9}$$

In equation (8), fe-households earn labour income $w_t l_t^{fe}$ plus production output $y_t = z_{t-1} l_{t-1}^f$, and this total income is used to pay for consumption, asset accumulation and taxes. Equation (9), the budget constraint of entrepreneurs, states that they entirely liquidate their stock of assets to finance consumption, taxes, and the wage bill $w_t l_t^f$ (i.e., they hold no bonds at the end of the period since they face binding borrowing constraints). Finally, we denote by $\Gamma \equiv (1-\theta)/(2-\theta)$ the asymptotic share of entrepreneurs in the economy and assume that the numbers of households of each type are at their asymptotic levels from date 0 onwards (so that ee- and fe-households are in numbers $1-2\Gamma$ and Γ, respectively).

From (3)–(4) and (7)–(9), the intratemporal and intertemporal optimality conditions of employed households are now, respectively:

$$w_t u'(c_t^e) = 1 \tag{10}$$

$$u'(c_t^e) = \beta R_t E_t(\theta u'\left(c_{t+1}^e\right) + (1-\theta) u'(c_{t+1}^f)). \tag{11}$$

From (9), entrepreneurs must allocate their after-tax income, $a_{t-1}R_{t-1} - T_t$, to current consumption, c_t^f, and the wage bill, $w_t l_t^f$, taking the real wage as given. From (5) and (9), together with the fact that entrepreneurs stay so for one period only, the solution to the entrepreneur's optimal labour demand, l_t^f, must satisfy:

$$w_t u'(c_t^f) = z_t \beta E_t u'\left(c_{t+1}^e\right). \tag{12}$$

The optimality condition (12) simply sets equal the utility fall implied by a decrease in current consumption necessary to hire an extra unit of labour to the utility gain that is expected from increasing current labour input (and thus future production) by that unit.

Finally, from the assumed transitions across status by entrepreneurs and the fact that their mass is normalised to 1, the number of projects being run in the economy is

$$\Omega = \frac{1-\theta}{2-\theta}.$$

Relatedly, the number of entrepreneurs who supply labour is $1-\Omega$. It is made of fe-entrepreneurs (in number Ω) and ee-entrepreneurs (in number $1-2\Omega$).

2.2 Workers

Workers share the same utility function as entrepreneurs (i.e., (1)), but supply inelastically one unit of labour when employed. When unemployed, they are entitled to an unemployment benefit of amount κ_t, paid out by the government. For simplicity we completely shut down potential means of private insurance for these workers. First, these households cannot rely on direct cross-household risk sharing for insurance against unemployment risk due to the lack of Arrow-Debreu securities conditional on their employment status. Second, unemployed households are not creditworthy and hence unable to borrow against their (expectedly higher) future income. Third, they do not have access to asset markets and hence cannot self-insure by accumulating precautionary wealth. It follows that the consumption of employed and unemployed workers are:

$$\tilde{c}_t^e = w_t$$
$$\tilde{c}_t^u = \kappa_t$$

Workers' transitions in the labour market are as follows. At the beginning of date t, a fraction ρ of existing employment relationships are broken up. Those freshly unemployed agents have a probability f_t to find a job during the period, just as those who where unemployed at the end of date $t-1$. Hence, the period-to-period separation rate is

$$s_t = \rho\left(1 - f_t\right), \tag{13}$$

that his, the probability of losing one's job at the beginning of the period, ρ, times that of not finding a job again in the same period, f_t. From the transition rates (f_t, s_t) we find that the share of employed workers (as a proportion of the total number of workers) evoloves according to the following law of motion:

$$n_t = \left(1 - n_{t-1}\right) f_t + \left(1 - s_t\right) n_{t-1}, \tag{14}$$

that is, unemployment at date t results from the flow of exits from unemployment, $\left(1 - n_{t-1}\right) f_t$, plus the fraction of previously employed workers who have not lost their jobs, $\left(1 - s_t\right) n_{t-1}$. The implied share of unemployed workers is simply $u_t = 1 - n_t$. Since the population is made of both workers and entrepreneurs (who are never "unemployed"), we must rescale u_t to find the unemployment rate in the population. The economywide unemployment rate is simply given by

$$U_t = \left(\frac{\mu}{1+\mu}\right) u_t, \tag{15}$$

that is, it is the number of unemployed workers, μu_t, divided by total working population (including entrepreneurs), $1+\mu$.

