A Model of Comprehensive Habits

with Psychological Effects of Work Effort.

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1st Draft: July 2004.

Abstract.

This paper develops a neoclassical growth model under the assumption of comprehensive habits that incorporate both consumption and labour supply decisions of the households. We show that in presence of comprehensive habits, households will supply more labour than in case of no habits. In addition we consider two possible psychological links between the wage rate and the habits mechanism. We distinguish between satisfaction effect of work effort and status effect of work effort by creating an explicit positive and negative links between higher wages and the importance of labour supply relative to consumption in determination of comprehensive habits stock. We analyse the different results obtained in the model under this distinction.

JEL Classification: D11, E21, J22

Key Words: habits, consumption, labour supply, status.

1. Introduction.

Over the years, macroeconomists studying different aspects of time persistency focused their attention on the habit formation mechanisms with respect to consumption as a possible source of solutions for various empirical puzzles. However, traditionally, habit formation models of consumption ignore the possibility of persistency in labour supply decisions of the agents. Yet, as argued in Faria (2001), Gurdgiev (2002, 2003, and 2004), and Faria and Leon-Ledesma (2004), the long-run dependency of labour supply choices on their history can act as a solution to several puzzles in macroeconomics that cannot be addressed by the references to consumption habits alone.

Faria (2001), Gurdgiev (2002, 2003, and 2004), and Faria and Leon-Ledesma (2004), argue that habits mechanism in labour supply or leisure demand can account for social phenomena, such as institutional, cultural and religious effects on supply of hours worked. Combining the models of consumption and leisure demand habits, Gurdgiev (2003) incorporates the possibility of comprehensive habits mechanism that simultaneously captures inertia in consumption and leisure demand. The model yields interesting implications in terms of labour income and consumption taxation not found in the general literature that ignores the possibility for existence of comprehensive habits.

In the present paper we extend the model of Gurdgiev (2003) in order to consider the possibility of linking habitual labour supply with the psychological effects of work effort. Using a neo-classical growth model we analyse two possible

extensions of the comprehensive habits model to incorporate the psychological effects of work effort on both, labour supply and consumption.

The first modelled effect captures the link between the work effort, wage rates and the incentives to supply labour. As wage rate increases, workers tend to value work more, so that higher wages provide incentives for greater work effort. In this case, as wages increase, habits dynamics are assumed to exhibit stronger positive correlation with the labour supply decisions and weaker correlation with consumption. Individuals pay greater attention to the habitual effects of labour supply decisions than to the past history of their consumption. Thus higher wages will be associated with a greater motive, on behalf of households, to smooth their labour supply, using consumption as the variable that absorbs more variation along the adjustment path to the steady state in a model of work effort satisfaction.

In contrast, under the assumption of status-like properties of work effort, an increase in the wage rate implies that households move from one category of status-ranked consumption to a new, higher category. In this case, an increase in the wage rate necessitates higher speed convergence in consumption component of habits and lower speed of convergence in the labour supply component. The households are becoming more concerned with the effects of past choices of consumption, than with the history of their labour supply decisions. Thus, the work-status model predicts that higher wages will be associated with greater

motivation for consumption smoothing and greater willingness to accept labour supply variability along the adjustment path.

Part 2 below outlines the benchmark model of comprehensive habits in the neoclassical growth model. The standard model distinguishes two possible cases. In the first case, consumption and labour supply components of comprehensive habits evolve independently of each other, so that the speed of each component convergence to the steady states is different. In the second case we simplify the model to assume homogeneous speed of convergence for both components. Following this, Part 3 introduces two psychological effects of work effort and develops the model of comprehensive habits in presence of these effects. Part 4 summarises and compares the results of the three models. Part 5 concludes.

2. Standard Model of Comprehensive Habits.

Assume, following Gurdgiev (2003), that habit formation mechanism covers both the consumption, C_t and leisure demand / labour supply components of the utility function. Specifically, assume that there are standard internal habits in consumption augmented by the separate habits mechanics over the leisure decisions of the households. Denoting by H_t the stock of comprehensive habits, let H_t^C and H_t^L be the stocks of habits in consumption and labour supply, respectively. Then we can define the comprehensive habits stock as:

$$H_t = \eta H_t^C + (1-\eta) H_t^L \quad (1)$$

where η is the parameter measuring the weight of consumption component of comprehensive habits relative to the labour supply component. As η rises, the importance of past consumption decisions rises in the context of the determining overall comprehensive habits stock. This implies that within each period there is a weak separability of habits in consumption from habits in leisure / labour supply in terms f the overall habits stock.

