UniS

University of Surrey

Discussion Papers in Economics

THE 24/7 SOCIETY AND MULTIPLE HABITS

By

Ali Choudhary
(University of Surrey)
&
Paul Levine
(University of Surrey)

DP 05/06

Department of Economics
University of Surrey
Guildford
Surrey GU2 7XH, UK
Telephone +44 (0)1483 689380
Facsimile +44 (0)1483 689548
Web www.econ.surrey.ac.uk
ISSN: 1749-5075

The 24/7 Society and Multiple Habits*

Ali Choudhary and Paul Levine†
University of Surrey, Guildford, GU2 7XH, UK.

March 6, 2006

Abstract

We examine a model where households develop external habits by following norms and therefore have multiple habits in both consumption and labour supply. In doing so, they contribute to habit formation and hence pose an externality effect on others. Our findings are: first, that consumption and work habit ('work ethic') drive us towards a 24/7 society; both forms of habit increase the labour supply of households. Second, the two externalities involved in external habit work in opposite directions. For consumption, external habit is a negative externality as it reduces the utility of others in the economy. By contrast work ethic reduces the disutility and is therefore a positive externality. Third, as a result of our second finding, multiple habits can involve both a consumption tax and subsidy to correct for these externalities. Fourth, with plausible parameter values, the welfare consequences of multiple habits are far greater where there are long-run inefficiencies compared with only transitional inefficiency.

JEL Classification: D12, E52.
Keywords: Catching-up with the Joneses, Work Ethic, Savings, Output Inefficiency and Taxation.

---

*We acknowledge financial support for this research from the ESRC, project no. RES-000-23-1126.
†Corresponding Author: p.levine@surrey.ac.uk; Tel:+44 (0) 1483 68 9928; Fax: +44 (0) 1483 68 9548.

1 Introduction

"Habit is second nature, or rather, ten times nature," William James (1957)

In this paper we address the effects of multiple external habits and the ensuing lifestyles which have received separate treatment in the literature but have not been examined together. By multiple external habits we mean habits in labour-effort and consumption. Thus, in the case of consumption the household derives utility on the basis of comparing their consumption to an exogenously given benchmark; commonly known in the literature as 'catching-up with the Joneses'. In the case of labour supply the household derives disutility by comparing his work effort relative to an exogenously given benchmark; possible reasons for such *work-ethic* will be discussed shortly. By lifestyle we mean the equilibrium values and the inter-temporal paths of consumption and labour-effort. While habits are often regarded as having a negative impact only during inter-temporal stages of an economic outcome, we suggest that this may not be the case: in particular we investigate the extent to which both the dynamics, as well as the long-run steady-state equilibrium values of an outcome, are driven by the strength of these two habits. To complete our investigation, we also discuss the welfare implications and policy implications of our results.

Consumption habits and the related inefficiencies are relatively well researched in the literature. In a series of important papers Alonso-Carrera, Caballé and Raurich (2004/5/6) show in models of capital accumulation with the AK technology[1] that convergence path towards the steady-state is inefficient relative to the preferred path of the social planner when consumption habits are external. Carroll, Overland and Weil (1997, 2000) consider the transitional dynamics of an endogenous growth model with AK technology and show that with consumption habits the economy sluggishly moves to the balanced growth path. Alvarez-Cuadrado, Monteiro and Turnovsky (2004) show that with external or internal habits the time paths of variables such as per capita savings, consumption and capital substantially differ from the case when preferences are fully exogenous. However, labour supply is inelastic in these papers; a shortcoming partially addressed elsewhere in the literature. Indeed, in a model of consumption-habits only, Seckin (2001) show that the consumption-leisure trade-off is weaker and thus agent's lifestyle is one of high consumption and low leisure. In an endogenous growth model with elastic labour-supply and no habits Turnovsky (2000) highlight the role of fiscal policy and its adverse affects for the balanced growth path. These results are of special relevance to us as they may be reversed or strengthened depending on the relative strength of the two habits; as we

[1] Alonso-Carrera (2004) is an exception. Here they employ what is known as the Sobelow production function: $f(k) = Ak + Bk^{\beta}$; a combination of the Cobb-Douglas and the AK functions.

discuss later.

Compared with consumption habit, the interest in the idea of work ethic in the sense that household supply labour by comparing to an externally given benchmark is sparse. Indeed, why should the household compare their work level with the Joneses when they dislike working at first place. To answer this question, it is best to separate it into two sub questions: a) why work more and b) why compare those levels to that of the Joneses. Tentative answers to these question may be provided by the research based on Max Weber's ideas of protestant work ethic (PWE), on the one hand, and information theory and behavioral economics on the other. Many authors believe PWE sowed the seeds for the contemporary work culture where a strong desire for money may be a sign for success. In the Victorian era such a desire would translate into *God's grace*. Although, it is not possible to summarize the vast literature on PWE, the following few lines from Oates (1971) capture its essence: 'A universal taboo is placed on idleness, and industriousness is considered a religious ideal; waste is a vice, and frugality a virtue; complacency and failure are outlawed, and ambition and success are taken as sure signs of God's favour; the universal sign of sin is poverty, and the crowning sign of God's favour is wealth.' Therefore, a PWE society is not only hard-working, but also one where there are incentives to exert as much effort as everyone else; answering the two questions. Nonetheless, the extent to which PWE is a sound justification for catching-up with Jonses in labour supply in the 21st century is open to criticism. Consequently, we turn to our second set of explanations.

The information economics literature such as Holmstrom (1992) develop a model of career-concern (reputation) where there is uncertainty about the ability of workers. In this framework workers will choose to provide high effort so as to positively affect the beliefs on their ability. In a multi-agent model where workers compete with one another for a prize, such as promotions, one can envisage a situation where the reputation concern induces agents to work at least as hard as their peers. Such an argument is well-known in the tournament theory (See Prendergast (1999) for a review of this literature). In these models, the desire to outperform players (workers) in the tournament, assuming homogenous ability, induces players to work-hard as much as one another. Finally, Kandel and Lazear (1992) argue that in the presence of peer pressure where deviating from a norm delivers disutility to the agent, workers will supply at least as much effort as anyone else in the group. All these arguments give some justification for conducting research in comparison utility in labour supply; a key aim of this paper.

At this stage it is useful to briefly consider the existing literature on consumption and work habits. At an empirical level, Woittiez and Kapteyn (1998) find a significant empirical role for social interaction and habit formation in explaining female labour supply.

At a theoretical level, Ljungvist and Uhlig (2000) consider a model of consumption habits with labour supply, but no work ethic, and analyze the role of taxes. They highlight the importance of fine-tuning the economy intertemporally through an income-tax and also show that the optimal tax policy is procyclical. Our results are generally supportive of this view. Where we differ are the level of taxes and size of inefficiencies. Indeed, in a multiple habit setup people are taxed less than single habit model the reason being that one habit tends to negate the effects of the other. Lettau and Uhlig (2000) consider a model of consumption and leisure habits in the context of analyzing business cycle stylized facts; thus ignoring taxation and welfare issues. They generally are not supportive of work habits. For example, with leisure habits they argue that labour input is too smooth. However, recent empirical work, such as Gali (2005), show some constancy in working hours. They find that the average growth in weekly hours of workers in 21 US manufacturing industries during the period of 1958-1996[2] is close to zero; this despite the technological advances that have taken in the last two decades. Why are workers, new and experienced, pegged to similar working hours? Is it due to regulation? Or, is it work ethic? Vendirk (1993) consider how labour market experience feeds back into preferences through multiple habits. This feedback mechanism is particularly relevant for explaining unemployment hysteresis where transitory shocks lead to permanent changes. Kubin and Prinz (2002) consider a model with only work habits and show the positive link between work habits and current labour supply. In their model current labour-supply is more wage elastic in the long-run relative to the short-run. Faria and Léon-Ledesma (2004) consider the steady-state properties of a neoclassical growth model with only work-habits. They show that agents tend to overwork compared with the neoclassical labour supply and the level of the steady-state labour-supply depends on the type of technology.

We consider a dynamic model where an agent accumulates a stock of capital together with consumption and work habits. The agent takes as exogenous consumption and work benchmarks on the basis of which habits are formed. In line with empirical literature and the idea that habits are an evolutionary process, the agent gradually adjusts to habits. The agent has a Cobb-Douglas production technology, a far less restrictive framework than the AK function (See Alvarez-Cuadrado et al. (2004) on this point). In the presence of these habits, welfare costs arise because the agent overlooks the externality of conforming and contributing to the process of habit-formation by choosing a *suboptimal* lifestyle given

[2]NBER Industrial Dataset: Annual Average Growth in Weekly Working Hours: Food: 0.000754, Tobacco: 0.0011, Textile: 0.001827, Apparel: 0.001204, Lumber: 0.001763, Furniture: 0.001132, Paper: 0.000907, Printing 0.000975, Chemical: 0.001555, Petrol: 0.00464, Rubber: 0.001219, Leather: 0.001477, Stone: 0.001225, Print: 0.003457, Fabric: 0.001619, Machine: 0.001939, Electric: 0.000787, Motor: 0.002056, Transport: -0.00017, Instrument: 0.000316, Miscellaneous: 0.001121.

the level of overconsumption and overwork. As discussed below, this method of modelling habits is different from what is available from other literature in this area.

We extend the literature in three ways: (i) situations where an agents accumulates simultaneous habits have received relatively little attention but, as we have argued, are clearly appropriate; (ii) we examine the problem in the context of a capital accumulation model with endogenous labour supply, compare the results with that of the social planner and examine its dynamic features; (iii) using empirical estimates from the literature, we provide numerical results on the nature of the inefficiencies that arise in a multiple habit and the optimal path of taxes that brings the economy in line with that chosen by the social planner.

The rest of the paper is organized as follows. In Section 1 we set up the household's optimization problem. In Section 2 we discuss the nature of steady-states for both the centralized and the decentralized economies. We devote Section 3 to a discussion on the implications for the fiscal policy. In Section 4 we compare the dynamic characteristics of both economies in the vicinity of the steady state. Section 5 provides simulation results for these characteristics and a final Section concludes.