Under our timing, the key labour market variable is the job-finding rate, f_t, which also determines the period-to-period separation rate s_t by equation (13). The job-finding rate must reflect tensions in the labour market and notably the pressure of aggregate labour demand. To encompass this mechanism in the simplest possible way, we assume that it is a (linear) function of entrepreneurs' labour demand (both as proportional deviations from the steady state), that is,

$$f_t = f + \gamma\left(l_t^f - l^f\right),\ \gamma > 0$$

where f is the steady state job-finding rate and l^f is steady state labour demand by an entrepreneur. In the aggregate, labour demand is met by the labour supply of employed workers as well as that of labour-supplying entrepreneurs (i.e., those not currently running a project).

From (13), (14), (15) and the fact that $u_t = 1 - n_t$ the average unemployment rate in this economy is given by:

$$U = \left(\frac{\mu}{1+\mu}\right)\left(\frac{\rho(1-f)}{f+\rho(1-f)}\right). \tag{16}$$

2.3 Government

Let T_t denote lump-sum tax collections during period t and B_t the stock of public debt at the end of period t. The government faces the budget constraint:

$$B_{t-1}R_{t-1} + \kappa_t u_t = B_t + T_t. \tag{17}$$

Government outlays during date t are the total amount paid as unemployment benefits, $\kappa_t u_t$, plus gross interest payment on outstanding debt, $B_{t-1}R_{t-1}$. Total income is made of newly issued debt, B_t, and total tax collection, T_t. We think of T_t as being endogenously determined by a fiscal rule running from macro and fiscal variables to the level of taxes, and restrict our attention to rules ensuring that public debt reverts towards its (exogenously given) long-run target B, at least asymptotically. Such rules, which exclude Ponzi schemes, are consistent with a wide variety of feedback mechanisms, including that from public debt to primary deficit as in Bohn (1998), from output and debt to structural deficits (e.g., Gali and Perotti, 2003), as well as from public debt and public spending to taxes (e.g., Gali *et* *al.*, 2007). Loosely speaking, stationarity requires the tax feedback to be sufficiently strong to never allow public debt to drift away from target forever. More specifically, the feedback rule we consider takes the form

$$T_t = T + \phi \left(B_t - B \right), \tag{18}$$

where $\phi > 0$ is assumed to be high enough to ensure the stationarity of the public debt. Note that ϕ effectively indexes the way in which countercyclical unemployment benefits are financed at various horizons. If ϕ is large, taxes rise quickly following a rise in UI spendings and public debt plays a relatively minor role in their short-run financing. Smaller values of ϕ, on the contrary, imply a muted short-run response of taxes and a more substantial role for public debt issuance in the short run; the ensuing rise in the stock of public debt then eventually triggers a rise in taxes in the medium run until the reversion of the public debt has been completed. Finally, for expositional clarity we shall normalise steady state UI to zero. This implies that in steady state tax revenues just cover interest rate payments on debt, i.e.,

$$T = B \left(R - 1 \right).$$

2.4 Market clearing

Given that entrepreneurs are in proportion Γ, clearing of capital, labour and goods markets now requires:

$$\left(1 - \Omega\right) a_t = B_t, \tag{19}$$

$$\left(1 - 2\Omega\right) l_t^{ee} + \Omega l_t^{fe} + \mu \left(1 - u_t\right) = \Omega l_t^{f}, \tag{20}$$

$$\left(1 - \Omega\right) c_t^{e} + \Omega c_t^{f} + \mu \left(1 - u_t\right) \tilde{c}_t^{e} + \mu u_t \tilde{c}_t^{u} = \Omega y_t. \tag{21}$$

Equation (19) reflects the fact that only entrepreneurs (and, more specifically, those who supply labour) hold positive end-of-period assets, and they hold the same level of assets. All in all, ee and fe entrepreneurs are in number $1 - \Omega$ in the economy. Each of them hold a_t units of assets, and the total supply of outside assets is B_t, i.e. the stock of public debt.

Equation (20), the clearing of the labour market, confronts the total labour demand by entrepreneurs running a project (they demand l_t^f units of labour each and are in number Ω) with the labour supply of all households who supply labour (ee entrepreneurs, in number $1 - 2\Omega$, fe entrepreneurs, in number Ω, and employed workers, in number $\mu \left(1 - u_t\right)$).

Finally, in equation (21), y_t is output per entrepreneur and thus $\Omega y_t = Y_t$ is total output; the latter is bought by employed entrepreneurs (in number $1-\Omega$), entrepreneurs currently running a project (in number Ω), as well as employed and unemployed workers (in numbers $\mu(1-u_t)$ and μu_t, respectively).