Let the laws of motion for two habits components be strongly separable. Then, denoting by ρ_C and ρ_L the speed of the variable of choice convergence to the stock of habits in this choice variable:

$$\dot{H}_t^C = \rho_C \left(C_t - H_t^C \right) \tag{2}$$

and

$$\dot{H}_t^L = \rho_L \left(l_t - H_t^L \right) \tag{3}$$

From definitions (1), (2) and (3):

$$\begin{aligned} \dot{H}_t &= \eta \rho_C \left(C_t - H_t^C \right) + (1-\eta) \rho_L \left(l_t - H_t^L \right) = \\ &= \eta \dot{H}_t^C + (1-\eta) \dot{H}_t^L \end{aligned} \tag{4}$$

The interpretation of equations (2) and (3) is straightforward: as ρ_C increases, the importance of past history of consumption choices falls. When $\rho_C = 1$ consumption catches up with habits stock within one period following the shock. Hence, only previous period consumption matters and our model reduces to the standard habits in consumption model, similar to the models employed by

Carroll, Overland and Weil (1994), Gurdgiev (2002) and others. When, however, $\rho_C = 0$ habits never fully catch up with consumption, so that infinitely long past history of consumption decisions determines overall level of habits stock. ρ_L is interpreted similarly. This assumption makes our model consistent with Faria (2001), Gurdgiev (2004), and Faria and Leon-Ledesma (2004). Equation (4) can be interpreted as follows. If $\rho = \rho_C = \rho_L$, equation (4) has the same implications as the standard habits-in-consumption law of motion in the literature with exception that habits stock evolves due to either changes in consumption, or changes in labour supply / leisure, or both. Only relative importance of consumption parameter η matters here, as discussed following equation (1). This is consistent with Gurdgiev (2003).

In the following parts of the paper we will focus our attention on the role of the habits parameter η. For now, however, it suffices to note that $\eta \in [0,1]$ captures two interacting effects of habits dynamics. The first effect, as should be clear from equation (1), is the relative weight of consumption component in the overall habits stock determination. As η increases, the comprehensive habits stock emphasises the importance of past history of consumption choices and downplays the role of the historical labour supply decisions in households' optimisation. The second effect is captured in equation (4), where changes in η are associated with changing the speed of variables of choice convergence to the steady state. An increase in η will result in a faster convergence of consumption component of habits stock that matches the increasing importance of

consumption in habits determination (effect 1 is reinforced by effect 2). As in Faria and Leon-Ledesma (2004), we shall postpone the discussion of the possible links between the speed of adjustment and the wage rates until the later parts of the paper.

Production.

On the production side, the firms employ labour and capital in producing final output of consumption goods under the standard Cobb-Douglas technology with no technological progress:

$$y_t = k_t^{\gamma} l_t^{1-\gamma} \tag{5}$$

As standard, optimising choices of the real interest rate and wages are given by:

$$w_t = (1-\gamma) l_t^{-\gamma} k_t^{\gamma} \tag{6}$$

and

$$r_t = \gamma l_t^{1-\gamma} k_t^{\gamma-1} \tag{7}$$

Finally, the law of motion for capital stock is standard:

$$\dot{k}_t = w_t l_t + r_t k_t - C_t \tag{8}$$

Households' Optimisation.

Households maximize lifetime utility $\max_{\{C_t, l_t\}} \int_0^{\infty} e^{-\sigma t} U(C_t, l_t, H_t) dt$ subject to the capital accumulation and habit formation constraints. We define the current value Hamiltonian for the optimisation problem as:

$$\begin{aligned} \mathrm{H}_{CV} &= U\left(C_t, l_t, H_t\right) + \lambda_t\left[w_t l_t + r_t k_t - C_t\right] + \\ &+ \mu_{1,t}\rho_C\left[C_t - H_t^C\right] + \mu_{2,t}\rho_L\left[l_t - H_t^L\right] \end{aligned} \tag{9}$$

The first order conditions with respect to $\left\{C_t, l_t; k_t, H_t^C, H_t^L\right\}$ are:

$$U_C = \lambda_t - \mu_{1,t}\rho_C > 0 \tag{10}$$

$$-U_L = \lambda_t w_t + \mu_{2,t}\rho_L > 0 \tag{11}$$

$$\dot{\lambda}_t = \lambda_t\left(\sigma - r_t\right) \tag{12}$$

$$\dot{\mu}_{1,t} = \mu_{1,t}\left(\sigma + \rho_C\right) - U_H\eta \tag{13}$$

$$\dot{\mu}_{2,t} = \mu_{2,t}\left(\sigma + \rho_L\right) - U_H\left(1-\eta\right) \tag{14}$$

Steady State Analysis.

