Envy, leisure, and restrictions on working hours

Francisco Alvarez-Cuadrado *Department of Economics, McGill University*

Abstract. We present a simple model of capital accumulation where agents care about their consumption relative to the consumption of other members of society, 'envy,' In this context we quantify the extent of the distortions and welfare costs associated with envy. Under conservative estimates of envy we find that the implied welfare losses are substantial. We explore the implications of alternative policy arrangements designed to minimize the effects of the consumption externality. Our results suggest that if the optimal tax policy is not politically feasible, restrictions on working hours provide an alternative tool to induce a market outcome that resembles the efficient allocation achieved under a benevolent central planner. JEL classification: D62, H21

Envie, loisir et restrictions sur les heures de travail. On présente un modèle d'accumulation où les agents sont affectés par leur niveau de consommation relativement à celui des autres membres de la société – il y a ≪envie≫. On quantifie jusqu'à quel point il y a distorsions et pertes de bien-être associées à l'envie. Des évaluations conservatrices montrent que les pertes de bien-être sont substantielles. On explore ce que ces résultats impliquent pour la définition de politiques de rechange visant à minimiser les effets de cet effet externe de consommation. On suggère que si la politique fiscale optimale n'est pas politiquement acceptable, des restrictions sur les heures de travail pourraient être un instrument de rechange qui pourrait produire des résultats de marché qui ressemblent à l'allocation efficace qui découlerait des actions d'un planificateur central bienveillant.

I gratefully acknowledge the constructive suggestions of Leah Brooks, Benjamin Dennis, John Galbraith, Jenny Hunt, Ngo Van Long and Chris Ragan and two anonymous referees, as usual all remaining errors are my own. Email: francisco.alvarezcuadrado@mcgill.ca

Canadian Journal of Economics / Revue canadienne d'Economique, Vol. 40, No. 4
November / novembre 2007. Printed in Canada / Imprimé au Canada

0008-4085 / 07 / 1286–1310 /

1. Introduction

The assumption that preferences are independent across households is standard in the economic literature, although it is not particularly appealing. Indeed, social scientists have long stressed the relevance of status seeking as being an important characteristic of human behaviour (see Aristotle 1941; Kant 1797; Schoeck 1966; Rawls 1971). In our discipline, the idea that the overall level of satisfaction derived from a given level of consumption depends not only on the consumption level itself, but also on how it compares with the consumption of other members of society, is not new. Though origins of this proposition can be traced as far back as Smith (1759) and Veblen (1899), it was not until the work of Duesenberry (1949) and Pollak (1976) that an effort was made to provide this idea with some micro-theoretic foundations. The subsequent literature has often referred to this type of interdependence as 'catching up with the Joneses' as in Abel (1990), 'keeping up with the Joneses' as in Gali (1994), 'status' as in Fisher and Hoff (2000), 'jealousy' as in Dupor and Liu (2003), or 'envy' as in Eaton and Eswaran (2003). A growing body of empirical evidence has confirmed the importance of preference interdependence. Clark and Oswald (1996), using a sample of 5,000 British workers, find that workers' reported satisfaction levels are inversely related to their comparison wage rates, emphasizing the role of positional externalities. Neumark and Postlewaite (1998) propose a model of relative income to rationalize the striking rise in the employment of married women in the U.S. during the past century. Using a sample of married sisters, they find that married women are 16% to 25% more likely to work outside the home if their sisters' husbands earn more than their own husbands. Luttmer (2005) matches individual-level panel data on well-being from the U.S. National Survey of Families and Households to census data on local average earnings. After controlling for income and other own characteristics, he finds that local average earnings have a significantly negative effect on self-reported happiness. Furthermore, his results highlight that the negative effect of neighbours' earnings is significantly stronger for those who socialize frequently with neighbours but not for those who socialize more frequently with relatives, friends outside the neighbourhood or colleagues.[1]

Frank (1985) stresses the conflict that arises between individual and social welfare in the presence of such consumption externalities. It is well known that envy creates a gap between the social and private benefits from consumption, increasing the relative appeal of consumption over leisure. As a result, envious households consume and work above the welfare-maximizing levels, providing a

1 Beyond these studies, status concerns have been introduced to account for observed departures from the neoclassical paradigm in the asset pricing literature (Abel 1990; Gali 1994; and Campbell and Cochrane 1999), the literature on labour market outcomes (Akerlof and Yellen 1990, the consumption literature (Van de Stadt et al. 1985; Kapteyn et al. 1997; Ravina 2005; Alvarez-Cuadrado and Sutthiphisal 2006), the experimental literature (Solnick and Hemenway, 1998; Johansson-Stenman et al. 2002; Alpizar et al. 2005) and the real business cycle literature (Ravn et al. 2006).

basis for welfare-improving government interventions. In general, any policy that increases the price of consumption relative to leisure, a tax on consumption or a subsidy to leisure, will move the competitive equilibrium closer to the efficient allocation of resources.

This paper develops a model, consistent with cross-country and time series variation in hours worked for the G-7 countries, to quantify the distortions introduced by envy in the equilibrium allocation of resources. We use this framework to explore the welfare properties of alternative policy arrangements designed to minimize these distortions.

Under conservative estimates of envy we find that the welfare gain associated with the optimal fiscal policy is equivalent to a permanent increase in consumption, today and in all future periods, close to one fourth of the laissez-faire level of consumption. Even when we incorporate information about the current levels of taxation for the G-7 economies, we still find important welfare gains in terms of permanent consumption increases that range from 4.5% of consumption for the U.S. and Japan down to 1% for France and Germany. More surprisingly, the welfare gains associated with limitations on working time are almost as large as the gains derived from the optimal fiscal policy. Regulations that impose restrictions on working hours, legally mandated vacations, or workweek limitations might serve as a coordination device that minimizes the negative effect of envy in the competitive choice of working hours. In view of these results, we conclude that, in circumstances where the optimal fiscal policy is difficult to implement, restrictions on working time provide an alternative tool to achieve a market outcome close to the efficient allocation. We speculate that such a consideration might provide a new rationale for the widespread use of work-time restrictions in developed economies.

Fischer and Hof (2000), Alvarez-Cuadrado, Monteiro, and Turnovsky (2005), Alonso-Carrera, Caballé, and Raurich (2006), and Liu and Turnovsky (2005) explore a theoretical framework similar to ours. Their focus is on the qualitative characterization of the optimal tax policy, while our emphasis is on the quantification of the distortions and welfare costs associated with envy and the evaluation of alternative policy actions. Our welfare results are closely related to the recent literature that explores the determinants of (self-reported) well-being, such as Easterlin (1995), Frey and Stutzer (2002), Helliwell (2003), and Layard (2005). This literature highlights the importance of interpersonal comparisons as a key determinant of self-reported happiness. Finally, our evaluation of the effects of working time limitations is consistent with the negative relationship between hours worked and life satisfaction that Alesina, Glaeser, and Sacerdote (2005) find across European countries.