3 Aggregate dynamics

3.1 Model equations

This section summarise the equations that appear in the Dynare code ("model" section) and summarise the behaviour of the economy. We must first derive the dynamic system characterising the equilibrium under the joint conjecture that entrepreneurs running a project are always borrowing-constrained while entrepreneurs who supply labour never are, and then derive from the steady-state relations the range of debt levels compatible with this joint conjecture. Equations (10) and (12) give:

$$c_t^e = u'^{-1}\left(w_t^{-1}\right),\ c_t^f = u'^{-1}\left(\beta z_t w_t^{-1} E_t\left(w_{t+1}^{-1}\right)\right) \tag{22}$$

Using a CRRA intra-temporal utility function, we have $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$ and thus:

$$c_t^e = w_t^{1/\sigma},\ c_t^f \simeq E_t\left(\frac{w_t w_{t+1}}{\beta z_t}\right)^{1/\sigma}. \tag{23}$$

The second relevant equations is the Euler equation of entrepreneurs who supply labour. Substituting (22) into (11), the Euler equations for these households is:

$$w_t^{-1} = \beta R_t\left(\theta E_t\left(w_{t+1}^{-1}\right) + (1-\theta) E_t\left(\beta z_t w_{t+1}^{-1} E_{t+1}\left(w_{t+2}^{-1}\right)\right)\right) \tag{24}$$

The third equation is the budget constraint of f-entrepreneurs (i.e., those currently running a project). It is given by

$$c_t^f + w_t l_t^f = a_{t-1} R_{t-1} - T_t \tag{25}$$

We must also incorporate market-clearing conditions. Walras' law implies that the labour market clears if both the asset and good markets clear. Clearing of the asset market simply given by (19). Substituting (22) into (21) and using the facts that $\Omega = (1-\theta)/(2-\theta)$ and $y_{t+1}^i = z_t l_t^{f,i}$, the goods market clearing equation is:

$$\frac{1}{2-\theta} c_t^e + \Omega c_t^f + \mu(1-u_t) w_t + \mu u_t \kappa_t = \Omega z_{t-1} l_{t-1}^f, \tag{26}$$

and where the first and second terms are just $w_t/(2-\pi)$ and $\Omega w_t w_{t+1}/\beta$ under log utility of consumption.

The model is completed with the government budget constraint, the tax rule and the productivity process and unemployment benefit process. The productivity process is assumed to take the form

$$\ln z_t = \rho \ln z_{t-1} + \epsilon_t.$$

Finally, we directly index the countercyclical response of unemployment benefits to productivity:

$$\kappa_t = -\psi \ln z_t.$$

Other more realistic feedback could be introduced, without substantially affect the results; all that matters is that unemployment benefits effectively rise in recessions.

Finally, due to the production lag and the fact that active entrepreneurs are in number Ω in the economy, aggregate output at date t is given by:

$$Y_t = \Omega z_{t-1} l_{t-1}^f.$$

Essentially, we are comparing the dynamics of U_t and Y_t for different values of ψ.

3.2 Steady state

Steady state values can be computed recursively from the aggregate dynamics of the model as follows. First, the steady state gross real interest rate R is set at 1.01, which will ensures that entrepreneurs running a project are indeed borrowing-constrained (since $1/R > \beta = 0.98$). The rest of the model is determined as follows.

First, the steady state counterpart of (24) gives the steady state real wage:

$$w = \beta^2 (1-\theta) R / (1 - \beta\theta R),$$

from which the steady state consumption levels of entrepreneurs in (23) can be computed, i.e.,

$$c^e = w^{1/\sigma},\ c^f = \left(w^2/\beta\right)^{1/\sigma}.$$

Second, the steady state counterpart of (26) gives the labour demand of an entrepreneur running a project as a function of w,c^e and c^f. We find:

$$l^f = \left(\frac{1}{1-\theta}\right) c^e + c^f + \frac{\mu(1-u)w}{\Omega},$$

where $1-u$ directly follows from (14).

Finally, the steady state counterparts of (25) and (19) give the following steady state leve of public debt:

$$B=\frac{c^{f}+wl^{f}}{1+(1-\pi)R}. \tag{27}$$

Equation (27) gives the level of steady state public debt that "produces" a given targeted equillibrium interest rate. Aggregate shocks will cause all terms in (17) – including B_t – to depart from their steady state counterpart following aggregate shocks, but B_t will revert to B asymptotically provided that ϕ in (18) is sufficiently large.

4 The dynamic effects of countercyclical unemployment benefits

We now analyse the macroeconomic impact of countercyclical unemployment risk by comparing the dynamic adjustment of the economy to a typical recessionary shock with and without such policy. This is done by first calibrating the model, and then by computing impulse-response functions following a negative productivity shock.