Assuming that utility function takes logarithmic form, so that:

$$U\left(C_t, l_t, H_t\right) = \log C_t + \phi\log\left(1 - l_t\right) + \delta\log H_t \tag{15}$$

we define the steady state as: $\dot{H}_C = \dot{H}_L = \dot{H} = \dot{k} = \dot{\lambda} = \dot{\mu}_1 = \dot{\mu}_2 \equiv 0$. With some algebra, solving the system of equations (10)-(14), using equations (2), (3), (6)-(8) and (15), we arrive at the following implicit solution for the steady state labour supply in case of no psychological effects (*NP*) and in the presence of heterogeneous parameters of convergence in consumption and labour components of comprehensive habits ($\rho_L \neq \rho_C$):

$$\left(\frac{\phi l_{ss}}{1 - l_{ss}}\right)^{NP}_{\rho_C \neq \rho_L} = \frac{a_2}{a_1} + \frac{a_2\delta\eta\rho_C}{\left(\sigma + \rho_C\right)\left[1 - \eta + \eta a_1\right]} + \frac{\delta\left(1-\eta\right)\rho_L}{\left(\sigma + \rho_L\right)\left[1 - \eta + \eta a_1\right]} \tag{16}$$

where parameters a_1 and a_2 are defined below in equations (19), and σ is the rate of time preferences.

According to equation (16), the ratio of labour hours supplied to leisure demanded depends on three forces defined in the model. On the right-hand side of equation (16) the first term $\frac{a_2}{a_1}$ captures the effects of production technology on consumption and leisure in the steady state. Specifically, from definitions in (19) below we can re-write this term as:

$$\frac{a_2}{a_1} = \frac{(1-\gamma)\gamma^{\gamma/(1-\gamma)}}{(1-\gamma)\gamma^{\gamma/(1-\gamma)} + \gamma^{1-\gamma}} = \frac{w_{ss} l_{ss}}{C_{ss}}$$

Hence, the first term deals directly with the ratio of labour income to consumption expenditure (since the price of consumption is normalized to 1).

The second term in equation (16)

$$\frac{a_2 \delta \eta \rho_C}{(\sigma + \rho_C)[1 - \eta + \eta a_1]} = w_{ss} l_{ss} \frac{\delta \eta \rho_C}{(\sigma + \rho_C)[1 - \eta + \eta C_{ss}]}$$

captures the effect of habits in consumption component of comprehensive habits mechanism on the overall choice of leisure. *Ceteris paribus,* as habits in consumption become more important in overall determination of habits (this happens whenever η, or ρ_C rise), or the overall habits importance increases (when δ increases) the leisure demand by the agents falls.

Finally the third term is

$$\frac{\delta(1-\eta)\rho_L}{(\sigma+\rho_L)[1-\eta+\eta a_1]}.$$

This term can be interpreted as the effect of leisure component of habits on the overall choice of labour supply relative to leisure. Note that this term captures the remaining share of the overall habits effect on utility, δ, as well.

Case of Homogenous Speed of Convergence in Habits.

First, for simplicity, we consider the case of

$$\rho_C = \rho_L = \rho \tag{17}$$

From (16) we can solve explicitly for the steady state level of labour supply:

$$0 < l_{ss} = \frac{d_1}{d_2} < 1 \tag{18}$$

where

$$\begin{aligned} d_1 &= \frac{a_2}{a_1}[\sigma+\rho](1-\eta+\eta a_1)+\delta\rho(1-\eta+a_2\eta) \\ d_2 &= \phi(\sigma+\rho)(1-\eta+\eta a_1)+d_1 \\ a_1 &= a_2+\sigma^{\gamma/(\gamma-1)}\gamma^{1-\gamma} \\ a_2 &= (1-\gamma)\left(\frac{\sigma}{\gamma}\right)^{\gamma/(\gamma-1)} \end{aligned} \tag{19}$$

Notice that regardless of the size of the time preference discount factor, σ, and the degree of capital intensity of production, γ, $d_1, d_2 > 0$ for any $\eta < 1$.