The paper is organized as follows. Section 2 sets out the basic model and compares the decentralized and centrally planned solutions. Section 3 quantifies the consequences of comparative consumption in the equilibrium allocation of resources and characterizes the optimal fiscal policy. Section 4 contrasts the implications of our model with G-7 countries' data on working hours, and section 5 evaluates the consequences of limitations imposed on working hours. The conclusions are summarized in section 6, while the appendix provides some technical details.

2. The model

Consider an economy populated by N identical and infinitely lived households. Population grows at the exogenous rate $\dot{N}/N = n$. The ith agent is endowed with a unit of time that can be enjoyed in the form of leisure, l_i, or devoted to work, $L_i \equiv 1 - l_i$. At any point in time, households derive utility from their leisure time, their current level of consumption, C_i, and the comparison of their consumption to the economy-wide average level of consumption, $\bar{C} \equiv \sum_{i=1}^{N} C_i/N$. Following Abel (1990), Carroll, Overland, and Weil (1997) and Alonso-Carrera, Caballé, and Raurich (2005, 2006) we adopt the following iso-elastic specification:[2]

$$U(C_i, \bar{C}, l_i) \equiv \frac{1}{1-\varepsilon}\left[C_i \bar{C}^{-\gamma} l_i^{\theta}\right]^{1-\varepsilon} = \frac{1}{1-\varepsilon}\left[C_i^{(1-\gamma)}\left(\frac{C_i}{\bar{C}}\right)^{\gamma} l_i^{\theta}\right]^{1-\varepsilon},$$
$$0 < \gamma < 1, \varepsilon > 1, \theta > 0. \qquad (1)$$

This specification captures the intuition that lies behind the growing body of empirical evidence that places interpersonal comparisons as a key determinant of individual well-being. As we can see from the second expression in (1), agents derive utility from a geometric weighted average of absolute and relative consumption. The restrictions imposed on the consumption externality parameter, γ, guarantee that agents are in fact envious and that a proportional increase in individual and average consumption increases utility.[3]

Individual output, Y_i, is produced combining the agent's capital stock, K_i, her labour, $1 - l_i$, and the publicly available level of technology, assumed to grow at the exogenous constant rate $\dot{A}/A = g$, according to the Cobb-Douglas technology,

$$Y_i = \alpha(A(1 - l_i))^{\sigma} K_i^{(1-\sigma)}, \quad 0 < \sigma < 1. \qquad (2)$$

The technology exhibits diminishing marginal product to each private factor and constant returns to scale in the two factors, capital and labour in efficiency units.

2 Under our preference specification agents exhibit 'jealousy' but not 'keeping up with the Joneses' as defined by Dupor and Liu (2003). We use the term 'envy' as synonymous of 'jealousy'.

3 The central planner acknowledges the effects of individual consumption choices on average consumption internalizing the external effect. Under those circumstances the utility function is not jointly concave in both C_i and $\bar{C}$ and the first-order conditions may not yield a maximum. In this case Alonso-Carrera et al. (2005) argues that the interior solution will ensure utility maximization if one restricts $\varepsilon > 1$. This restriction is consistent with the available empirical evidence and therefore we impose it.

2.1. Competitive solution

The agent's objective is to maximize the present value of (1), discounted using the rate of time preference, β, subject to her capital accumulation equation,

$$\dot{K}_i = (1-\tau_k)rK_i + (1-\tau_w)w(1-l_i) - (1+\tau_c)\,C_i - (n+\delta)\,K_i + T_i, \tag{3}$$

where r is the gross return on capital, w is the wage rate, τ_k, τ_w, and τ_c are taxes on capital income, labour income, and consumption, respectively, and T_i is a per capita lump-sum transfer. We assume that capital depreciates at the exponential rate δ.

Since agents are atomistic, they ignore the effects of their individual consumption and leisure choices on the evolution of aggregate consumption, capital, and labour supply, taking prices and average consumption as given. Performing the optimization, we reach the following first-order conditions, where λ_i is the co-state variable associated with the individual's capital stock and the superscript d denotes decentralized choices,

$$\left(C_i^d\right)^{-\varepsilon}(\bar{C}^d)^{-\gamma(1-\varepsilon)}\left(l_i^d\right)^{\theta(1-\varepsilon)} = \lambda_i^d\,(1+\tau_c) \tag{4a}$$

$$\theta\left(C_i^d\right)^{1-\varepsilon}(\bar{C}^d)^{-\gamma(1-\varepsilon)}\left(l_i^d\right)^{\theta(1-\varepsilon)-1} = \lambda_i^d w^d(1-\tau_w) \tag{4b}$$

$$(1-\tau_k)r^d - \delta - n = \beta - \dot{\lambda}_i^d/\lambda_i^d. \tag{4c}$$

Equation (4a) equates the utility of an additional unit of consumption to the tax-adjusted shadow value of capital. Equation (4b) equates the marginal utility of leisure to its opportunity cost in terms of consumption, the after-tax wage, valued at the shadow value of capital. Equation (4c) is the standard intertemporal allocation condition equating the after-tax marginal return to capital to the rate of return on consumption. Finally, in order to ensure that the intertemporal budget constraint is satisfied, the following transversality condition is imposed:

$$\lim_{t\to\infty} e^{-\beta t}\lambda_i^d K_i^d = 0. \tag{4d}$$

Combining (4a) and (4b), we obtain the familiar static allocation condition that equates the marginal rate of substitution between consumption and leisure to their after-tax relative price,

$$\frac{l_i^d}{\theta C_i^d} = \frac{1+\tau_c}{w^d(1-\tau_w)}. \tag{4e}$$

As we will see later, this relation is the only channel through which the distortions introduced by envy affect the equilibrium behaviour of our economy.