2 The Model

Consider an infinite horizon economy in continuous time that consists of infinitely-lived identical households. The household is assumed to have additively separable preferences over consumption $c(t)$ and labour-effort $l(t)$. The individuals take into consideration certain benchmark given externally when making decisions. Thus, they derive utility from consumption relative to a benchmark level $z(t)$. Hence, they are catching-up with the Joneses type agents. In line with the discussion in the Section (1), the individuals derive disutility by providing labour relative to a benchmark level $n(t)$. This benchmark level can be the result of PWE or peer-pressure so individuals do not feel bad so long as they work as much as anyone else[3]. Consequently, the instantaneous utility takes the form

$$U(c(t),l(t)) = \frac{(c(t)/z(t)^{\gamma})^{1-\sigma}}{1-\sigma} - \chi\frac{(l(t)/n(t)^{\varepsilon})^{1+\phi}}{1+\phi} \text{ with } \sigma,\phi > 0 \text{ and } \gamma,\varepsilon \in [0,1), \quad (1)$$

The power utility is standard and consistent with the requirements of RBC literature see Caroll et al. (2000), King et al. (1988), Campbell (1994) and Alvarez-Cuadrado (2004). The terms γ and ε capture the weight assigned to the consumption benchmarks and work ethic where unity implies the strongest form of conformity and zero implies a society is

[3]We exclude the possibility of pusnishment when the agent works over the benchmark.

free from benchmarking. When $\gamma = 0$, $\sigma > 1$ is the relative risk aversion parameter (or the inverse of the intertemporal elasticity of substitution). The constant $\chi > 0$ is a preference parameter and $\phi > 0$ is the elasticity of labour supply. In the steady state equilibrium of identical households, $c = z$ and $n = l$ and $U(c,l) = \frac{c^{(1-\gamma)(1-\sigma)}}{1-\sigma} - \chi \frac{l^{(1-\epsilon)(1+\phi)}}{1+\phi}$. We impose concavity in c and semi-convexity in l which requires

$$\sigma(1-\gamma) + \gamma > 0\,; \quad \phi(1-\epsilon) - \epsilon \geq 0. \tag{2}$$

The production function is a standard Hicks-neutral Cobb-Douglas given by

$$y(t) = f(k(t), l(t)) = Ak(t)^a l(t)^{1-a}, \; 0 < a < 1 \text{ and } A > 0. \tag{3}$$

where A represent the technology shocks. This production function has important merits. First, it conveniently allows for labour in the neoclassical model. Second, it is less restrictive in that it allows for time paths consistent with stylized facts something the AK technology lacks.

When household's output net of depreciation and consumption is positive there is capital stock accumulation so that

$$\dot{k}(t) = f(k(t), l(t)) - \delta k(t) - c(t), \tag{4}$$

where $\delta > 0$ is the rate at which capital depreciates. The economy is assumed to be closed.

The benchmarks or habits are subject to an evolutionary process and change over time according to:

$$\dot{z}(t) = \rho(c(t) - z(t)), \tag{5}$$

and

$$\dot{n}(t) = \alpha(l(t) - n(t)). \tag{6}$$

The Eq. (5) shows that the intertemporal change in the stock of consumption norms or habits depend on individual's current consumption relative to a benchmark. Likewise, Eq. (6) captures the evolution of work ethic and it depends on current work pattern relative to the levels inherent in society. Thus, whenever the current values for consumption or labour effort outweigh existing accepted norms the habit benchmarks evolves to a higher levels. The parameters ρ and α represent the relative importance of consumption and labour effort at various point in time. For example, as $\rho \to \infty$ consumption habits are instantaneously absorbed in current consumption without any friction. However, it is reasonable to assume for all habits that $\rho, \alpha \in (0,1)$; an assumption also found in Fuhrer (2000), Carroll et al. (2000), Abel (1990) and Constantinides (1990) for consumption habits. Therefore, agents only gradually adjust to new benchmarks.

3 The Optimization Problem

3.1 The Decentralized Economy

The representative consumer maximizes the discounted sum of utilities

$$U(0) = \int_0^\infty U(c(t), l(t))e^{-\theta t}dt, \tag{7}$$

by choosing a time path for consumption $c(t)$ and labour supply $l(t)$. The present is normalized so that $t = 0$. Therefore, lifetime utility is given by, $U(0)$ and θ is the pure rate of the time preferences. The consumer faces a lifetime constraint (4). In this version of the model the household takes habit stocks, $z(t)$ and $n(t)$, as exogenous in her optimal choices of consumption and labour effort. It is convenient to adopt a 'Yeoman-Farmer' model as the separation of household and firms is not central to our analysis[4].

Using the Maximum Principle the first-order necessary conditions, dropping t for ease of exposition, are

$$U_c = \psi, \tag{8a}$$

$$U_l = -\psi f_l, \tag{8b}$$

$$\dot{\psi} = (\theta + \delta)\psi - \psi f_k. \tag{8c}$$

where ψ is the shadow price of capital, i.e. the co-state variable associated with the constraint (4). At the equilibrium (8a) says that the utility from an additional unit of consumption adjusted for its affects on future habits equals the shadow value of capital ψ–the value of sacrificing a unit of households' assets in the future. Using (8a), the condition (8b) show that the marginal rate of substitution between consumption and labour is given by the marginal productivity of labour; giving the neoclassical labour supply curve. In both these conditions the household ignores the effect of his actions on the evolutionary process of habits. Equation (8c) is the standard inter-temporal allocation condition that equates the rates of returns on consumption and capital. Setting, $\dot{\psi} = 0$ the equation gives the well-known *modified-golden-rule* which ensures maximum consumption when the net marginal productivity of capital equals the rate of time preference. The transversality condition is $\lim_{t\to\infty}[e^{-\theta t}\psi(t)k(t)] = 0$ and says that the value of capital–the quantity $k(t)$ time its shadow price–approaches zero to time goes to infinity. The intuition is that if we think of $t = \infty$ as some final point in household's planning, then at this point in time he does not want to leave behind any unconsumed asset. Finally, the initial condition $k(0)$ is exogenously given.

[4] It is straightforward to show the standard result that separating households and firms lead to the same equilibrium.

The steady-state values for labour effort, consumption and capital stock in the decentralized economy (DE) are obtained by substituting out the derivatives of the utility and production functions in the first order conditions. Then manipulating and evaluating at the steady-state gives:

$$l^{DE} = \left[\frac{\chi^{-1} A(1-a) \left(\frac{aA}{\theta+\delta}\right)^{\frac{a-[(1-\gamma)\sigma+\gamma]}{1-a}}}{\left(\frac{\theta+(1-a)\delta}{a}\right)^{[(1-\gamma)\sigma+\gamma)]}} \right]^{\frac{1}{(1-\varepsilon)\phi-\varepsilon+\sigma(1-\gamma)+\gamma}} \tag{9a}$$

$$c^{DE} = \left(\frac{aA}{\theta+\delta}\right)^{\frac{1}{1-a}} \left[\frac{\theta+(1-a)\delta}{a}\right] l^{DE} \tag{9b}$$

$$k^{DE} = \left(\frac{aA}{\theta+\delta}\right)^{\frac{1}{1-a}} l^{DE} \tag{9c}$$

The economy is entirely driven by labour-effort which in turn strongly responds to deeply rooted habitual patterns. For example, it is straight forward to check from (9a) that given (2), households unambiguously supply more labour when the work ethic, ε, increases; a result also present in Kubin and Prinz (2002). Similarly, the household labour supply is unambiguously positively related to the consumption habit parameter γ provided that $\sigma > 1$. The equilibrium consumption in (9b) depends on the labour-supply which in turn depends on the habits. Finally, from (9c), the accumulation of capital also increases with habit. Thus to summarize we have:

Proposition 1

Provided the concavity and convexity condition holds and $\sigma > 1$, individuals in the economy consume, work and produce more as both consumption and work habits assume greater importance.

Habit in short produces high consumption, output and labour supply; a lifestyle unambiguously inefficient in the eyes of the social planner as we discuss next.

3.2 The Social Optimum or Internal Habit

The analysis thus far was restricted to a decentralized economy with competitive households. We can use the same setup of the model and pretend that the economy is run by a benevolent social planner who maximizes the household's the lifetime expected utility (7) by internalizing the presence of the two habits. Hence, alongside (4) the planner is also constrained by (5) and (6). There are now three state variables $n(t), z(t)$ and $k(t)$ which are affected by households decisions. The current value Hamiltonian, dropping t, is

$$H = U(c, z, n, l) + \lambda\rho(c - z) + \beta\alpha(l - n) + \psi[f(k, l) - c - \delta k], \tag{10}$$

where ψ, λ and β are the shadow values of capital, consumption and working habits respectively. The necessary first-order conditions are

$$U_c + \lambda\rho - \psi = 0, \tag{11a}$$

$$U_l + \beta\alpha + \psi f_l = 0, \tag{11b}$$

$$\dot{\lambda} = -\frac{\partial H}{\partial z} + \theta\lambda = -U_z + (\rho + \theta)\lambda, \tag{11c}$$

$$\dot{\beta} = -\frac{\partial H}{\partial n} + \theta\beta = -U_n + (\alpha + \theta)\beta, \tag{11d}$$

$$\dot{\psi} = -\frac{\partial H}{\partial k} + \theta\psi = -\psi(f_k - \delta) + \theta\psi. \tag{11e}$$

Laws of motions (5), (6) and (4), and first-order conditions (11a) to (11e) gives us eight equations for sequences $c(t)$, $z(t)$, $n(t)$, $l(t)$, $k(t)$, $\lambda(t)$, $\beta(t)$ and $\psi(t)$. The initial conditions are $z(0) = z_0$, $n(0) = n_0$ and $k(0) = k_0$ for the non-determined variables and the transversality conditions:

$$\lim_{t\to\infty} e^{-\theta t}\psi(t)k(t) = 0, \tag{12a}$$

$$\lim_{t\to\infty} e^{-\theta t}\lambda(t)z(t) = 0, \tag{12b}$$

$$\lim_{t\to\infty} e^{-\theta t}\beta(t)n(t) = 0. \tag{12c}$$

The conditions (11a) and (11b) are the first-order condition adjusted for evolutionary nature of habits. The left-hand-side of (11a) says that a rise in consumption has two effects: it raises marginal utility and makes the household catch-up with the benchmark. The consumption norms have a shadow-value λ which is then discounted by the strength of its habit evolution, ρ. At the equilibrium these increments must be matched by an equal decrease in the accumulation of future capital stock, evaluated at ψ. By substituting (12a) in (12b) we get the labour supply of the neoclassical model with the difference that optimal wage (marginal-product of labour) must now balance the trade-offs of relative marginal utilities and the relative importance of consumption and work habits through time. The tranversality conditions for capital stock is the same as is the DE. The intuition for the conditions (12b) and (12c) is that it only makes sense to conform and reform to habits before the household reaches the end of his planning horizon, i.e. when time is strictly finite, after this point the value of habits reaches zero.