As shown in the Appendix, equations (18) and (19) define the following relations between the habits parameters, η, δ and ρ:

$$\frac{d(l_{ss})}{d\delta}, \frac{d(l_{ss})}{d\rho} > 0 \qquad \textbf{(R1), (R2)}$$

$$\frac{d(l_{ss})}{d\eta} < 0 \qquad \textbf{(R3)}$$

Hence, overall, the steady state labour supply is increasing in the strength of comprehensive habits in the utility function, and decreasing in the speed of habits stock adjustment to the steady state level and the relative weight of consumption in habits stock determination. The first two results are relatively standard to the literature. The third result, however, is entirely new. As consumption becomes more important in determination of habits, so that η increases, agents prefer to absorb any changes in income into leisure demand, so as not to sustain negative effects of comprehensive habits on the utility. Since δ is positive, habits in consumption act to develop a rational-style addiction, as in Becker (1992). Thus agents will tend to supply lower hours of labour and consume less in the steady state in presence of such habits. The more important is consumption to habit formation, the lower will be optimal consumption and the higher will be optimal choice of leisure.

Case of No Habits.

Finally we define the case of no habits as:

$$H = \mu \equiv 0 \qquad (20)$$

so that

$$l_{ss}^{NH} = \frac{a_2}{\phi a_1 + a_2} \qquad (21)$$

Comparing equations (21) and (18), it is straightforward to show that in absence of psychological effects of work effort:

$$l_{ss}^{NP} > l_{ss}^{NH} \qquad \textbf{(R4)} \quad (22)$$

so that the presence of comprehensive habits will result in higher steady state labour supply.

The steady state equations for consumption, output and capital stock follow directly from (19).

General Case: Heterogeneous Speed of Convergence, $\rho_C \neq \rho_L$

From Equation (16), we have:

$$\frac{d\left[l_{ss}/\left(1-l_{ss}\right)\right]}{d\rho_C} = \frac{a_2\sigma\delta\eta}{\phi\left(\sigma+\rho_C\right)^2\left[1-\eta+\eta a_1\right]} > 0 \qquad \textbf{(R5)} \quad (23)$$

$$\frac{d\left[l_{ss}/\left(1-l_{ss}\right)\right]}{d\rho_L} = \frac{\sigma\delta\left(1-\eta\right)}{\phi\left(\sigma+\rho_L\right)^2\left[1-\eta+\eta a_1\right]} > 0 \qquad \textbf{(R6)} \quad (24)$$

Hence, the ratio of labour supply to leisure demand rises in response to an increase in the speed at which either component of habits moves to the steady state. Moreover, from equations (23) and (22),

$$\frac{d\left[l_{ss}/\left(1-l_{ss}\right)\right]}{d\rho_L} \Big/ \frac{d\left[l_{ss}/\left(1-l_{ss}\right)\right]}{d\rho_C} = \frac{\left(\sigma+\rho_C\right)^2\left(1-\eta\right)}{\left(\sigma+\rho_L\right)^2 a_2\eta} >, < 1$$

if and only if

$$\frac{\eta}{\left(1-\eta\right)} <, > \frac{\left(\sigma+\rho_C\right)^2}{\left(\sigma+\rho_L\right)^2 a_2}$$

Hence, the response of the ratio of the steady state labour supply to leisure demand to changes in the speed of adjustment in leisure habits is stronger than the response of the steady state ratio to changes in the speed of adjustment in consumption habits whenever relative importance of consumption in habit formation is stronger. The interpretation of this result is as follows. Whenever habits in consumption act as the dominant component in habit formation relative to habits in leisure, agents are willing to smooth consumption more than they want to smooth leisure demand. Hence, the response of leisure demand and labour supply to changes in the habit formation parameters will be stronger than the response in consumption.

3. Psychological Satisfaction Model of Comprehensive Habits.

Assume that the relative importance of consumption in the comprehensive stock of habits is directly related to the overall wage rate. Such dependence can be motivated by considering the link between the wage rate and the work effort incentives.