Since all individuals are assumed to be identical, individual consumption and average consumption coincide, and so $\bar{C}^d = C_i^d$. Aggregating across households, the aggregate capital stock becomes $K^d = NK_i^d$ and aggregate output is given by

$$Y^d = NY_i^d = \alpha\big(AN\big(1 - l_i^d\big)\big)^{\sigma}\big(NK_i^d\big)^{(1-\sigma)} = \alpha(AN(1 - l^d))^{\sigma}(K^d)^{(1-\sigma)}. \qquad (5)$$

The equilibrium returns to capital and labour are given by their respective marginal products evaluated at the aggregate level, according to

$$r^d = (1-\sigma)\frac{Y^d}{K^d}; \quad w^d = \sigma\frac{Y^d}{N(1-l^d)}. \qquad (6)$$

Finally, we assume that the government balances the budget in every period, so that $\tau_k r^d K^d + \tau_w w^d N + \tau_c C^d = T^d$, where $T^d = NT_i^d$ and $C^d = NC_i^d$ are aggregate transfers and aggregate consumption, respectively.

We define a balanced growth path as one along which all variables grow at a constant rate and per capita work effort is constant. Because capital is accumulated from final output, the only balanced solution is one in which the capital-output ratio is constant. With population and technology growing at exogenous rates, it is convenient to define variables expressed in units of effective labour, $k^d \equiv K^d/AN$, $c^d \equiv C^d/AN$, and $y^d \equiv Y^d/AN$. The equilibrium dynamics of our economy are fully determined by the initial condition $k^d(0) = k_0$, the transversality condition (4d), and the following pair of differential equations in k^d and l^d, derived in the appendix:

$$\dot{k}^d = \left(1 - \frac{c^d}{y^d}\right)y^d - (\delta + g + n)k^d \qquad (7a)$$

$$\dot{l}^d = F(l^d)\left[\left((1-\tau_k) - \eta\left(1 - \frac{c^d}{y^d}\right)\right)(1-\sigma)\frac{y^d}{k^d} - (\beta + (1 - \eta(1-\sigma))(\delta + n) + \eta\sigma g)\right] \qquad (7b)$$

$$\frac{c^d}{y^d} = \frac{\sigma}{\theta}\frac{l^d}{1-l^d}\frac{1-\tau_w}{1+\tau_c} \qquad (7c)$$

$$F(l^d) \equiv \frac{l^d(1-l^d)}{\eta(1-\sigma l^d) - (1-\varepsilon)\theta(1-l^d)} > 0, \qquad (7d)$$

where $y^d = \alpha(1-l^d)^{\sigma}(k^d)^{1-\sigma}$ is the aggregate production function expressed in units of effective labour, $\eta \equiv \gamma(1-\varepsilon) + \varepsilon$ is a measure of the willingness to shift consumption across time, and (7c) is the equilibrium counterpart of (4e). Imposing the steady-state condition, $\dot{k}^d = \dot{l}^d = 0$, the previous system can be solved for the equilibrium values of the relevant variables noting that (7a) and (7b) imply the following steady-state output-capital ratio and saving rate for the decentralized solution:

$$\frac{\tilde{y}^d}{\tilde{k}^d} = \frac{\beta + \delta + n + \eta g}{(1 - \tau_k)(1 - \sigma)} \tag{8a}$$

$$\tilde{s}^d \equiv 1 - \frac{\tilde{c}^d}{\tilde{y}^d} = \frac{(1 - \tau_k)(1 - \sigma)(\delta + g + n)}{\beta + \delta + n + \eta g}. \tag{8b}$$

Combining (8b) with (7c), we obtain the steady-state level of leisure $\tilde{l}^d$, which jointly with (8a) and the production function determines the steady-state level of scale adjusted capital $\tilde{k}^d$. Finally, (7c) determines the steady-state level of scale adjusted consumption $\tilde{c}^d$.

2.2. *The planner's solution*

In a competitive equilibrium individual agents ignore the effects that their consumption choices have on the utility of other agents. As a consequence, agents' consumption, leisure, and capital may diverge from the socially optimal levels that would be chosen by a benevolent central planner. The central planner acknowledges that individual consumption choices create distortions through their effects on average consumption. Under our representative household assumption the planner realizes that $\bar{C} = C_i$, and therefore he perceives the following utility specification,

$$U(C, l) = \frac{1}{1 - \varepsilon}[C^{1-\gamma} l^{\theta}]^{1-\varepsilon}.$$

Setting taxes equal to zero, the planner maximizes the present value of his perceived utility subject to the aggregate resource constraint given by

$$\dot{K} = \alpha(AN(1 - l^d))^{\sigma}(K^d)^{(1-\sigma)} - C - \delta K. \tag{3'}$$

The optimality conditions are identical to the aggregate version of (4), except for (4a), which becomes

$$(1 - \gamma)(C^p)^{-\varepsilon-\gamma(1-\varepsilon)}(l^p)^{\theta(1-\varepsilon)} = \lambda^p, \tag{9}$$

where the superscript p denotes the planner's choices. Comparing (9) and (4a) with $\tau_c = 0$, we see that the distortion introduced by the externality takes the form of an overvaluation, by a factor $1/(1 - \gamma)$, of the marginal utility of consumption.

This overvaluation of consumption distorts the marginal rate of substitution between consumption and leisure. Combining (4a), (4b), and (9) we reach the following relation between the marginal rates of substitution of the decentralized and the centrally planned economies for given levels of consumption and leisure:

$$MRS^{d}_{c,l} = \frac{l}{\theta C} > \frac{(1-\gamma)l}{\theta C} = MRS^{p}_{c,l}.$$

Since envious households overvalue consumption, their willingness to substitute from leisure towards consumption is too high relative to the socially desirable level. This distortion leads to a competitive solution characterized by an inefficiently low level of leisure and thus inefficiently high levels of labour supply and consumption.

Following an approach similar to that used for the decentralized economy, we see that the equilibrium dynamics of the centrally planned solution are characterized by

$$\dot{k}^p = \left(1 - \frac{c^p}{y^p}\right) y^p - (\delta + g + n)k^p \tag{10a}$$

$$\dot{l}^p = F(l^p)\left[\left(1 - \eta\left(1 - \frac{c^p}{y^p}\right)\right)(1-\sigma)\frac{y^p}{k^p} - (\beta + (1 - \eta(1-\sigma))(\delta + n) + \eta\sigma g)\right] \tag{10b}$$

$$\frac{c^p}{y^p} = \frac{(1-\gamma)\sigma}{\theta}\frac{l^p}{1-l^p} \tag{10c}$$

$$F(l^p) \equiv \frac{l^p(1-l^p)}{\eta(1-\sigma l^p) - (1-\varepsilon)\theta(1-l^p)} > 0, \tag{10d}$$

together with the initial condition $k(0) = k_0$ and the transversality condition (4d). When we impose the steady-state condition $\dot{k}^p = \dot{l}^p = 0$, the equilibrium output-capital ratio and the saving rate are again given by (8a) and (8b), respectively. Since the consumption to income ratio coincides in both solutions, comparing (7c) and (10c), it becomes clear that the equilibrium labour supply (leisure) is inefficiently high (low) in the competitive solution.