4.1 Calibration

Preferences and technology The parameters are chosen so as to generate plausible steady state values as well as realistic patterns for the dynamics of the job finding rate and unemployment following a recessionary shock. The standard deviation of the technology shock is set to 1% of steady state output, which in our case implies an absolute level change in labour productivity of 0.0124. The persistence of the technology shock is set to 0.9. The coefficient of relative risk aversion σ is set to 0.1, implying a substantial (compensated) labour supply elasticity on the part of entrepreneurs. Finally, the subjective discount factor is set to $\beta=0.98$.

Labour market flows. We think of the "entrepreneurs" as being agents in the top half of the skill distribution and set their share in the economy to 1/2 (that is, $\mu=1$, so that total population size is 2). One may think of those agents has having a very small probability to be unemployed for more than a quarter, and the model simply sets this probability to zero.

This implies that the unemployment pool is made only of the other half of the agents, the workers. For these agents, we set $f = 60\%$ and $\rho = 0.30$, so that $s = \rho(1 - f) = 0.12$. This implies that a currently employed worker has a 12% probability of being unemployed in the next period, while an unemployed worker has a 40% probability to be so in the next period. Under these parameters, the unemployment rate at the steady state in equation (16) becomes:

$$U = 8.33\%.$$

As emphasized above the length of projects is exactly one period. We set θ, the probability that an entrepreneurs meets an investment opportunity, to 0.8. This implies that at any point in time the proportion of agents who are actively running a project (and hence hiring others) in the economy is:

$$\frac{\Omega}{1 + \mu} = 8.33\%.$$

Government. The long-run (steady state) level of public debt B is chosen so as to produce a steady state quartely gross interest rate R of 1.01 (that is, a annual interest rate of about 4%). This implies setting $B = 6.01$. The responsiveness of taxes to public debt, ϕ, is set to 0.2. The last parameter to set is ψ, which indexes the (negative) reaction of unemployment benefits to the productivity shock (and hence to the business cycle). In what follows we compare a situation without countercyclical benefits (i.e., $\psi = 0$) and one with countercyclical benefits (and set $\psi = 1$).

4.2 Impulse-response analysis

Figure 2 shows the impulse responses of the key variables of the model following a negative (recessionary) productivity shock of size 1% of steady state output, without unemployment benefits. Figure 3 runs the same impulse-response functions with the policy in place.

Comparing the two policies illustrate that countercyclical unemployment benefits do stabilise the economy by dampening output and unemployment fluctuations. The key mechanism by which this dampening effect operates is the following: After a negative productivity shock, labour demand by entrepreneurs running a project goes down, as they expect less output from the same wage bill (this follows from (12) and the budget constraints of such entrepreneurs). Consequently, the job-finding rate for workers goes down, the separation rate goes up, and unemployment is persistently higher.