By substituting out for various derivatives of the utility and production functions in the first-order conditions and evaluating at the steady-state after some manipulation we obtain the soically-optimal (SO) steady-state levels of labour supply, consumption and capital

$$l^{SO} = \left[\frac{\chi^{-1} A(1-a) \left(\frac{aA}{\theta+\delta}\right)^{\frac{a-[(1-\gamma)\sigma+\gamma]}{1-a}}}{\left(\frac{\theta+(1-a)\delta}{a}\right)^{[(1-\gamma)\sigma+\gamma)]}} \times \frac{\left(1-\frac{\rho\gamma}{\rho+\theta}\right)}{(1-\frac{\varepsilon\alpha}{\alpha+\theta})} \right]^{\frac{1}{(1-\varepsilon)\phi-\varepsilon+(1-\gamma)\sigma+\gamma}}, \tag{13a}$$

$$c^{SO} = \left(\frac{aA}{\theta+\delta}\right)^{\frac{1}{1-a}} \left[\frac{\theta+(1-a)\delta}{a}\right] l^{SO}, \tag{13b}$$

$$k^{SO} = \left(\frac{aA}{\theta+\delta}\right)^{\frac{1}{1-a}} l^{SO}. \tag{13c}$$

The intuition of the factors that affect labour supply are same as in the decentralized economy. However, there is one extra term, the second term in the square brackets in (13a), which is the ratio of the parameters representing work to consumption habits. As is the in the case of DE, the consumption levels and capital stock depend on the labour supplied.

Proposition 2

In the steady state, the level of labour-effort in the decentralized economy, l^{DE}, is *less* than the efficient level, l^{SO}, if only and if

$$\left(1-\frac{\rho\gamma}{\rho+\theta}\right) > \left(1-\frac{\alpha\varepsilon}{\alpha+\theta}\right). \tag{14}$$

Taking propositions 1 and 2 together we can see that consumption and work habit have the same effect on labour supply, consumption and output. External habits (or Keeping-up with the Jones) means that people consume more at the expense of leisure. The work ethic effect of habit in labour supply mean that households work more adding to the consumption habit effect. *Both forms of habit drive us towards the 24/7 society. However, the two externalities involved in external habit work in opposite directions.* For consumption external habit is a negative externality as it reduces the utility of others in the economy. By contrast external habit in labour supply reduces the disutility and therefore is a positive externality. Hence the inefficiencies move in opposite directions and tend to cancel out, as in proposition 2.

.

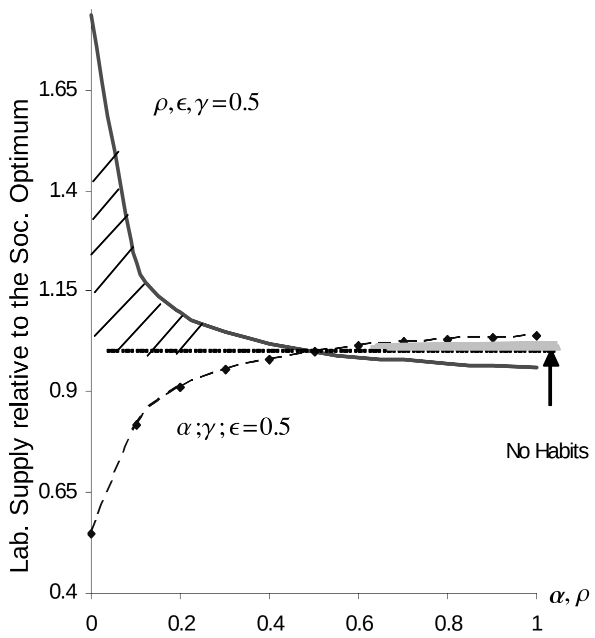

Figure 1: Relative Labour Supply

In case where there is no presence for both consumption and labour effort habits, $\gamma = \varepsilon = 0$ the both sides of (14) is unity and the decentralized economy is efficient. For the social optimum or an economy where habits formation is internalized, i.e., (11a)-(11e), the level of labour effort supplied is determined as follows. On the one hand, it depends on the importance of consumption relative to the benchmark, γ, and the relative weight of consumption at different times, ρ. On the other hand, it depends on the importance of work ethic, ε, and the relative weight of work-effort at different times α. In a steady-state where consumption habits dominate working habits (i.e., $\frac{\rho\gamma}{\rho+\theta} > \frac{\alpha\varepsilon}{\alpha+\theta}$) the supply of labour is always greater than the one chosen by the social planner. Similarly, the consumption and capital stock are greater than those chosen by the social planner when social consumption habit dominate work habits [5]. To illustrate this point, consider Figure 1 where we plot labour supply of the decentralized economy relative to the centralized economy by dividing Eq. (13a) and (9a). We use the parameters values collected from the literature in Table 1 below.

For the solid line in Figure 1 we set $\rho, \varepsilon, \gamma = 0.5$, $\theta = 0.05$ and vary the speed of adjustment to labour-benchmark α between zero and unity. When there are no accumulation of

[5] A similar result was obtained in Choudhary and Levine (2006) where ρ, $\alpha \to \infty$ and they get $(1-\gamma) > (1-\epsilon)$ but in a New Keynesian model output and labour market imperfections, but without capital.

work habits, as is commonly done in the growth literature, the amount of labour supplied is always greater than the social optimum. However, as work habits accumulate, the level of decentralized labour supplied gradually falls in line with that of the social optimum. Now, consider the broken-squared-line where we set α, ε,$\gamma = 0.5$, $\theta = 0.05$ and instead vary between zero and unity the speed of adjustment consumption benchmark ρ. As long as the adjustment in consumption habit dominate the work habit parameter ($\rho > \alpha$), the decentralized labour supply exceeds the social optimum i.e., the shaded areas. However, the empirical estimates of γ, ρ and ε, α are mixed and this has non-trivial implications for studies such as Fuhrer (2000), Carroll et, al. (2000), Abel (1990) and Constantinides (1990), Faria and León-Ledesma (2004), Alvarez-Cuadrado et, al. (2004). For most studies is the grey area in Fig. 1.

Table 1. The Range of Parameters from the Literature

		Parameters										
Papers		ρ	γ	σ	ε	φ	χ	α	A	a	δ	θ
Alanso-Carrera, et al. (2005)	US		0.5	5					0.18	0.35	0.09	0.03
Alanso-Carrera et. al. (2004)	US	0.35	0.15	2					1		0.06	0.03
Carroll et al. (2000)	US	0.2	0.25-0.75	11/3-9							0.09	0.03
Carroll et al. (1997)	US	0.2	0.5	2							0.05	0.05
Alvarez-Caudrado et al (2004)	US	0.2	0.5	2.5					1	0.35	0.05	0.04
Choudhary and Levine (2006)	US		0.8		0.5							0.01
IMF (2003) (Bayoumi et al.)	WORLD		0.5-0.97	5.0	$\epsilon = \gamma$	3						-
Euro-Model (2003) (Smets et al.)	Euro Zone			1.4		2.4						-
Basu and Kimball (2000)	US					0.35						-
Ham and Reilly (2003)	UK					0.5-1.5						-
Baseline		0.2	0.5	2	0.5	0.2	1	2.0	1	0.35	0.05	0.03

4 The Decentralized Economy with Taxes

In order to study the role of taxation in correcting for inefficiencies in the households optimization problem, we now add a consumption tax $\tau(t)$ to the model which is redistributed as a flat-rate transfer $S(t)$ back to households.[6] The capital stock accumulation (4) now becomes

$$\dot{k}(t) = f(k(t), l(t)) + S(t) - \delta k(t) - (1 + \tau(t))c(t), \tag{15}$$

[6] Other taxes to capital or labour can be shown to have exactly the same role.

The household now maximizes the utility (7) with respect to $c(t)$, $l(t)$ and subject to capital stock accumulation (15) taking $z(t)$, $n(t)$ and $S(t)$ as given. After redistribution $S(t) = \tau(t)c(t)$, so in an equilibrium of identical households, (15) is no different from (4), but household consumption is changed.

Using the Maximum Principle the first-order conditions for this optimization problem are

$$\begin{aligned} \frac{\partial H}{\partial c} &= U_c - \psi(1+\tau) = 0, && (16a) \\ \frac{\partial H}{\partial l} &= U_l + \psi f_l = 0, && (16b) \\ \dot{\psi} &= -\psi f_k + (\theta + \delta)\psi. && (16c) \end{aligned}$$

The first-order conditions are interpreted in a similar in Section 2. The key difference is that in (16a) a fraction of marginal utility is shaved-off as a result of the taxes on consumption.

Let $\bar{\tau}$ be the steady-state value of the consumption tax. Then the steady-state level of labour effort, consumption and capital stock corrected for the inefficiency is

$$l^{DE} = \left[\frac{\chi^{-1} A(1-a) \left(\frac{aA}{\theta+\delta}\right)^{\frac{a-[(1-\gamma)\sigma+\gamma]}{1-a}}}{(1+\bar{\tau}) \left(\frac{\theta+(1-a)\delta}{a}\right)^{[(1-\gamma)\sigma+\gamma)]}} \right]^{\frac{1}{(1-\varepsilon)\phi-\varepsilon+\sigma(1-\gamma)+\gamma}} \qquad (17)$$

$$c^{DE} = \left(\frac{aA}{\theta+\delta}\right)^{\frac{1}{1-a}} \left[\frac{\theta+(1-a)\delta}{a}\right] l^{DE} \qquad (18)$$

$$k^{DE} = \left(\frac{aA}{\theta+\delta}\right)^{\frac{1}{1-a}} l^{DE} \qquad (19)$$

The introduction of taxes has the affect of directly reducing the steady-state levels of work effort in (17) and indirectly, the level of consumption and capital stock in (19). Hence output falls as well. In order to find the optimal level of taxation, we divide (13a) by (9a). The optimal level of taxes is then given by

$$\bar{\tau} = \left[\frac{\frac{\rho\gamma}{\rho+\theta} - \frac{\alpha\epsilon}{\alpha+\theta}}{1 - \frac{\rho\gamma}{\rho+\theta}} \right] \qquad (20)$$

It follows that in the steady state consumption should be taxed or subsidized according to whether the total consumption habit effect, $\frac{\rho\gamma}{\rho+\theta}$ is greater or less than the total work ethic effect $\frac{\alpha\varepsilon}{\alpha+\theta}$. All this, of course, is in accordance with proposition 2.