On one hand, work ethics and social norms present in various societies can result in a direct link between the wage-incentives to supply labour and the social/cultural values of work. As the wage rate increases, it can be argued that individuals may value work effort more for the social recognition their hard-work ethics bring. In this case, higher wage rate can translate in a greater willingness of the households to adjust their labour supply along the transition path to the

steady state. Thus, the speed of habits stock convergence to the steady state may tilt in favour of labour supply component of habits, de-emphasising the effect of consumption component of comprehensive habits. We refer to this effect as the psychological satisfaction with work. Clearly, as wages rise, individuals can be expected to be more satisfied with the work effort than when the wages fall. As the result, we can anticipate that an increasing wage rate will be associated with a decreasing weight of consumption in the habit formation mechanism. This effect is consistent with the analysis presented in Faria and Leon-Ledesma (2004).

On the other hand, individual households may consider the wage rate as a determinant of their status group. Higher earning households can be expected to view their consumption relative to other high earners. This implies that households acquire habitual dependence of the Keeping-up-with-the-Joneses variety. Under the maintained assumptions of representative agent framework and internal nature of habits, this effect can be modelled without explicitly defining the aggregate referential consumption level. In this case, higher wages can be associated with increasing weight of consumption in overall habits stock determination. This possibility can be represented in our model by the direct positive link between the speed at which habits in consumption move to the steady state and the wage rate. Hereinafter we call this phenomenon a psychological status of work effort.

In the following we shall explore the implications of these two alternative possibilities.

Case 1: Psychological Satisfaction with Work Effort.

Suppose that as wage rate rises, individuals place greater emphasis on labour supply component of habits stock relative to the consumption component. In such a case, higher wage rate should be associated with increasing habituality of labour, so that there is a positive incentive to increase both the level labour supply and the speed of labour supply convergence to the steady state due to the rise of the opportunity cost of leisure. Thus,

$$\eta_S = \eta_S(w) = \frac{\eta}{w} \tag{25}$$

By equation (4) this implies that

$$\begin{aligned} \dot{H}_t &= \rho_C\left(C_t - H_t^C\right) + \rho_L\left(l_t - H_t^L\right) = \\ &= \frac{\eta}{w}\dot{H}_t^C + \frac{(w-\eta)}{w}\dot{H}_t^L \end{aligned} \tag{26}$$

In this case, refereeing to the work effort satisfaction mechanism by the superscript *S*, the model solutions are:

$$\left(\frac{\phi l_{ss}}{1-l_{ss}}\right)^S_{\rho_L \neq \rho_C} = \frac{a_2}{a_1} + \frac{a_2\delta\eta\rho_C}{(\sigma+\rho_C)\left[a_2-\eta+\eta a_1\right]} + \frac{\delta(a_2-\eta)\rho_L}{(\sigma+\rho_L)\left[a_2-\eta+\eta a_1\right]} \tag{27}$$

in general case of heterogeneous speed of convergence, and in case of homogeneous speed of convergence, so that $\rho_C = \rho_L = \rho$ we have:

$$\left(\frac{\phi l_{ss}}{1-l_{ss}}\right)^S_{\rho_L = \rho_C} = \frac{a_2}{a_1} + \frac{\delta\rho\left[a_2\eta + a_2 - \eta\right]}{(\sigma+\rho)\left[a_1\eta + a_2 - \eta\right]} \tag{28}$$

As above we can compute the effects of habits parameters changes on the steady state ratio of labour supply to leisure demand.

$$\frac{d\left(l_{ss}/\left(1-l_{ss}\right)\right)}{d\delta}=\frac{\rho\left[a_2\eta+a_2-\eta\right]}{\left(\sigma+\rho\right)\left[a_1\eta+a_2-\eta\right]}>,<0 \tag{29}$$

Three possible scenarios emerge from equation (29):

1. $a_2>\eta/\left(\eta+1\right)$, in which case, by definition of a_1 and a_2, $\frac{d\left(l_{ss}/\left(1-l_{ss}\right)\right)}{d\delta}>0$. **(R7)**

2. $\eta\left(1-a_1\right)<a_2<\eta/\left(\eta+1\right)$, in which case $\frac{d\left(l_{ss}/\left(1-l_{ss}\right)\right)}{d\delta}<0$ **(R8)**

3. $a_2<\eta\left(1-a_1\right)$ in which case $\frac{d\left(l_{ss}/\left(1-l_{ss}\right)\right)}{d\delta}>0$ **(R9)**

The same result applies in case of the effect of ρ on the steady state ratio of labour supply to leisure demand.

Only in the case of η does the new model correspond fully to the case described in the benchmark model (result R3).