In general, with a composite consumption good and an endogenous labour supply, a consumption externality can introduce distortions along two margins: the intertemporal allocation of consumption and the static trade-off between consumption and leisure. As shown by Liu and Turnovsky (2005) and Alonso-Carrera, Caballé and Raurich (2006), if preferences are time separable and isoelastic, the marginal rate of substitution of consumption between two points in time coincides under both competitive and centrally planned solutions. Since iso-elastic preferences are required for the existence of a balanced growth path, our model rules out by assumption the first channel for the externality to have an effect in equilibrium allocations. Nonetheless, envy still affects the second margin, and therefore envious households consume above the socially desirable level. Given their budget constraint, this excess consumption can be afforded only at the expense of inefficient reductions in leisure. The presence of envy shifts the consumption-leisure tradeoff towards the former, leading to inefficiently high levels of labour supply, capital accumulation, and output. In steady state this distortion is given by

$$\frac{1-\tilde{l}^d}{1-\tilde{l}^p} = \frac{\tilde{k}^d}{\tilde{k}^p} = \frac{\tilde{c}^d}{\tilde{c}^p} = \frac{\dfrac{\theta(1-\tilde{s})}{(1-\gamma)} + \sigma}{\theta(1-\tilde{s}) + \sigma}$$

$$= \frac{\left(\dfrac{\theta}{1-\gamma} + \sigma\right)\beta + (\eta - 1)g + \sigma\left(\dfrac{\theta}{1-\gamma} + 1\right)(\delta + g + n)}{(\theta + \sigma)\beta + (\eta - 1)g + \sigma(\theta + 1)(\delta + g + n)} > 1,$$

where $\tilde{s}$ is the steady-state saving rate defined in equation (8b). It is straightforward to show that the distortion caused by envious behaviour increases with the elasticity of output to capital, $(1 - \sigma)$, and with the elasticity of utility to leisure, θ. Increases in both elasticities increase the steady-state level of leisure, amplifying the misallocation of resources.

3. Assessing the effects of the distortion

In this section we calibrate our model to reproduce some of the key features of developed economies. Our goal is to quantify the importance of the distortions and welfare costs associated with envy. The rate of depreciation, $\delta = 0.05$, the rate of population growth, $n = 0\ .015$, and the rate of exogenous technological change, $g = 0.02$, are conventional values and require no further explanation. We set the rate of time preference, $\beta = 0.02$, and the parameter that governs the willingness to shift consumption across time, $\varepsilon = 2$, so that the steady-state saving rate is close to 25% and the steady-state net return on capital is 5%, both of them plausible long-run equilibrium values in closed economies with no public sector.

If factors are paid their marginal products and technology is Cobb-Douglas, the elasticity of output with respect to labour, σ, coincides with the labour income share. Consistent with the evidence presented by Gollin (2002), we set this elasticity equal to 0.67.

The leisure parameter, θ, governs the responsiveness of labour supply to changes in relative prices and the allocation of time between labour and leisure. In general, labour supply responds to changes in wages along two margins: the number of hours worked (intensive margin) and the decision to join the labour force (extensive margin). The micro-econometric evidence on labour supply elasticities along the intensive margin is abundant. Alesina, Glaeser, and Sacerdote (2005) provide a summary of this literature, concluding that the response of hours worked to changes in the real wage is relatively modest for men, with elasticities ranging from 0 to 0.84. In contrast, Cho and Cooley (1994) model the participation decision generating elasticities as high as 4 when choices are limited to the extensive margin. Since we plan to contrast our model with data that combine both margins, hours worked, and labour force participation, we choose a benchmark value of $\theta = 1.7$, the standard figure used in the real business cycle literature; see Cooley and Prescott (1995). Along the stable growth path, our choice leads to an elasticity of labour supply[4] below 2 and to a fraction of time devoted to leisure close to 66%, consistent with the microeconomic evidence on time allocation provided by Juster and Stafford (1991). Since an agent has about 100 hours of productive time per week, the steady-state workweek length is slightly above 34 hours.

Finally, direct evidence on the value of the envy parameter, γ, is sparse. The literature on the equity premium puzzle suggests values close to one; see Abel (1990), Gali (1994) and Campbell and Cochrane (1999). Easterlin (1995) and Frey and Stutzer (2002) evaluate the time series and cross-sectional properties of several measures of self-reported happiness. Their findings are consistent with preference specifications that place most of the weight on relative consumption. Alpizar, Carlsson, and Johansson-Stenman (2005) conduct several experiments to assess the importance of relative consumption. In the case of cars and housing their median estimate for γ is between 0.5 and 0.75. Ravn, Schmitt-Grohe, and Uribe (2006) report a point estimate of our envy parameter, where relative consumption is defined as a declining weighted average of past and present average consumption, of 0.86. Ravina (2005), using individual consumption data, estimates a weight of relative consumption close to one third. In view of these estimates, we choose a conservative value, $\gamma = 0\ .5$, for the benchmark calibration and conduct extensive sensitivity analysis based on the range of reported estimates.

Table 1 summarizes the steady-state values for the competitive and the efficient solutions, the size of the steady-state distortion generated by envy, and a measure of the welfare cost associated with it. All the calculations are made under the assumption that all the tax rates are equal to zero. In our benchmark calibration, $\gamma = 0.5$, the competitive economy chooses a labour effort along the stable growth path close to 34 hours per week, compared with the 21 hours chosen along the efficient solution. The presence of envy increases the private value of consumption above its social value, leading to a steady-state level of consumption that is 66% larger than the efficient one. Over-consumption could be sustained only at the expense of parallel increases in both inputs of production, and therefore the steady-state levels of labour and capital exceed by two-thirds the efficient levels.

4 As Glaeser et al. (2003) and Alesina et al. (2005) argue, elasticities in this range could be reconciled with micro-data estimates in the presence of social multipliers that in our context arise naturally from status concerns.