The decentralized economy can be brought into line with the social optimum at each point in time by a tax rate that equates the marginal rate of substitutions (MRS) between consumption and work in the two economies. From the first order conditions (16a) and (16b) we have that the MRS for the decentralized economy is given by

$$MRS^{DE} \equiv -\frac{U_c^{DE}}{U_l^{DE}} = \frac{1+\tau}{f_l^{DE}} \tag{21}$$

It follows that the optimal tax rate that achieves $MRS^{DE} = MRS^{SO}$ is given by

$$\tau = MRS^{SO} f_l^{DE} - 1. \tag{22}$$

Consider Table 2 below we look at variations in the parameters of Eq. (20) and their corresponding affect on the optimal tax.

Table 2: Optimal taxes in a variety of cases.

Cases	Taxes ($\bar{\tau}$)
(a) Symmetric Habits ($\gamma = 0.4$, $\epsilon = 0.4$, $\alpha = \rho = 2, \theta = 0.03$)	0
(b) Only Consumption Habit ($\gamma = 0.4$, $\epsilon = 0$, $\alpha = \rho = 2, \theta = 0.03$)	0.65
(c) Con. Habits>Work Habit ($\gamma = 0.6$, $\epsilon = 0.4$, $\alpha = \rho = 2, \theta = 0.03$)	0.48
(d) Only Work Habit ($\gamma = 0$, $\epsilon = 0.4$, $\alpha = \rho =2$, $\theta = 0.03$)	-0.39
(e) Con. Habit<Work Habit ($\gamma = 0.4$, $\epsilon = 0.6$, $\alpha = \rho = 2, \theta = 0.03$)	-0.32

In case (a) in Table 2 habits are symmetric and there is no need to for taxes. This is because the negative externality, due to the consumption habit, is cancelled out by the positive externality of work ethic. In case (b) when there are no work habits; a case usually considered in literature. For example, Ljungqvist and Ulhig (2000) show that without work habits and external consumption habit, the taxes should equal 0.60; using parameters values in Table 2. However, with the introduction of work habits and assuming that consumption habits dominate, their optimal tax falls to 0.33[7]. In this simple comparison taxes are 45% lower which is non-trivial. Therefore, the relative importance of the two habits matters a great deal for taxation at the steady-state; a result different from Alsonso-Carrera et al. (2005) In case (c) where consumption habits are 33% higher our economy, taxes are 17% lower than in a model where work habits are ignored. In case (d) where households only develop work-habits the social planner subsidizes consumption instead. This is done so as to bring the marginal rate of substitution in line with that of the SO economy as we discuss later.

[7]When we introduce work habits in Ljungqvist and Uhlig (2000) model and assume instantaneous absorption of habits, as they do, the optimal tax becomes: $\tau = 1 - \frac{1-\gamma}{1-\epsilon}$

5 The Dynamic Analysis

In this section we study the convergence of our model economies towards the steady state. Convergence occurs if only and if the model is stable . We confine ourselves to the examination of local stability in the vicinity of the steady state. First we linearize U_c, U_l, U_z and U_n about the steady state to give

$$\begin{aligned}
U_c(z,c) &\simeq U_c(\bar{z},\bar{c}) + U_{cz}(\bar{z},\bar{c})(z-\bar{z}) + U_{cc}(\bar{z},\bar{c})(c-\bar{c}) && (23)\\
U_l(n,l) &\simeq U_l(\bar{n},\bar{l}) + U_{ln}(\bar{n},\bar{l})(n-\bar{n}) + U_{ll}(\bar{n},\bar{l})(l-\bar{l}) && (24)\\
U_z(z,c) &\simeq U_z(\bar{z},\bar{c}) + U_{zz}(\bar{z},\bar{c})(z-\bar{z}) + U_{zc}(\bar{z},\bar{c})(c-\bar{c}) && (25)\\
U_n(n,l) &\simeq U_n(\bar{n},\bar{l}) + U_{nn}(\bar{n},\bar{l})(n-\bar{n}) + U_{nl}(\bar{n},\bar{l})(l-\bar{l}) && (26)
\end{aligned}$$

It is convenient to express variables as proportional deviations $\hat{x} = \frac{x-\bar{x}}{\bar{x}} \simeq \log\frac{x}{\bar{x}}$. Then

$$\begin{aligned}
U_c(z,c) &\simeq U_c(\bar{z},\bar{c}) + \bar{z}U_{cz}(\bar{z},\bar{c})\hat{z} + \bar{c}U_{cc}(\bar{z},\bar{c})\hat{c} && (27)\\
U_l(n,l) &\simeq U_l(\bar{n},\bar{l}) + \bar{n}U_{ln}(\bar{n},\bar{l})\hat{n} + \bar{l}U_{ll}(\bar{n},\bar{l})\hat{l} && (28)\\
U_z(z,c) &\simeq U_z(\bar{z},\bar{c}) + \bar{z}U_{zz}(\bar{z},\bar{c})\hat{z} + \bar{c}U_{zc}(\bar{z},\bar{c})\hat{c} && (29)\\
U_n(n,l) &\simeq U_n(\bar{n},\bar{l}) + \bar{n}U_{nn}(\bar{n},\bar{l})\hat{n} + \bar{l}U_{nl}(\bar{n},\bar{l})\hat{l} && (30)
\end{aligned}$$

We now consider the social optimum and the decentralized economy in turn:

5.1 The Social Optimum (SO)

Using (27)-(30), the linearized system for the SO becomes

$$\dot{\hat{z}} = \rho(\hat{c} - \hat{z}) \quad (31)$$

$$\dot{\hat{n}} = \alpha(\hat{l} - \hat{n}) \quad (32)$$

$$\dot{\hat{k}} = (f_k - \delta)\hat{k} + \frac{\bar{l}}{\bar{k}} f_l \hat{l} - \frac{\bar{c}}{\bar{k}}\hat{c} \quad (33)$$

$$\bar{z}U_{cz}\hat{z} + \bar{c}U_{cc}\hat{c} + \rho\bar{\lambda}\hat{\lambda} - \bar{\psi}\hat{\psi} = 0 \quad (34)$$

$$\bar{n}U_{ln}\hat{n} + \bar{l}U_{ll}\hat{l} + \alpha\bar{\beta}\hat{\beta} + f_l\bar{\psi}\hat{\psi} + \bar{\psi}(\bar{l}f_{ll}\hat{l} + \bar{k}f_{lk}\hat{k}) = 0 \quad (35)$$

$$\dot{\hat{\lambda}} = -\frac{\bar{z}}{\bar{\lambda}}U_{zz}\hat{z} - \frac{\bar{c}}{\bar{\lambda}}U_{zc}\hat{c} + (\rho + \theta)\hat{\lambda} \quad (36)$$

$$\dot{\hat{\beta}} = -\frac{\bar{n}}{\bar{\beta}}U_{nn}\hat{n} - \frac{\bar{l}}{\bar{\beta}}U_{nl}\hat{l} + (\alpha + \theta)\hat{\beta} \quad (37)$$

$$\dot{\hat{\psi}} = -(\bar{l}f_{kl}\hat{l} + \bar{k}f_{kk}\hat{k}) \quad (38)$$

where all partial derivatives are evaluated at the steady state.

The model can be set up in state space form as a linear system

$$\begin{bmatrix} \dot{\mathsf{z}}(t) \\ \dot{\mathsf{x}}(t) \end{bmatrix} = A \begin{bmatrix} \mathsf{z}(t) \\ \mathsf{x}(t) \end{bmatrix} + B \begin{bmatrix} \hat{c}(t) \\ \hat{l}(t) \end{bmatrix} \tag{39}$$

$$\begin{bmatrix} \hat{c}(t) \\ \hat{l}(t) \end{bmatrix} = C \begin{bmatrix} \mathsf{z}(t) \\ \mathsf{x}(t) \end{bmatrix} \tag{40}$$

where $\mathsf{z}(t) = [\hat{z}(t), \hat{n}(t), \hat{k}(t)]$ is a vector of predetermined variables at time t and $\mathsf{x}(t) = [\hat{\lambda}(t), \hat{\beta}(t), \hat{\psi}(t)]$ are non-predetermined variables. The condition for saddle-path stability is that the matrix $A+BC$ should have 3 eigenvalues; One with real part greater than zero and two with less than zero[8].

Matrices A, B and C are given by

$$A = \begin{bmatrix} -\rho & 0 & 0 & 0 & 0 & 0 \\ 0 & -\alpha & 0 & 0 & 0 & 0 \\ 0 & 0 & \theta & 0 & 0 & 0 \\ -(\rho+\theta)(1+\gamma(1-\sigma)) & 0 & 0 & \rho+\theta & 0 & 0 \\ 0 & \frac{(\alpha+\theta)}{(1+\varepsilon(1+\phi))^{-1}} & 0 & 0 & \alpha+\theta & 0 \\ 0 & 0 & (1-a)(\theta+\delta) & 0 & 0 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} \rho & 0 \\ 0 & \alpha \\ -\frac{(\theta+(1-a)\delta)}{a} & \frac{(1-a)(\theta+\delta)}{a} \\ -(\rho+\theta)(1-\sigma) & 0 \\ 0 & -(\alpha+\theta)(1+\phi) \\ 0 & -(1-a)(\theta+\delta) \end{bmatrix}$$

$$C = \begin{bmatrix} -\frac{\gamma(1-\sigma)}{\sigma} & 0 & 0 & -\frac{\rho\gamma}{\sigma(\rho+\theta)} & 0 & -\frac{1}{\sigma}(1-\frac{\gamma\rho}{\rho+\theta}) \\ 0 & \frac{\varepsilon(\alpha+\theta)(1+\phi)}{x} & \frac{((\alpha+\theta)-\alpha\varepsilon)a}{x} & 0 & \frac{\alpha\varepsilon}{x} & \frac{(\alpha+\theta)-\alpha\epsilon}{x} \end{bmatrix}$$

where $x = [(\alpha+\theta)-\alpha\varepsilon]a + \phi(\alpha+\theta)$.

Simulation using baseline values of parameters and a range of alternatives around the baseline showed the saddle-path stability condition is satisfied and robust. Looking at our matrices A, B and C it is clear that there are two driving forces in our transitional dynamics. The first are the parameters of the speed of adjustments to habits and the weight assigned to habit benchmarks in both consumption and labour supply. The second

[8]See Blanchard and Kahn (1980) for the discrete-time case and Levine and Currie (1987) for the continuous-time case appropriate for this paper.

is the diminishing returns in our production function. Say, for sake of argument, we rid ourselves of diminishing returns and ignore work-habits so that $a = 1$ and $\varepsilon, \alpha = 0$. In this case the dynamics are entirely driven by the speed of adjustments and the weight assigned to consumption benchmarks and as a result an important piece of action goes missing. Carroll et al., Alonso-Carrera et al. and Alvarez-Cuadrado et al. incorporate only consumption dynamics. However, Alvarez-Cuadrado et al. and Alonso-Carrera et al. (2004) highlight the important role diminishing returns play during transitional dynamics with internal consumption habits formation.