These results present an improvement on the results shown in Faria and Leon-Ledesma (2004). In their case, $\frac{dl_{ss}}{d\delta},\frac{dl_{ss}}{d\rho}>0$. Recall that a_2 captures the labour income, while η reflects the importance of consumption relative to labour supply in the determination of overall habits. Thus, in contrast to Faria and Leon-Ledesma (2004), our model captures the dependence of responsiveness of labour supply to habits parameters on the interactions between the labour markets variables, a_2, and the habits parameters η, as well as the interactions between the labour markets and the markets for consumption.

Case 2: Psychological Status of Work Effort.

Alternatively, we can express the potential link between habits in consumption component and the status-type nature of consumption by making the weight of habits in consumption relative to leisure demand an increasing function of wage rate. In such a case, as wages rise, consumers experience increasing importance of consumption in overall comprehensive habits, so that

$$\eta_{WS} = \eta_{WS}(w) = \eta w \tag{30}$$

In this case, the solutions to the model, refereeing to work-status by the superscript *WS*, corresponding to equations (27) and (28) are given by:

$$\left(\frac{\phi l_{ss}}{1-l_{ss}}\right)^{WS}_{\rho_L \neq \rho_C} = \frac{a_2}{a_1} + \frac{a_2{}^2 \delta \eta \rho_C}{(\sigma+\rho_C)[a_1 a_2 \eta - a_2 \eta + 1]} + \frac{\delta(1-a_2\eta)\rho_L}{(\sigma+\rho_L)[a_1 a_2 \eta - a_2 \eta + 1]} \tag{31}$$

in general case of heterogeneous speed of convergence, and in case of homogeneous speed of convergence, so that $\rho_C = \rho_L = \rho$ we have:

$$\left(\frac{\phi l_{ss}}{1-l_{ss}}\right)^{WS}_{\rho_L = \rho_C} = \frac{a_2}{a_1} + \frac{\delta\rho\left[a_2{}^2\eta + 1 - a_2\eta\right]}{(\sigma+\rho)[a_1 a_2 \eta - a_2 \eta + 1]} \tag{32}$$

The following section outlines the results of the status-of-work-effort model with respect to the parameters of habit formation and compares these results with the case of work-effort-satisfaction model discussed earlier. It is worth noting at this stage that the results of the present model of habit formation in presence of psychological effects of status of work effort are unique to the present paper.

4. Comparing the Results.

We summarise the results of the General model in absence of psychological effects, and both models with psychological effects in the following Table 1 below that shows the direction of the habits parameters effects on the steady state ratio of labour supply to leisure demand.

Finally, we can compare different cases of comprehensive habits to the benchmark case of no habits.

From equations (21) and (16), as mentioned earlier, in case of ordinary comprehensive habits in absence of psychological effects of work effort and in case of non-homogeneous speed of convergence, habitually determined labour supply exceeds the labour supply in benchmark case.

$$\left(\frac{l_{ss}}{1-l_{ss}}\right)^{NP}_{\rho_L \neq \rho_C} > \left(\frac{l_{ss}}{1-l_{ss}}\right)_{NH}$$

Likewise, assuming that the speed of habits convergence is homogeneous across the two habits components,

$$\left(\frac{l_{ss}}{1-l_{ss}}\right)^{NP}_{\rho_L = \rho_C} > \left(\frac{l_{ss}}{1-l_{ss}}\right)_{NH}.$$

Hence, in both cases, in absence of psychological effects in work effort, comprehensive habits lead to an increase in the labour supply.

Table 1. Habits parameters effects on the steady state ratio of labour supply to leisure demand

Parameters	Psychological Effects		
	None	**Effort Satisfaction**	**Effort Status**
Homogeneous Convergence, $\rho_C = \rho_L = \rho$			
δ	**(+)**	**(+)/(-): 3 cases**	**(+)**
ρ	**(+)**	**(+)/(-): 3 cases**	**(+)**
η	**(-)**	**(-)**	**(-)**
Specific Convergence, $\rho_C \neq \rho_L$			
δ	**(+)**	**(+)/(-): 2 cases**	**(+)**
ρ_C	**(+)**	**(+)**	**(+)**
ρ_L	**(+)**	**(+)**	**(+)**
η	**(-)**	**(-)**	**(-)**

From equations (21) and (27), for $a_2 > 1$ we have:

$$\left(\frac{l_{ss}}{1-l_{ss}}\right)^{S}_{\rho_L \neq \rho_C} >,< \left(\frac{l_{ss}}{1-l_{ss}}\right)_{NH} \text{ whenever } \eta <,> \frac{a_2 \rho_L (\sigma + \rho_C)}{\rho_L (\sigma + \rho_C) - a_2 \rho_C (\sigma + \rho_L)}$$

so that in the presence of work effort satisfaction (superscript *S*), comprehensive habits can lead to a lower (higher) labour supply than in the case of no habits, whenever the share of consumption in overall comprehensive habits is low (high).