Figure 2: No unemployment benefits

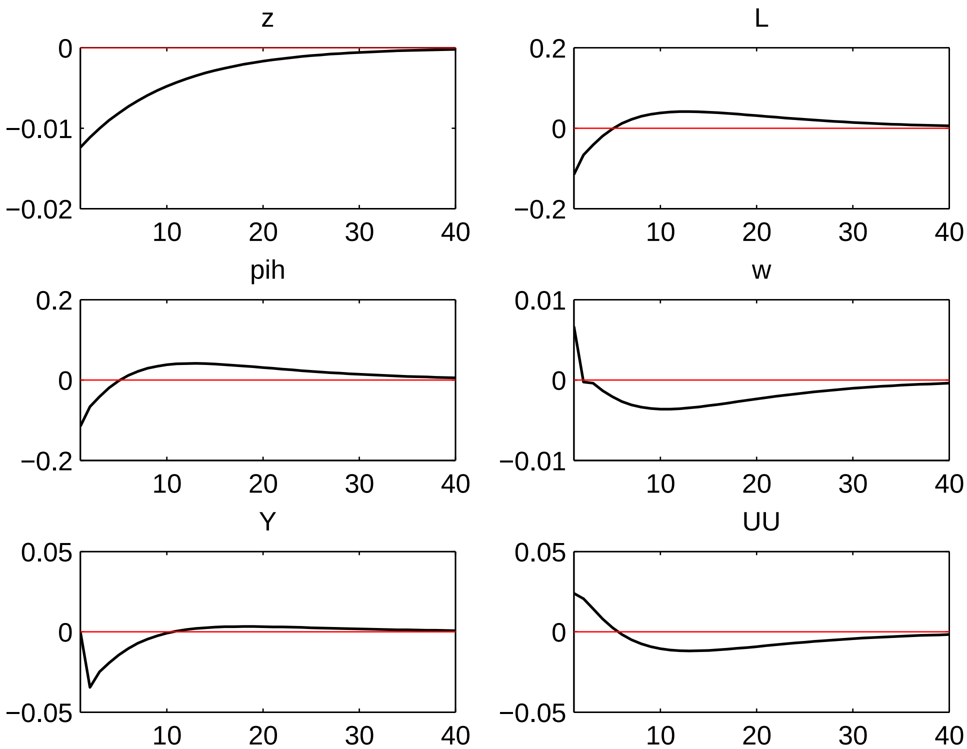
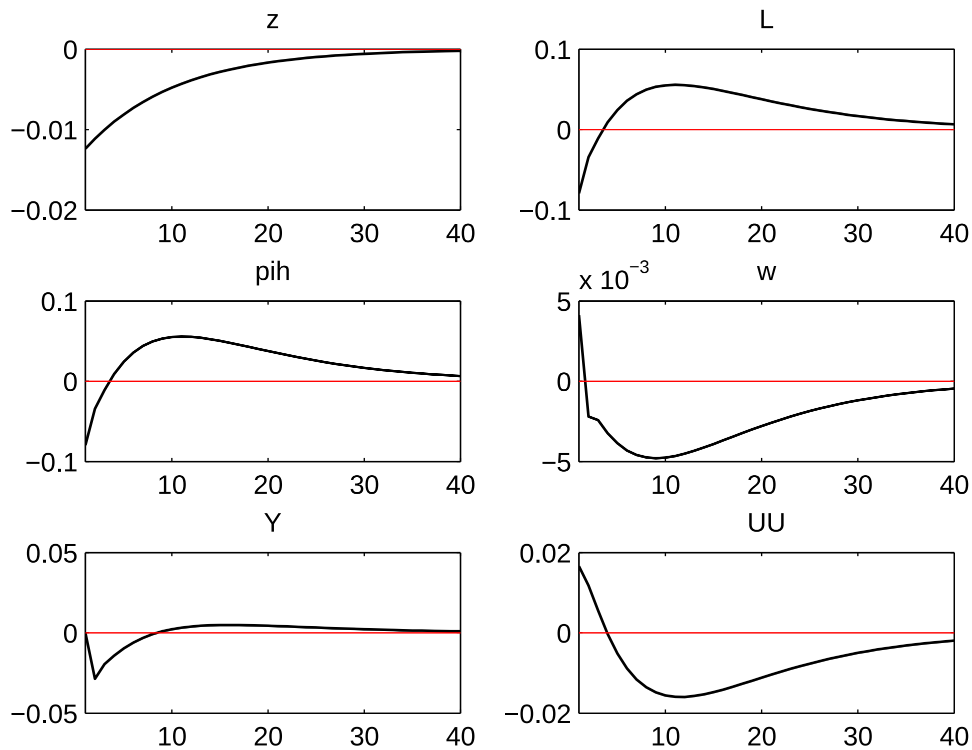


Figure 3: Countercyclical unemployment benefits ($\psi = 1$).



Relative to this situation, countercyclical unemployment benefits have two effects, one direct, one indirect. The direct effect is to raise consumption by unemployed workers. Importantly, this increase in workers' consumption is not matched by a one-for-one decrease in entrepreneurs' consumption, despite the fact that the latter are the only agents to pay taxes. The reason is that UI is partly financed by debt in the short-run (since the governement does not follow a balanced budget rule), and hence the immediate rise in taxes in (18) is limited.

The indirect effect works through the impact of the policy on the stock of public debt in the economy. Since higher UI benefits translate into higher government outlays and that the latter are partly financed by public debt, the aggregate supply of liquidity in the economy increases. As a consequence, the ability of entrepreneurs to hoard liquidity improves, which aleviates the effect of the borrowing constraint and translates into higher labour demand on the part of entrepreneurs running a project (relative to the behaviour of labour demand without the policy in place). This effect in turn produces a milder increase in unemployment after the shock.

5 Concluding comments

This paper has analysed the impact of countercyclical unemployment benefits in a dynamic general equilibrium model with imperfect financial markets wherein entrepreneurs must finance their wage bill via previously accumated liquidity. Our main result is that such a policy may be effective at stabilising output and unemployment, whilst at the same time boosting the consumption of all agents in the economy (and hence aggregate welfare).

These results have been derived using a stripped-down framework that shuts down all market imperfections apart from the borrowing constraint. To better understand the impact and effectiveness of alternative labour market policies and their potential interactions with UI benefits, the model should be enriched, notably by re-introducting labour market (search-and-matching) frictions and also a more realistic characterisation of wage setting (including real and/or nominal rigidities).

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