5.2 The Decentralized Economy (DE)

Consider the decentralized economy without taxes. The linearized system for the DE follows by putting $\hat{\lambda}(t) = \hat{\beta}(t) = 0$ in (31)-(38) to get

$$\dot{\hat{z}} = \rho(\hat{c} - \hat{z}) \tag{41}$$

$$\dot{\hat{n}} = \alpha(\hat{l} - \hat{n}) \tag{42}$$

$$\dot{\hat{k}} = (f_k - \delta)\hat{k} + \frac{\bar{l}}{\bar{k}} f_l \hat{l} - \frac{\bar{c}}{\bar{k}}\hat{c} \tag{43}$$

$$\bar{z}U_{cz}\hat{z} + \bar{c}U_{cc}\hat{c} - \bar{\psi}\hat{\psi} = 0 \tag{44}$$

$$\bar{n}U_{ln}\hat{n} + \bar{l}U_{ll}\hat{l} + f_l\bar{\psi}\hat{\psi} + \bar{\psi}(\bar{l}f_{ll}\hat{l} + \bar{k}f_{lk}\hat{k}) = 0 \tag{45}$$

$$\dot{\hat{\psi}} = -(\bar{l}f_{kl}\hat{l} + \bar{k}f_{kk}\hat{k}) \tag{46}$$

where all partial derivatives are evaluated at the steady state of the decentralized economy. The state-space form of DE is (39) and (40) where $\mathsf{z}(t) = [\hat{z}(t), \hat{n}(t), \hat{k}(t)]$ is a vector of predetermined variables at time t as for the SO, but now $\mathsf{x}(t) = [\hat{\psi}(t)]$ consists of only one non-predetermined variable. The condition for saddle-path stability is that there should be 3 eigenvalues real part less than zero and 1 with real part greater than zero.

Matrices A, B and C for with the parameter values for which the steady-state is same to that of the social optimum are

$$A = \begin{bmatrix} -\rho & 0 & 0 & 0 \\ 0 & -\alpha & 0 & 0 \\ 0 & 0 & \theta & 0 \\ 0 & 0 & (1-a)(\theta+\delta) & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} \rho & 0 \\ 0 & \alpha \\ -\frac{(\theta+(1-a)\delta)}{a} & \frac{(1-a)(\theta+\delta)}{a} \\ 0 & -(1-a)(\theta+\delta) \end{bmatrix}$$

$$C = \begin{bmatrix} -\frac{\gamma(1-\sigma)}{\sigma} & 0 & 0 & -\frac{1}{\sigma} \\ 0 & \frac{(\phi+1)\varepsilon}{a+\phi} & \frac{a}{a+\phi} & \frac{1}{a+\phi} \end{bmatrix}$$

As for the SO, simulation using baseline values of parameters and a range of alternatives around the baseline showed the saddle-path stability condition is satisfied and robust. So far we have considered the DE without taxes. With taxes

$$\bar{z}U_{cz}\hat{z} + \bar{c}U_{cc}\hat{c} - (\bar{\psi} + \bar{\tau})\hat{\psi} - \bar{\psi}\hat{\tau} = 0 \tag{47}$$

where $\hat{\tau} = \tau - \bar{\tau}$. Then with $\bar{\tau}$ given by (20) the DE can be put on the path of the SO if $\hat{\tau}$ is chosen such that

$$\hat{\tau} = -(1-\sigma)\gamma\hat{z}^{DE} - \psi^{DE} - \sigma\hat{c}^{SO} \tag{48}$$

5.3 Simulations

5.3.1 Simulations where the SO and DE Steady States Coincide

We now turn to simulations of the SO and the DE economies. We assume that at time $t = 1$ the capital stock is 10% below its long-run steady steady in both cases so that $\hat{k}(0) = -10$. The parameter values are baseline values from Table 1: $\rho = \alpha = 0.2$, $\gamma = \epsilon = 0.5$, $\sigma = \phi = 2.0$, $\theta = 0.02$, $\delta = 0.05$ and $A = \chi = 1$. For these symmetrical parameter values the steady-states of the SO and the DE are the same. In fact its the the point where the two curves meet in Figure 1. The simulations we present isolate the effects of habit in consumption and labour supply on the transitional dynamics.

Insert Figures 2 and 3 Here

Figures 2 and 3 compare consumption and consumption habit in the SO and the DE. In both cases consumption immediately falls by $3\% - 4\%$ (relative to the steady state for all variables), and savings rise but the first-period adjustment is greater for the DE. Because this drop is too high relative to the SO a *consumption subsidy* starting at 1.5% is required to bring the DE in line with the SO. The reason is that in the DE the household ignores that effect of a fall in current consumption on the evolution of the habit, whereas, the SO internalizes this effect. Consequently, prevented by the habit, the initial drop in consumption is less pronounced for the SO than for the DE; Alvarez et al. (2004) find a similar result. Corresponding to the immediate fall in consumption *levels* we see a gradual drop in the stock of consumption habit reaching $2\% - 2.5\%$ after almost 10 years, this being more pronounced for the DE. The trough occur with some lag as habit evolution is not instantaneous.

Insert Figures 4 and 5 Here

Figures 4 and 5 compare labour supply and labour supply habit in the SO and the DE. In both cases labour supply immediately rises by 1.7% for the DE and 2.2% for the SO. The planner supplies more labour in the SO as he can see the future benefit arising from of the externality of working harder. This increases output and provides a further resource available for investment. Corresponding to this immediate rise in labour supply see a gradual rise in the stock of labour supply habit peaking at round after 12 years for both the SO and the DE. In later years labour supply returns to its steady state and is consistently higher in the SO compared with the DE. The subsidy for consumption then encourages the substitution of leisure for consumption and work effort increases.

As a result of more saving by the household and more effort resources are channeled into investment and capital stock returns to its steady state. Although more labour is employed in the SO which tends to increase output, savings out of a given level of output is lower (recall that consumption drop in SO was less pronounced). The net effect is that investment is lower in the SO and hence the capital stock, as Figure 6 shows. Our result show that capital destruction is followed be a period of high savings and increased economic growth is consistent with the empirical observation. We also find that this shock leads to a drop in habits. However, Carroll et. al (1997) find different results. This is because they examine models without variable labour supply and an AK production function so that growth does not gradually rise following a destruction in capital as in our case.

Insert Figures 6 Here

Finally, we compare the consumer's welfare under the SO and the DE. Let $c^{SO}(t) = c^{SO}(1 + \hat{c}^{SO})$ be the actual transition path for consumption under the SO, where c^{SO} is the steady state. The same procedure is carried out the rest of the variables and also the DE. Define the intertemporal utility of the household over the horizon $[1, T]$ as:

$$\Omega^{SO}(T) = \int_1^T \left(\frac{(c^{SO}(t)/z^{SO}(t)^{\gamma})^{1-\sigma}}{1-\sigma} - \chi \frac{\left(l^{SO}(t)/n(t)^{SO^{\varepsilon}}\right)^{1+\phi}}{1+\phi} \right) e^{-\theta t} dt \tag{49}$$

Then we can write down the percentage welfare gain from having a social planner (in other words, the inefficiency of the DE) as

$$G(T) = \frac{\Omega^{SO}(T) - \Omega^{DE}(T)}{\mid \Omega^{SO}(T) \mid} \times 100 \tag{50}$$

Another way of measuring these welfare gains is in terms of the *equivalent permanent % increase in consumption.* Expanding the single-period utility function as a Taylor series and integrating the discounted utility over time, a 1% permanent increase in consumption increases the steady state inter-temporal utility at the SO by $(1-\gamma)(c^{SO})^{(1-\gamma)(1-\sigma)}/\theta \times 0.01$. An intertemporal welfare difference of $\Omega(\infty)^{SO} - \Omega(\infty)^{DE}$ is therefore equivalent to a permanent consumption equivalent % increase, c_e, given by

$$c_e = \frac{\Omega(\infty)^{SO} - \Omega(\infty)^{DE}}{(1-\gamma)(c^{SO})^{(1-\gamma)(1-\sigma)}/\theta \times 0.01} \tag{51}$$

This function of T is plotted in Figure 7. The higher proportional divergence between the SO and the DE in the earlier years means that the welfare gain starts at a high level but thereafter falls.

Insert Figure 7 Here

As $t \to \infty$ the welfare gain tends to around $G(\infty) = 0.5\%$ for which using (51), $c_e = 0.08\%$. This, it should be stressed, is for parameter values for which the steady-states of the SO and the DE are the same so the result that emerges is that *the inefficiency of the DE in terms only of transitional dynamics seems to be small.* This result is in stark contrast contrast with Alonso-Carrera et al. (2005) who stress on the importance of dynamics inefficiency; hence taxation during transition. However, this result is in line with Ljungqvist and Uhlig (2000) who also find the dynamic fine-tuning less important when the social planner sets the optimal tax rate to its steady-state value. The intuition behind this result is that the inefficient consumption-leisure choice in the DE quickly fades away as the economy returns to its efficient steady state since the agent can choose the optimal labour supply. If the steady state of the DE is inefficient however the welfare implications are quite different, as we now see.

5.3.2 Simulations where the SO and DE Steady States Differ

We now consider the case where the steady states of the SO and the DE differ. We retain previous parameter values except now $\epsilon = 0$ so there is only consumption habit, but no labour supply habit, as in much of the literature. Now according to proposition 2 the steady state consumption and labour supply in the DE is above that of the SO.

Insert Figures 8-13 Here

We now carry out a similar exercise to above. Capital stocks is initially 10% below the steady state of the SO. Figures 8 to 13 show the results for this case. All values are measured relative to the steady state of the SO, so for the latter the relevant variable converges to zero, but for the DE it converges to the difference between the steady states of the DE and the SO.

There are now welfare gains from the SO in the steady state[9] and during the transition path. The overall inter-temporal welfare gain in the SO $G(\infty) = 0.68\%$, which corresponds to $c_e = 1.33\%$, a considerable increase on the previous case where only transitional dynamics were involved. Table 3 compares the inefficiencies of the DE in these two cases.