From equations (28) and (21), whenever work-effort satisfaction habits are associated with the homogeneous speed of convergence, habitual labour supply will unambiguously exceed labour supplied under no habits case:

$$\left(\frac{l_{ss}}{1-l_{ss}}\right)^{S}_{\rho_L=\rho_C} > \left(\frac{l_{ss}}{1-l_{ss}}\right)_{NH}$$

Denoting by the superscript *WS* the case of work status,

$$\left(\frac{l_{ss}}{1-l_{ss}}\right)^{WS}_{\rho_L\neq\rho_C} >,< \left(\frac{l_{ss}}{1-l_{ss}}\right)_{NH} \text{ whenever } \eta <,> \frac{\rho_L\left(\sigma+\rho_C\right)}{a_2\rho_L\left(\sigma+\rho_C\right)-a_2{}^2\rho_C\left(\sigma+\rho_L\right)}$$

and

$$\left(\frac{l_{ss}}{1-l_{ss}}\right)^{S}_{\rho_L=\rho_C} >,< \left(\frac{l_{ss}}{1-l_{ss}}\right)^{WS}_{\rho_L=\rho_C} \text{ if and only if } a_2 <,> 1.$$

The last result is of some intuitive interest.

Consider first the case of high impatience (high real interest rate) corresponding to the condition $a_2 < 1$. In this case, psychological effect of work-effort satisfaction (*S*-type) increases the steady state level of labour supply above the level attained in the case of habits in labour acting as the status determinant (*WS*-type). For both types of households, high degree of impatience implies that there are lower incentives to delay both consumption and leisure demand. This effect, however, is completely offset by the standard habit formation mechanism, so that regardless of the degree of impatience, households will supply more labour in case of habit formation, than in case of no habits. In case of satisfaction For *S*-type households, high impatience impacts more consumption than labour supply,

as households' stock of habits is driven more by their labour supply decisions then by consumption. In addition, consumption is now less impacted by the recent past decisions than leisure, since $\rho\eta_S$ falls with rising wages, while $\rho(1-\eta_S)$ rises. Thus, *S*-type households are more willing to postpone leisure. As the result, consumption adjusts slower than labour supply along the path to the steady state, and labour supply dominates the households' comprehensive habits stock. Hence, high impatience and satisfaction in work effort reinforce each other, ameliorating the effects of habits, and in reducing the household labour supply. For *WS*-type households, the opposite holds. As the status effect increases household's desire to delay consumption, and thus offsets the effect of impatience. Thus for $a_2 < 1$, we have $\left(\frac{l_{ss}}{1-l_{ss}}\right)^{WS}_{\rho_L=\rho_C} > \left(\frac{l_{ss}}{1-l_{ss}}\right)^{S}_{\rho_L=\rho_C}$.

In the case of $a_2 > 1$, impatience is relatively low, so that the households have now lower incentives to counteract habitual tendency to reduce adjustments in their consumption and leisure demand. As the result, for *S*-type households, the added propensity to delay labour supply adjustments due to habits is reinforced by lower degree of impatience, while for the *WS*-type households low impatience is counteracted by the status-driven propensity to delay consumption and speed up adjustment in labour supply. As the result of this, for low impatience case, $a_2 > 1$, we have $\left(\frac{l_{ss}}{1-l_{ss}}\right)^{WS}_{\rho_L=\rho_C} < \left(\frac{l_{ss}}{1-l_{ss}}\right)^{S}_{\rho_L=\rho_C}$.

5. Conclusions.

The present paper develops a neoclassical growth model of comprehensive habits that extends the Gurdgiev (2003) model. We show that in the presence of habitual dependency of consumption and labour supply, households will choose greater level of labour than in case of no habits. In addition, we show that the model can account for variable speed of adjustment in consumption and labour supply. In analysing the role of habits parameters in determination of the steady state level of labour supply, we confirm the main results shown in Gurdgiev (2003 and 2004), Faria (2001), and Faria and Leon-Ledesma (2004).