TABLE 1
Steady-state values and welfare losses under alternative weights of envy

	$\gamma = 0$	$\gamma = 0.2$	$\gamma = 0.4$	$\gamma = 0.5$	$\gamma = 0.6$	$\gamma = 0.8$
Saving rate	23%	23.8%	24.7%	**25%**	25.5%	26.5%
K/Y	2.7	2.8	2.9	**2.95**	3	3.1
Interest rate	6%	5.6%	5.2%	**5%**	4.8%	4.4%
Growth rate		**2%**				
Market hours/week	33.5	33.8	34	**34.1**	34.3	34.5
Efficient hours/week	33.5	29	23.6	**20.6**	17.3	9.6
Steady-state distortion	0%	17%	43%	**66%**	98%	261%
Welfare cost	0%	1.6%	10.5%	**22.1%**	47.5%	439%
τ_c^{opt} when $\tau_w = 0$	0%	33%	66%	**100%**	150%	400%
τ_w^{opt} when $\tau_c = 0$	0%	25%	40%	**50%**	60%	80%

We measure the welfare cost as the percentage increase in individual (and average) consumption, today and at all future dates, that an agent living in the laissez-faire economy should receive in order to enjoy the same intertemporal welfare as an agent, with identical initial conditions, following the choices determined by the central planner.[5]

The reported welfare costs are calculated assuming that both economies begin in the laissez-faire steady state, but, with the externality only distorting the static trade-off between consumption and leisure, our estimates hold for any set of initial conditions. In our benchmark economy the potential welfare gains from eliminating the distortions created by envy are very high, equivalent to a 22.1% permanent increase in consumption.

The remaining columns in table 1 explore the steady-state effects of changes in the importance of comparative consumption. When preferences are independent, $\gamma = 0$, the competitive solution is efficient and thus coincides with the planner's choice. As envy increases, the central planner realizes that the social gains from additional consumption are only a fraction $(1 - \gamma)$ of the private gains, and, as a result, he chooses lower levels of consumption and capital and higher levels of leisure. On the other hand, as envy increases, so do the private marginal benefits of consumption increase, and therefore competitive agents chose higher steady-state levels of consumption and capital, thus reducing their leisure time. Both responses reinforce each other, leading to the steady-state distortion presented in table 1 that represents the percentage difference in consumption, capital, and hours worked between the competitive and efficient solutions. As is evident from the table, the distortion induced by the externality grows at an increasing rate with envy. If envy does not matter much, low values of γ, the implied distortions are small, and, more important, the associated welfare losses are limited; as an example, if $\gamma = 0.2$, competitive agents consume and work around 17% in excess

5 See the appendix for a formal derivation.

of the efficient level, but their welfare loss is only 1.6%. On the other hand, as we move closer to the values of γ suggested by the asset pricing, subjective happiness, and experimental literatures, the distortions and the associated welfare losses become huge; when $\gamma = 0.8$, consumption, capital, and hours of work under laissez-faire are almost four times larger than the efficient levels, and we need to increase current and future consumption by a factor of 4.4 to compensate a competitive household for the negative impact of envy.[6]

A competitive economy populated by envious households reaches a steady state characterized by over-consumption, over-investment, and over-working. Under these circumstances the government can restore efficiency by means of distortionary taxation. In general, any policy that increases the price of consumption relative to leisure, a tax on consumption, or a subsidy on leisure, will move the economy closer to the efficient allocation.[7] When we compare the marginal rate of substitution between consumption and leisure for the centrally planned and decentralized solutions, the following relation for the optimal tax rates emerges:

$$\frac{1-\tau_w}{1+\tau_c} = 1 - \frac{\tau_c+\tau_w}{1+\tau_c} \equiv 1 - \tau = 1 - \gamma. \tag{11}$$

This result is consistent with the optimal fiscal policy derived under more general specifications of envy by Fischer and Hof (2000) and Liu and Turnovsky (2005). The last two rows of table 1 present the implied tax rates that allow the decentralized equilibrium to mimic the results of the centrally planned economy. In our benchmark calibration, if labour is untaxed, consumption should be taxed at a rate of 100% to induce the first-best outcome. Once the effects of the consumption externality have been taken care of, the optimal tax on capital income is zero.

Finally, figure 1 explores the sensitivity of the distortion to changes in our benchmark parameter values. The steady-state distortion is very sensitive to envy, γ, the elasticity of utility to leisure, θ, and the elasticity of output to capital, $(1-\sigma)$. On the other hand, the extent of the distortion is rather robust to changes on the remaining parameters of the model.

4. Envy, working hours, taxes, and welfare in the G-7 countries

There is considerable time series and cross-sectional variation in the average number of working hours among G-7 countries. According to the Groningen Growth

6 Since the effects of envy on welfare are channeled through an inefficient increase in working hours, reductions on the importance of leisure in preferences, θ, lead to reductions in the size, and welfare costs, of the distortion. In the limiting case where labour is inelastically supplied, $\theta = 0$, envy does not distort the competitive allocation of resources.

7 As opposed to Alonso-Carrera et al. (2006) where the externality leads to an inefficient transition through its effects on the willingness to substitute consumption through time, under our specification the externality only affects the evolution of key variables through its effects on the willingness to substitute consumption and leisure at any point in time. With the externality only distorting this static allocation, a constant tax rate will suffice to restore efficiency.

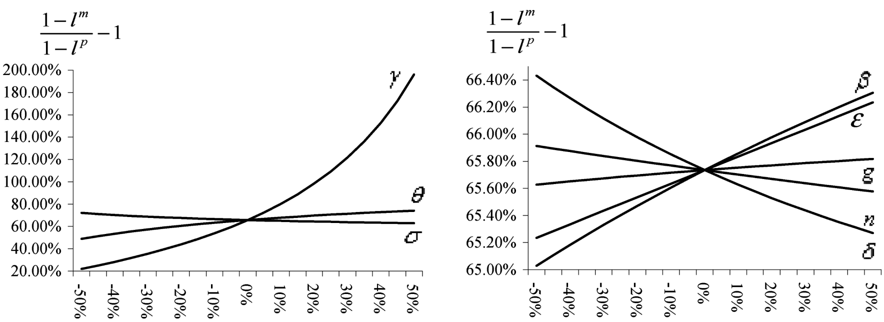

FIGURE 1 Sensitivity of the steady-state distortion as we deviate from our benchmark calibration

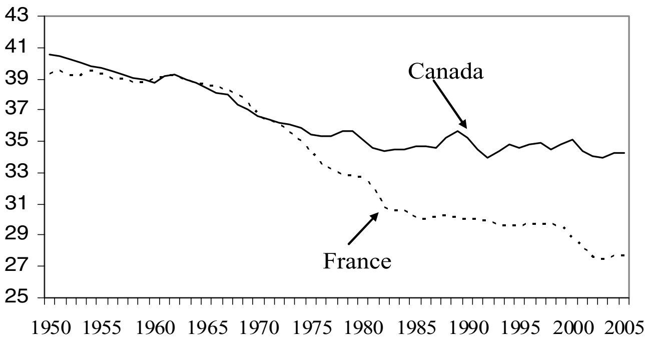

FIGURE 2 Working hours per week per person employed
SOURCES: GGDC (2006), ILO (2005)

and Development Centre, GGDC (2006), in 2005 the average French worker spent less than 28 hours per week in the workplace, compared with the average Canadian, who worked almost 35 hours per week. These differences are even larger across time; in 1950 both French and Canadian workers spent close to 40 hours per week at work. This variation is summarized in figure 2, which presents the evolution of working hours per week, total hours worked per week divided by average employment, for both countries.[8] These important differences in the number of hours worked could arise as a consequence of different institutional environments, different constraints, or differences in tastes across countries and time. In the context of the model presented in the previous sections we explore to what extent the observed differences in the length of the workweek could be the response of envious households to differences in the after-tax prices of labour, consumption, and capital.