Table 3. The Inefficiency of the DE

Parameters	$G(\infty)$	c_e
$\epsilon = \gamma = 0.5$	0.05	0.08
$\epsilon = 0,\ \gamma = 0.5$	0.68	1.33

The behavior of taxes under this situation is in contrast to the results in the literature. Consider Figure 8 where we can see the inter-temporal path of taxes which does not converge to zero over time. In fact the intervention starts off with a subsidy ($\tau < 0$ before developing into a permanent consumption tax ($\tau > 0$) in order to correct the persistent high consumption in the DE relative to the SO. The reason for the initial subsidy is that faced with only a permanent consumption tax, agents would overreact to the shock by under consuming relative to the social planner. Our economy without this tax or subsidy is not only less inefficient during the transition path, it is permanently inefficient at the steady state. Therefore, there is a *sustained* need for the government. Recent literature, for example Coenen, McAdam and Straub (2005) call for relaxing constraints in the Euro-zone labour market, via lower labour taxes, in the European in order to encourage working hours. Our paper, on the contrary, suggest that policies trying improve work-hours may not be desirable if habit in consumption exceeds that in labour supply, which is the case in typical dynamic stochastic general equilibrium (DSGE) models.[10]

6 Conclusion

In this paper we analyze a dynamic equilibrium model where the households choose both consumption and labour supply and adopt multiple habits of the ring to which they belong.

[9] This is not always the case with discounting because then the steady state of the inter-temporal optimum is not the same as the optimum of the steady state. For parameter values that bring the steady state of the SO and the DE closer we find that with a discounting parameter $\theta = 0.03$, the steady state of the SO does actually yield a higher welfare than that for the DE.

[10] Indeed this is true for the model of Coenen, McAdam and Straub (2005) which is based on Smets and Wouters (2003), since these models only have habit in consumption.

Our main findings are: First, consumption and work habit have the same effect on labour supply, consumption and output. Keeping up with the Jones means that people consume more at the expense of leisure. The work ethic effect of habit in labour supply mean that households work more, adding to the consumption habit effect. Both forms of habit, drive us towards the 24/7 society. Second, the two externalities involved in external habit work in opposite directions. For consumption external habit is a *negative* externality as it reduces the utility of others in the economy. By contrast external habit in labour supply reduces the *disutility* and therefore is a *positive* externality. Hence the inefficiencies move in opposite directions and tend to cancel out. Multiple habits can therefore involve both a consumption tax and subsidy to correct for these externalities. Third, with plausible parameter values the welfare consequences of multiple habits are far greater where there are long-run inefficiencies compared with only transitional inefficiency, as in much of the literature that ignores changes in labour supply. Finally there are important policy implications for the proposed liberalization of the European labour market. Our paper suggests that the lower working hours observed in Europe compared with the US may not be welfare-reducing if habit in consumption exceeds that in labour supply.

The most pressing issue for future research is the empirical relevance of the multiple habit model and indeed whether habit is external or internal. A systematic empirical assessment of the various forms of habit in the literature is clearly required.[11]. One way of proceeding is by a direct estimation of the two Euler equations in the present model. Another approach is to incorporate the competing models of habit into a DSGE model such as Smets and Wouters (2003) and use Bayesian methods to determine the preferred formulation. Both these avenues are the subject of current research by the authors.

[11] This could be extended to include 'deep habits' as in Ravn, Schmitt-Grohe and Uribe (2006).

References

[1] Abel, A. B. (1990), Asset Prices under Habit Formation and Catching up with Joneses, The American Economic Review, 80(2), 38-42.

[2] Abel, A. B. (1999), Risk Premia and Term Premia in General Equilibrium, Journal of Monetary Economics, 43, 3-33.

[3] Alesina, A., Glaaeser, E. and Sacerdote, B. (2005), Work and Leisure in the U.S. and Europe: Why so different?, NBER, Working paper 11278.

[4] Alonso-Carrera, J., Caballē, J. and Raurich, X. (2004), Growth, Habit Formation, and Catching-up with the Jonses, European Economic Review, 49, 1665-1691

[5] Alonso-Carrera, J., Caballē, J. and Raurich, X. (2005), Consumption, Externalities, Habit Formation and Equilibrium Efficiency, Scandinavian Journal of Economics 106(2), 231-251.

[6] Alonso-Carrera, J., Caballē, J. and Raurich, X. (2006), Welfare Implications of the Interactions between Habits and Consumption Externalities, International Economic Review. Forthcoming.

[7] Alvarez-Cuadrado, F., Monteiro G. and Tunrnovsky S., J. (2004), Habit Formation, Catching up with the Jonses, and Economic Growth, Journal of Economic Growth, 9, 47-80.

[8] Basu, S. and M. Kimball, (2000) Long-run labour supply and the Elasticity of Intertemporal Substitution for Consumption, Working paper, University of Michigan.

[9] Bayoumi, T., D. Laxton and P. G. Pesenti, 2004, Measuring the benefits and spillovers of greater competition in Europe: A macroeconomic assessment, European Central Bank, Working Paper No. 34.

[10] Blanchard, O. J. and C. M. Kahn. (1980), The Solution of Linear Difference Models Under Rational Expectations, Econometrica,5, 1305–1311.

[11] Campbell, J. Y. (1994), Inspecting the Mechanism, Journal of Monetary Economics, 33, 463-506.

[12] Carroll, C. D., Overland, J. and Weil, D. N. (2000), Saving and Growth with Habit Formations, The American Economic Review, 90(3). 341-355.

[13] Carroll, C. D., Overland, J. and Weil, D. N. (1997), Comparison Utility in a Growth Model, Journal of Economic Growth, 2, 339-367.

[14] Choudhary, M.A. and Levine, P. (2006), Idle Worship, Economics Letters, 90(1), 77-83.

[15] Coenen, G., McAdam, P. and Straub, R. (2005), 'Tax Reform and Labour Market Performance in The European: A Simulation Based Analysis Using the New Area Model,' ECB Working Paper.

[16] Constantinides, G., M. (1990), Habit Formation: A Resolution of the Equity Premium Puzzle, Journal of Political Economy, 98(3), 519-543.

[17] Fuhrer, J. C. (2000), Habit Formation in Consumption and Its Implications for Monetary Policy, American Economic Review, 90(3), 367-390.

[18] Faria, J. R. and Leon-Ledesma, M. (2004), Habit Formation, Work ethic and Technological Progress, The Manchester School, 72(3), 403-413.

[19] Gali, J. (1994), Keeping Up with the Jonses, Consumption Externalities, Portfolio Choice, and Asset Prices, Journal of Money Credit and Banking, 26, 1-8.

[20] Gali, J. (2005), Trends in Hours, Balanced Growth, and the Role of Technology in the Business Cycle, University of Pompeu Fabra, Working Paper 829.

[21] Ham, J.C. and Reilly K.T., (2002), 'Testing Intertemporal Substitution, Implicit Contracts, and Hours Restriction Models of the Labor Market Using Micro Data,' American Economic Review, 92,905-927.

[22] Holmström, B (1992), Managerial Incentive Problems- a dynamic perspective. In Essays in Economic and Management in Honor of Lars Wahlbeck, Helsinki. Swedish School of Economics.

[23] James, W. (1957), 'Principles of Psychology,' Dover Publications, Vol 1.

[24] Kendal, E. and Lezear E., P. (1992), "Pressure and Partnerships," Journal of Political Economy, 100(4), 801-817.

[25] King, R. G., Plosser, C. I. and Rebelo, S. T. (1988), Production, Growth and the Business Cycles II. New Directions, Journal of Monetary Economics, 21, 195-232.

[26] Kubin, I. and Prinz, A., (2002), Labour Supply with Habit Formation, Economics Letters, 75, 75-79.

[27] Lettau, M. and Uhlig, H. (2000), Can Habit Formation Be Reconciled with Business Cycle Facts? Review of Economic Dynamics, 3, 79-99.

[28] Levine, P. and Currie, D. A. (1987), The design of feedback rules in linear stochastic rational expectations models, Journal of Economic Dynamics and Control, 11, 1–28.'

[29] Ljungqvist, L. and Uhlig, H. (2000), Tax Policy and Aggregate Demand Management with Catching Up with the Joneses, American Economic Review, 90, 356-366.

[30] McGrattan, E. R. and Rogerson, R. (2004), Changes in Hours Worked, 1950-2000, Federal Reserve Bank of Minneapolis Quarterly Review, 28, 14-33.

[31] Oates, Wayne E. (1971), Confession of a Workaholic; the Facts about Work Addiction. New York: World.

[32] Prendergast, C. (1999), "The Provision of Incentives in Firms," Journal of Economic Literature, XXXVII(1), 7-63.

[33] Ravn, M., Schmitt-Grohe, S. and Uribe, M (2006), Deep Habits, Review of Economic Studies, forthcoming.

[34] Seckin, A. (2001), Consumption-Leisure Choice with Habit Formation, Economics Letters, 70, 115-120.

[35] Smets, F. and R. Wouters, 2003, An estimated stochastic dynamic general equilibrium model of the European, *Journal of the European Economic Association*, **1 (5)**, 1123-1175.

[36] Vendrik, M.C.M. (2002), Habits, Hysteresis and catastrophes in labour supply, Journal of Economic Behavior and Organization, 20, 353-372.

[37] Walter, H. F. and Hof, F. X. (2000), Relative Consumption, Economic Growth, and Taxation, Journal of Economics, 72, 241-262.

[38] Woittiez and Kapteyn (1998), 'Social Interaction and Habit Formation in Model of Female Labour Supply,' Journal of Public Economics, 70, 185-205.