Following the analysis of the main model, we link the habitual labour supply with the psychological effects of work effort.

The first modelled effect is the link between the work effort, wage rates and the incentives to supply labour. As the wage rate increases, households pay greater attention to the habitual effects of labour supply decisions than to the past history of their consumption. We compare the results of our model with the standard model of no habits. Independent of the relative importance of consumption in determination of overall stock of habits, the habitual model in presence of work-satisfaction effects of work effort yields higher level of labour supply than the standard neoclassical growth model in absence of habits.

In contrast, under the assumption of status-like properties of work effort, an increase in the wage rate implies that households move to a higher category of

status consumption. In this case, an increase in the wage rate necessitates higher speed convergence in consumption component of habits and lower speed of convergence in the labour supply component. As households are becoming more concerned with the effects of past choices of consumption, than with the history of their labour supply decisions, the model generates two possible results with respect to the labour supply decisions. Depending on the overall level of impatience, households will supply more or less labour in case of status effects of work effort than in case of satisfaction effects. In addition, depending on the relative importance of consumption relative to labour in determination of the comprehensive habits, the model of work-related status predicts either higher or lower level of labour supply relative to the model of no habits.

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Appendix. Model Solutions.

Assume that the instantaneous utility function is logarithmic in all variables of choice, so that, as stated in equation (15) in the text:

$$U\left(C_t, l_t, H_t\right) = \log\left(C_t\right) + \phi \log\left(1 - l_t\right) + \delta \log\left(H_t\right) \tag{A1}$$

Using (A1), the system of the first order conditions (10)-(14) and equations (2), (3), (6)-(8) can be solved directly to derive equation (16).

In order to simplify our analysis of the steady state labour supply, from (17) and (18):

$$\frac{d\left(d_1\right)}{d\delta} = \frac{d\left(d_2\right)}{d\delta} = \rho\left[1 - \eta + a_2\eta\right] > 0 \tag{A2}$$

$$\frac{d\left(d_1\right)}{d\rho} = \frac{a_2}{a_1}\left[1 - \eta + a_1\eta\right] + \gamma\left[1 - \eta + a_2\eta\right] > 0 \tag{A3}$$

$$\frac{d\left(d_2\right)}{d\rho} = \frac{d\left(d_1\right)}{d\rho} + \phi\left[1 - \eta + a_1\eta\right] > 0 \tag{A4}$$

$$\frac{d(d_1)}{d\eta} = \frac{a_2}{a_1}(\sigma+\rho)[a_1-1] + \rho\delta[a_2-1] >,<0 \quad iff \quad a_2 >,<1 \tag{A5}$$

$$\frac{d(d_2)}{d\eta} = \phi(\sigma+\rho)[a_1-1] + \frac{d(d_1)}{d\eta} >,<0 \quad iff \quad a_2 >,<1 \tag{A6}$$

Note that $a_2 > 1$ corresponds to the assumption that $w_{ss} l_{ss} > 1$. Alternatively, by equation (18) it requires that $\left(\frac{\sigma}{\gamma}\right)^{\gamma/(\gamma-1)} > \frac{1}{1-\gamma}$. Observing that the share of capital in production, $\gamma < 1$, while σ as the intertemporal discount factor is small, and $\sigma = r_{ss} << 1$, our assumption is reasonable whenever the share of capital in production significantly exceeds the rate of time preference discounting. However, for sufficiently low capital intensity and sufficiently high degree of impatience the opposite applies.

To illustrate this point, below we tabulate the cut-off point values for $\sigma = r_{ss}$ corresponding to the various possible capital intensity assumptions.

γ	**If** $a_2 >,<1$**, then** $\sigma = r_{ss} <,>$	**If** γ **is given in column 1, while** $\sigma = \{0.01, 0.03, 0.05, 0.10\}$**, then** $a_2 =$
0.1	0.0387	$a_2 = \{1.162, 1.029, 0.971, 0.9\}$
0.2	0.0819	$a_2 = \{1.692, 1.285, 1.131, 0.951\}$
0.3	0.1305	$a_2 = \{3.022, 1.884, 1.513, 1.123\}$
0.4	0.1859	$a_2 = \{7.104, 3.403, 2.417, 1.519\}$
0.5	0.2500	$a_2 = \{25.00, 8.333, 5.000, 2.500\}$
0.7	0.4178	$a_2 = \{6057, 466.7, 141.72, 28.12\}$