8 The reader should be aware that estimates of working hours present serious cross-country comparability problems since the method of calculation varies from country to country.

Following Mendoza, Razin, and Tesar (1994) and Prescott (2004), we compute effective tax rates on consumption, labour income, and capital income, combining revenue statistics data and model-specific accounting relations. The resulting rates are consistent with the tax distortions faced by a representative household in each of the G-7 economies. The Organization for Economic Cooperation and Development *Revenue Statistics* (1999) provides data on revenues as a percentage of GDP for taxes on consumption, T_c, personal income, T_{pi}, corporate income, T_{ci}, social security, T_{ss}, and payroll, T_p. Since nominal consumption expenditures in the national accounts are valued at post-tax prices, the relevant tax on consumption, τ_c, satisfies the following relation:

$$\tau_c = T_c\left(\frac{y + c\tau_c}{c}\right),$$

where lower case letters refer to our model-specific variables described in section 2. Since the typical household files a single return for capital and labour income, revenue data on personal income taxes do not distinguish between these two sources of income. We follow Mendoza, Razin, and Tesar (1994) by assuming that all sources of personal income are taxed at the same level, which, combined with our theoretical assumption that factors are paid their marginal product, yields the following relations for the effective tax rates on labour income, τ_w, and capital income τ_k:

$$\tau_w = (\sigma T_{pi} + T_{ss} + T_p)\left(\frac{y + c\tau_c}{\sigma y}\right) \quad \tau_k = ((1-\sigma)T_{pi} + T_{ci})\left(\frac{y + c\tau_c}{(1-\sigma)y}\right).$$

Since we calibrate our model under the assumption that the representative agent adjusts her labour-leisure choice along both the intensive and the extensive margins, we need to construct a measure of labour supply that captures changes along both margins. *Key Indicators of the Labour Market*, published by the International Labor Organization (2005), provides data on labour force participation and annual hours worked per person employed. We can compute the measure of labour supply relevant for our model economy, hours worked per person between 15 and 64 years of age, as the product of those two data series.

Table 2 and figure 3 compare the data on weekly hours worked per person aged 15 to 64 with its model counterpart, the hours worked by the representative agent living in our model economy in the face of tax distortions equivalent to the ones faced by households in the G-7 countries during 1998. The model is calibrated as the benchmark economy in the previous section, allowing for country-specific tax rates. Despite the simplifying assumptions the model captures an important share of the variation in working hours in our sample. Differences in tax rates can account for around one-third of the variation in working hours observed in the data.[9] Figure 4 compares the evolution of actual and predicted hours worked

9 As Alesina et al. (2005) point out, besides tax rates, there is a host of other variables such as strength of unions, extent of welfare coverage, and degree of income inequality that move

TABLE 2
Actual and predicted hours worked for G-7 countries for 1998. Potential welfare gains. Calibration: Benchmark parameters from section 3 combined with country-specific tax rates

	Canada	U.S.	Japan	France	Germany	Italy	U.K.
Actual τ_c	12.1%	5.7%	6.5%	16.3%	13.5%	14.5%	16%
Actual τ_w	25.1%	24.1%	23.7%	37.1%	34.6%	32.4%	21.8%
Actual τ_k	26.7%	20.7%	17.7%	16.9%	14.9%	20.9%	23.9%
Actual hours per worker	33.9	36	35.5	29.7	28.6	32	33.2
Participation rate	75%	77.4%	72.6%	67.4%	71.4%	59.2%	75.7%
Actual hours per person	25.4	27.8	25.8	20	20.5	18.9	25.1
Predicted hours	24.5	26.4	26.5	21.4	22.6	22.7	24.9
Deviation (in hours)	0.9	1.5	−0.7	−1.4	−2.2	−3.7	0.2
Welfare gain $\tau_k = 0$	0.72%	−0.6%	−0.76%	0.8%	0.3%	1.2%	0.2%
Welfare gain $(\tau_c + \tau_w)/(1 + \tau_c) = \gamma$	0.9%	2.8%	3.1%	−0.2%	0.1%	−0.01%	1.24%
Total welfare gain	3.86%	4.5%	4.3%	1%	1%	1.8%	3.6%
Welfare gain $\tau_k = \tau_w = \tau_c = 0$	−14.4%	−14%	−14.3%	−16.8%	−16.9%	−16.1%	−14.7%

SOURCES: ILO (2005), OECD (1999)

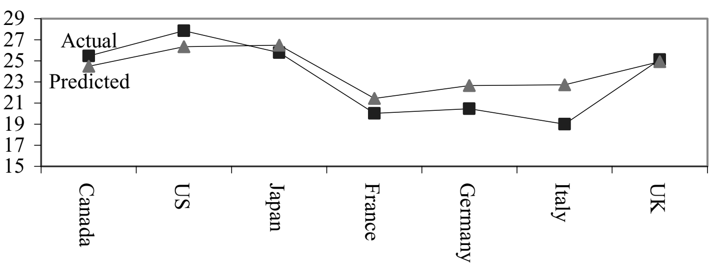

FIGURE 3 Working hours/week/person between 15 and 65 years of age for 1998; model vs data. Calibration: Benchmark parameters from section 3 combined with country-specific tax rates
SOURCES: ILO (2005), OECD (1999)

for Canada and France from 1965 to 1995. Predicted hours are calculated as the steady state of our benchmark calibration with the tax rates that prevailed at each point in time for each country. It is surprising that a framework that abstracts from institutional differences, population structure and other factors relevant for labour market outcomes is able to capture the basic features of the changes in labour supply that took place over the last decades of the past century.[10]

together in our sample economies and that potentially influence the amount of hours worked. Their estimate of the elasticity of labour supply, derived from aggregate data, is able to explain around 36% of the difference in hours worked between France and the US and 34% between Italy and the US, very much in line with our numerical results.