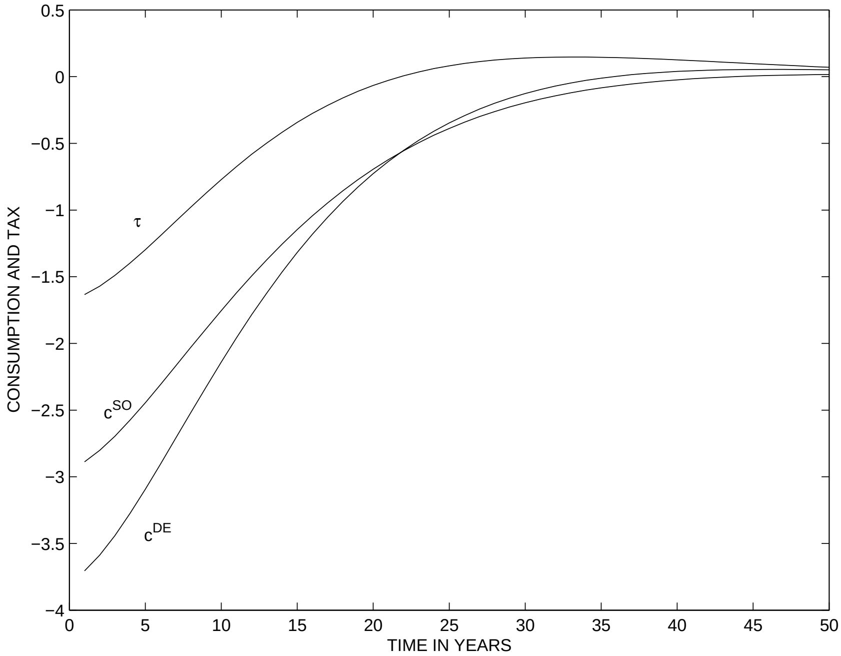

Figure 2: Transitional Path for Consumption $\hat{c}(t)$

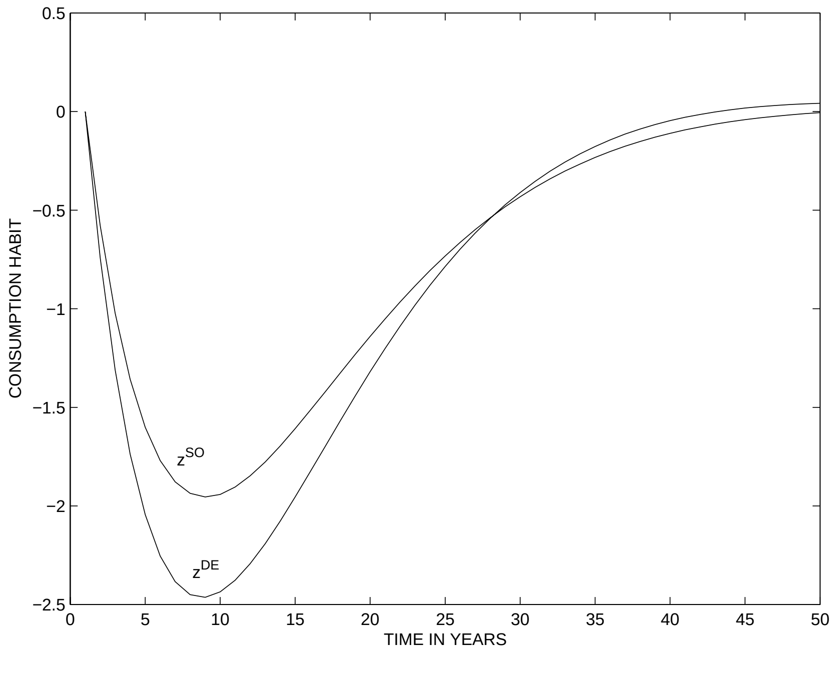

Figure 3: Transitional Path for Consumption Habit $\hat{z}(t)$

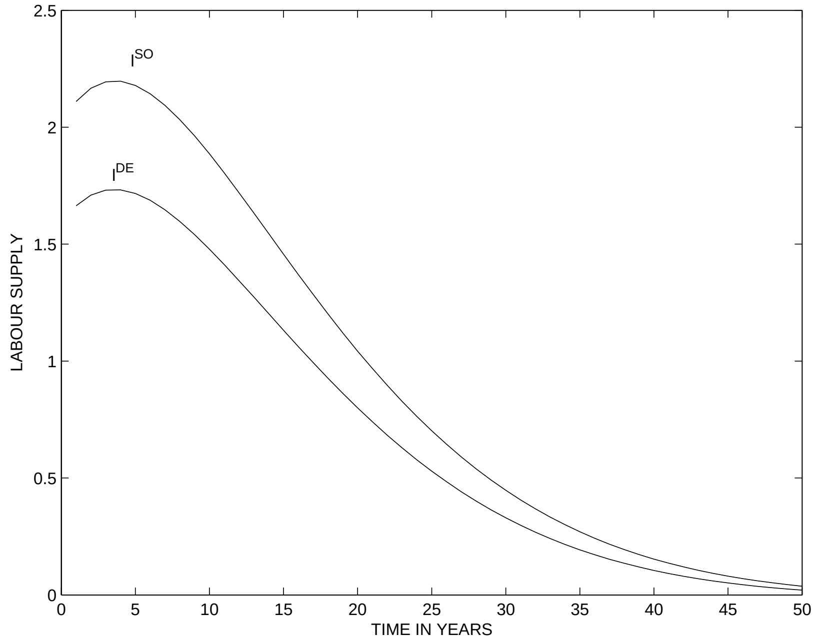

Figure 4: Transitional Path for Labour Supply $\hat{l}(t)$

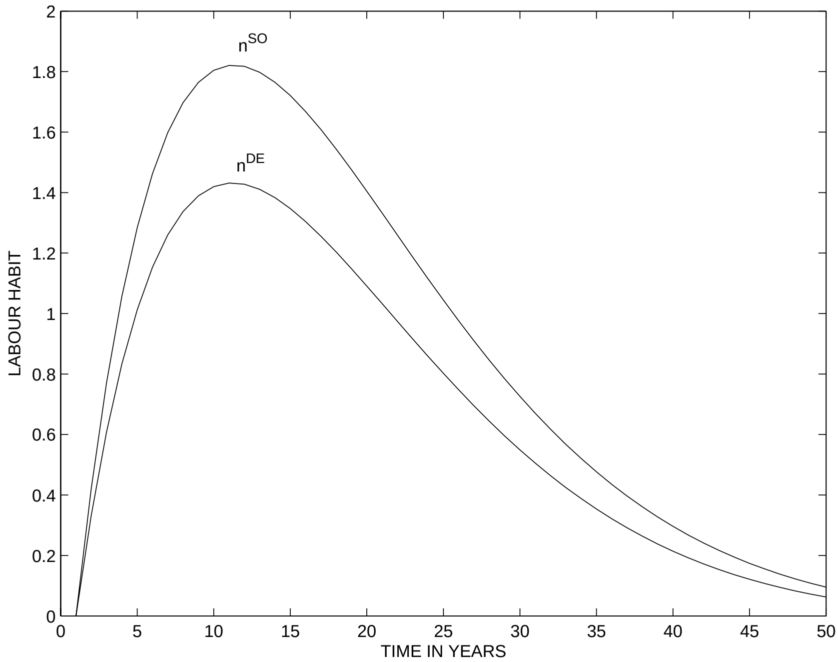

Figure 5: Transitional Path for Labour Habit $\hat{n}(t)$

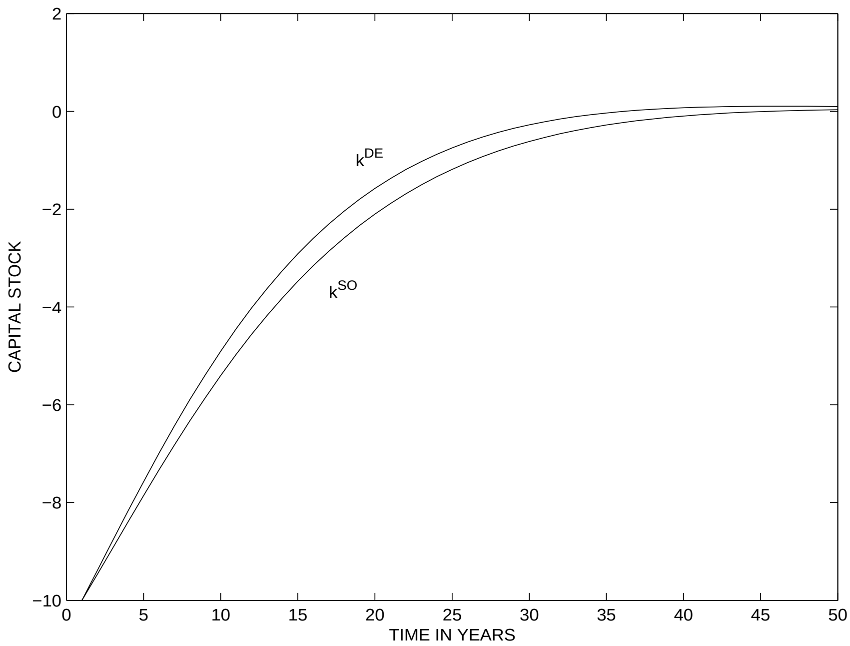

Figure 6: Figure 6:Path for Capital Stock $\hat{k}(t)$

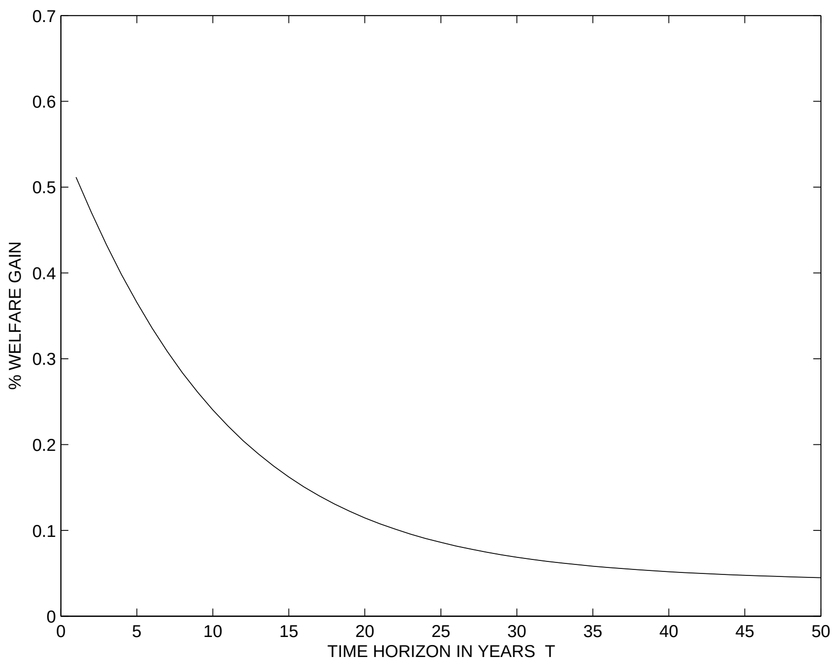

Figure 7: Welfare Gains from Social Planning $G(T)$.

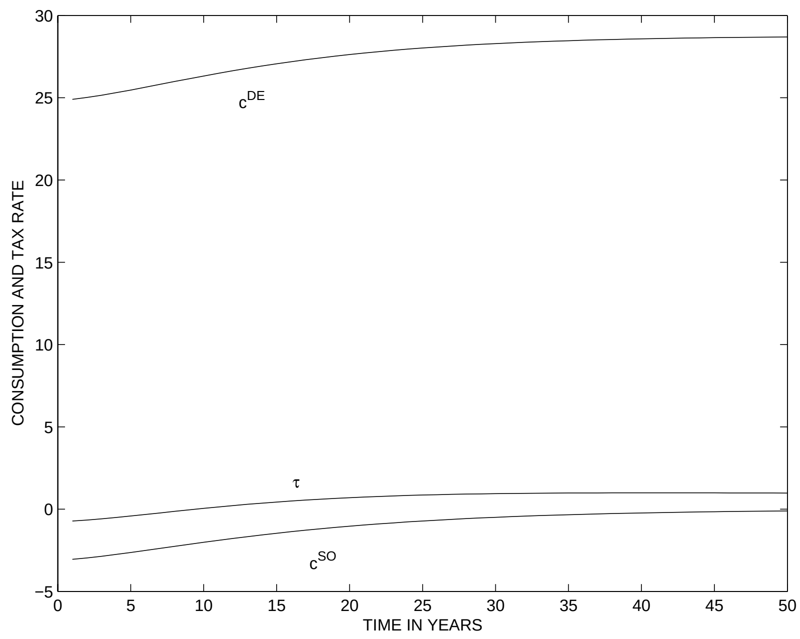

Figure 8: Transitional Path for Consumption $\hat{c}(t)$

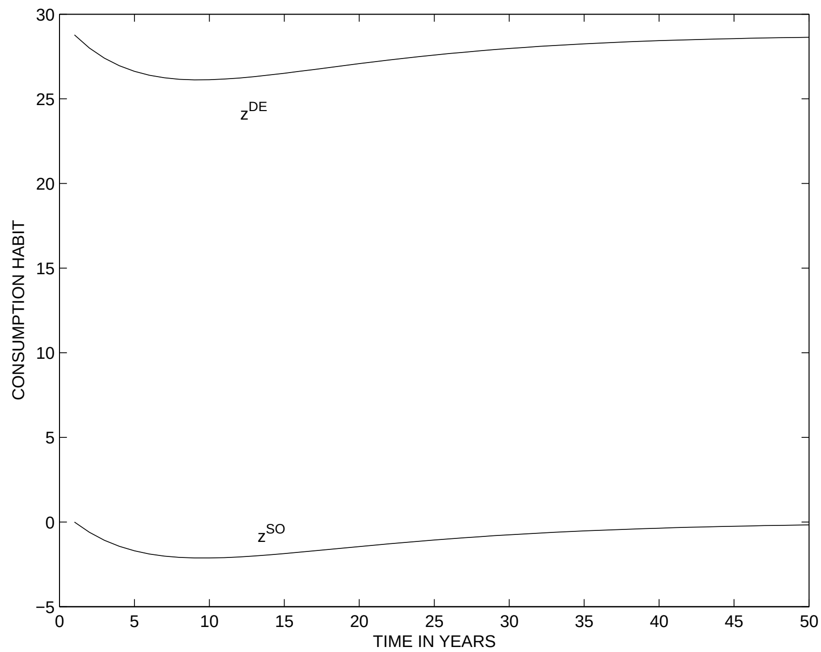

Figure 9: Transitional Path for Consumption Habit $\hat{z}(t)$

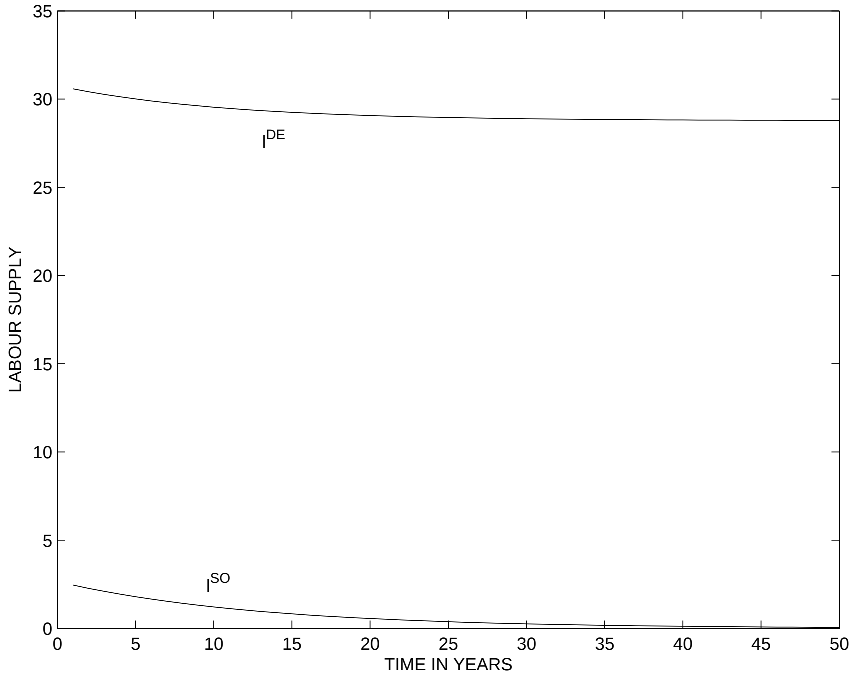

Figure 10: Transitional Path for Labour Supply $\hat{l}(t)$

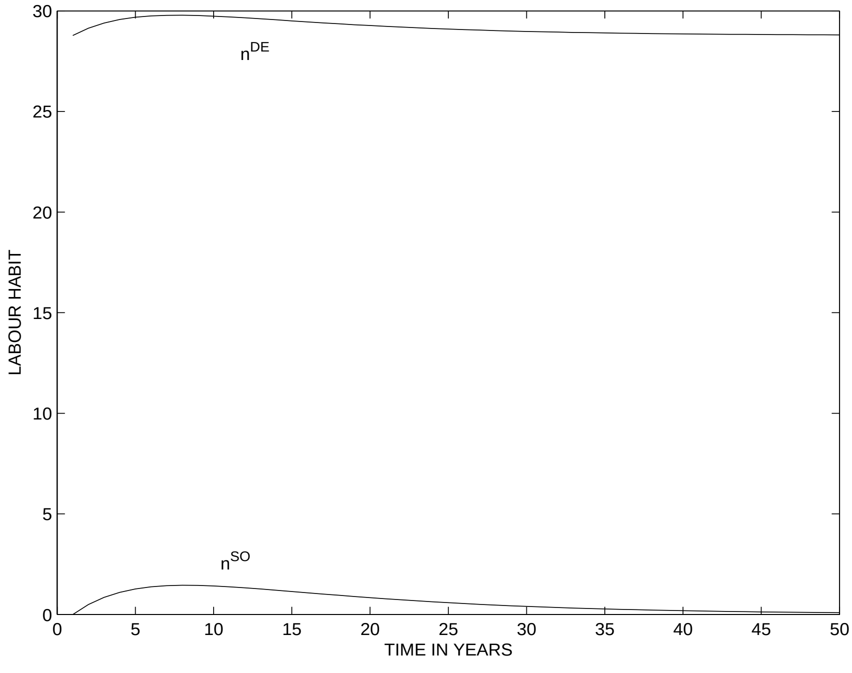

Figure 11: Transitional Path for Labour Habit $\hat{n}(t)$

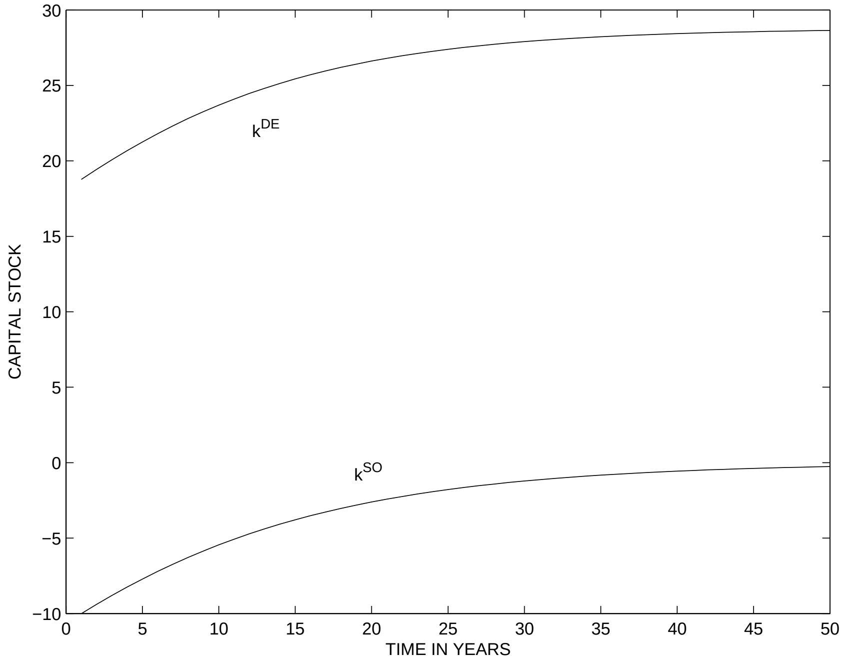

Figure 12: Transitional Path for Capital Stock $\hat{k}(t)$

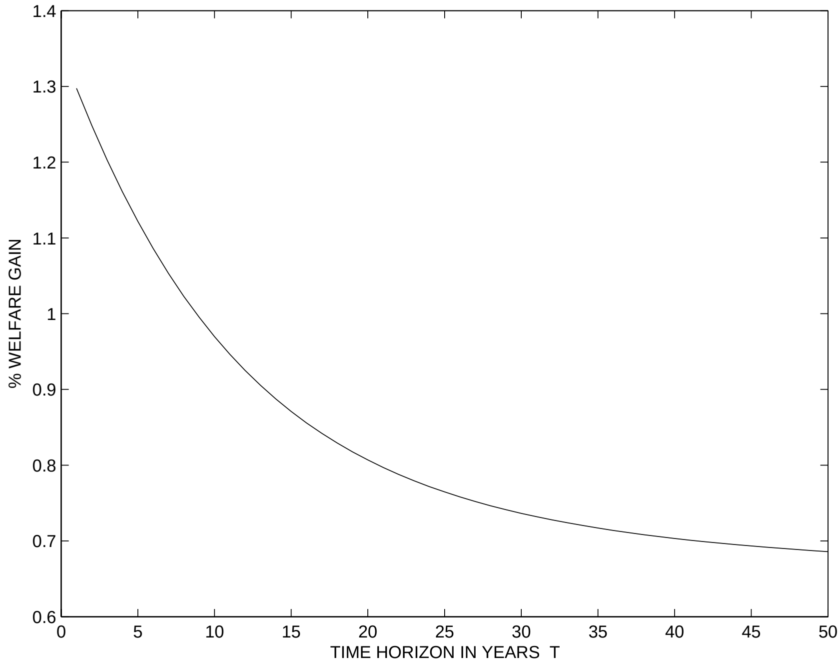

Figure 13: Welfare Gains from Social Planning $G(T)$