10 Under homothetic preferences increases in envy lead to identical behavioral responses than decreases in the degree of curvature of the utility function in the consumption dimension,

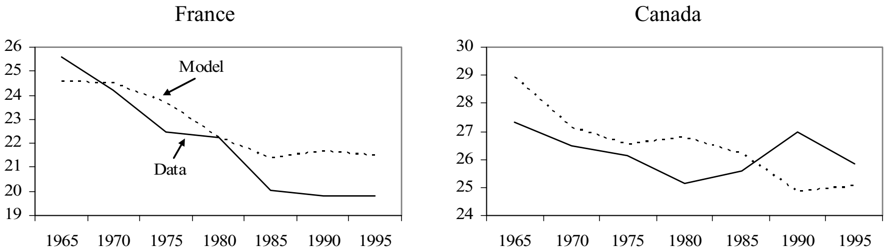

FIGURE 4 Average working hours per week per person between 15 and 65 years of age; model vs data. Calibration: Benchmark parameters from Section 3, country-specific tax rates every five years
SOURCES: GGDC (2006) , ILO (2005), OECD (1999)

We use this simple framework to investigate the potential welfare gains associated with the introduction of the optimal fiscal structure as defined in the previous section. In all our calculations we assume that each of the G-7 economies starts along the stable growth path consistent with the observed tax rates for 1998. First, we calculate the welfare gain associated with the complete elimination of capital income taxation, leaving labour income and consumption taxation at their 1998 levels. Second, we calculate the welfare gain associated with the introduction of the optimal fiscal package characterized in (11), leaving capital income taxation at the 1998 level. Third, we calculate the welfare gain associated with the optimal fiscal policy that combines the elimination of capital income taxation with the optimal mix of consumption and labour income taxation. Finally, we calculate the welfare gain associated with the complete elimination of the current tax schedules. The last four rows of table 2 report these calculations.

For our benchmark calibration of envy, $\gamma = 0.5$, countries with relatively low consumption and labour income taxes, Japan and the U.S., suffer a 1% welfare loss as a consequence of the elimination of capital taxation. On the other hand, countries that begin with relatively high levels of taxation, France and Italy, do not benefit from additional increases in taxes, experiencing small welfare losses when the optimal value of (11) is implemented. In the former economies, a positive tax on capital income, through its depressing effects on investment and labour supply, improves welfare by reducing the distortions introduced by envy. These low-tax economies would experience substantial welfare gains, close to 3%, after the introduction of the optimal mix of consumption and labour income taxes. In the latter economies the already high initial level of taxes reduces the scope for any benefit derived from additional increases in consumption or labour income taxes. These high-tax economies would experience important welfare gains, in the order of 1%, after the elimination of the capital income tax. In general, the

captured by the inverse of the intertemporal elasticity of substitution, $\eta \equiv \gamma\,(1-\varepsilon)+\varepsilon$. In this sense the results for the $\gamma > 0$-economy with $\gamma = \gamma_0$ and $\varepsilon = \varepsilon_0$ are observationally equivalent to those for an economy with $\gamma = 0$ and $\varepsilon \equiv \gamma_0(1-\varepsilon_0)+\varepsilon_0$.

benefits from implementing the optimal fiscal package are large, ranging from 4.5% for the U.S. to slightly below 1% for Germany.

Finally, the last row of table 2 presents the welfare losses associated with setting all the taxes equal to zero. As we have already argued, substantial consumption and labour income taxes are required to prevent envious households from over-consuming, over-investing, and over-working. Not surprisingly the elimination of the actual taxes is associated with welfare losses as high as 17% in the cases of Germany and France.[11]

5. Envy and working time regulations

The reduction in working hours reported in the previous section is both a recent phenomenon and part of a secular trend.[12] When we examine combined data from Huberman (2004) and ILO (2005), we see that the estimated average yearly working hours per worker have declined from around 3,000 in 1870 to less than 1,700 in 2005 for our sample of economies. Apart from other institutional changes, the continuous tightening of working time regulations has played an important role in this reduction of working hours.

In 1870 the average working time of a Canadian manufacturing worker was close to 65 hours per week. In 1889 the Royal Commission on the Relations of Labour and Capital promoted the nine-hour day for women and children, but it was not until the 1920s and 1930s that maximum-hour legislation covering adult male workers was adopted in some provinces. In 1922 the One Day's Rest in Seven Act provided for at least 24 consecutive hours of rest per week. In 1968 Ontario introduced the Employment Standards Act, which limited the workweek to a maximum of 48 hours.

The extent of government intervention is stronger in France. The 12-hour workday was introduced in 1841. At the turn of the 20th century the Millerand Law reduced the workday to 11 hours in 1902 and 10 hours in 1904. In 1936 the left-wing coalition that formed the Popular Front introduced the 40-hour week. In 1986 a regulation reducing the workweek to 39 hours was approved, and in 1998, under Prime Minister Lionel Jospin, the Aubry Law initiated the move towards the 35-hour workweek.[13]

An additional limitation to working hours takes the form of statutory vacation time. Alesina, Glaeser, and Sacerdote (2005) find that roughly one-quarter of

11 In the era of globalization one might argue that envy is a transnational phenomenon. If a mixture of national and transnational comparisons matters, national policies that limit the amount of working hours might have ambiguous effects on welfare. Despite this, most of the available evidence suggests that interpersonal comparisons are most important at a relatively local level.

12 See Ramey and Francis (2006) for an alternative interpretation of the evolution of leisure over the 20th Century in the US.

13 Data for France is from Marchand and Thelot (1991) and for Canada is from Woods and Ostry (1962).

the total differences in hours worked among Germany, France, and the U.S. is explained by differences in the standard week, while almost one-third is explained by differences in mandated holidays.

The traditional arguments in support of working time regulations appeal to their beneficial effects on the living standards of workers. In contrast, the recent debate that accompanied the approval of the Aubry Law in France has shifted these arguments towards employment creation and work-sharing. Hunt (1998) and Marimon and Zilibotti (2000) conclude the employment effects of workweek regulations are almost negligible. Nevertheless, despite the ambiguous effects in terms of job creation, if envy is an important feature of human behaviour, workweek regulations can play an important role by limiting the distortions introduced by envious consumption.[14] In a context where the optimal fiscal package described in (11) is not politically feasible, policies that enjoy broader popular support, such as workweek limitations or mandatory vacation time, could be an alternative instrument for the government to induce a market outcome closer to the social optimum. We modify the framework presented in section 2 to introduce working time limitations. We impose that the labour supply at any point in time coincides with its efficient long-run value,[15]

$$l_i(t) = \tilde{l}^p. \tag{12}$$

The optimality conditions for this program are a version of (4a) obtained using (12) and the Euler equation (4c). If we denote with the superscript r the optimal choices under regulations on working hours, this economy reduces to a neoclassical growth model with exogenous labour, and its equilibrium dynamics are described by the following pair of differential equations:

$$\dot{k}^r = \alpha(1-\tilde{l}^p)^\sigma (k^r)^{1-\sigma} - (\delta + n + g)k^r - c^r \tag{13a}$$

$$\dot{c}^r = \frac{c^r}{\eta}\left(\alpha(1-\sigma)\left(\frac{1-\tilde{l}^p}{k^r}\right)^\sigma - \beta - \delta - n - \eta g\right), \tag{13b}$$

together with the initial condition, $k^r(0) = k_0$, and the transversality condition (4d). Along the stable growth path, $\dot{k}^r = \dot{c}^r = 0$, it is easily shown that the levels of capital and consumption chosen by competitive agents are identical to the efficient levels chosen by a central planner.

14 Along these lines Alesina et al. (2005) find a negative relationship between hours worked and life satisfaction across European countries. This relation is robust to the introduction of country and year fixed effects and the use of collective bargaining agreements as an instrument for hours worked.

15 In a previous version of the paper we modeled workweek regulations as an inequality constraint, $l_i(t) \geq \tilde{l}^p$, that requires the representative agent to choose a level of leisure at any point in time at least as high as the steady state level of leisure in the efficient solution. Both approaches are equivalent as long as the inequality constraint is binding at every point in time.

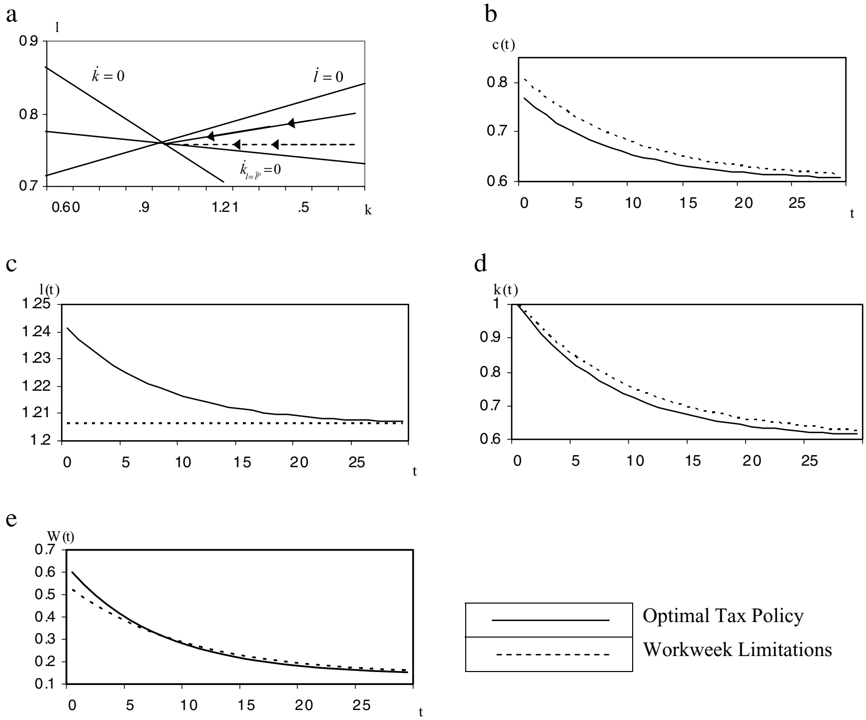

FIGURE 5 Transitional dynamics under the two alternative policy arrangements. Panel a is the phase-diagram; $\dot{k}_{l=\bar{l}_p} = 0$ is the set of combinations of working-time restrictions and capital such that the capital stock is constant. Panels b, c, and d are expressed as deviations from the laissez-faire steady state

We can use this framework to compare the adjustment of the economy under two alternative policy arrangements: the optimal fiscal policy that induces the decentralized economy to mimic the behaviour of the centrally planned economy and working time regulations that impose at least the same level of leisure that a central planner would choose in steady state. Figure 5 summarizes the dynamic adjustment of the key economic variables, expressed as percentage deviations from their initial steady states, after the two policies are implemented. In both cases we assume that the economy begins along the laissez-faire steady state. Along the initial steady-state consumption, capital and labour supply exceed their efficient levels by two-thirds. Once the optimal fiscal policy is in place, the increase in the after-tax relative price of consumption with respect to leisure leads to an immediate decrease in consumption (panel b) and an increase in leisure (panel c). With capital and labour being complementary in production, the decrease in labour supply reduces the average product of capital below its replacement rate, and, despite the decrease in consumption, capital begins to fall (panel d). This process of disinvestment leads to further decreases in output and consumption that are only partially compensated by a continuous increase in the number of hours worked induced by the income effect. The remaining adjustment is characterized by monotonic decreases in capital, leisure, output and consumption until the new steady state is reached.

The adjustment of the constrained economy is qualitatively similar to the efficient adjustment, with the key difference arising from the fact that the optimal fiscal policy allows agents to adjust along two margins, consumption and leisure, while the reduction in the workweek only allows the representative agent to adjust along the consumption-saving tradeoff. When the government imposes the working time restriction, relative prices are not directly affected, and nor is the willingness of the agent to over-work and over-consume. Given the constraint the agent reduces her working hours to the highest feasible level, which at the initial stage of the transition exceeds by 12% the level chosen under the optimal fiscal package. Since the capital stock is fixed, the decrease in working hours leads to an immediate decrease in output and consumption. The decrease in consumption, which is only a fraction of the decrease under the optimal tax policy, cannot sustain the initial level of capital, so capital begins to decumulate. The unsustainably high, but decreasing, level of consumption leads to a transition characterized by monotonic decreases in capital and output.

Panel e compares the evolution of the instantaneous welfare gain associated with the policy change, defined as the percentage increase in individual (and average) consumption in period t that an agent living in the laissez-faire economy should receive in order to enjoy the same welfare in period t as an agent living under each of the policy arrangements considered. In the initial stage of the transition the relatively low level of leisure under workweek regulations leads to a welfare loss, relative to the optimal fiscal package, which is partially compensated by the higher level of consumption achieved. After a decade, this relative loss is reversed when the reduction in welfare caused by over-working is more than compensated by the higher feasible consumption level. The intertemporal welfare gain associated with the optimal fiscal policy is 22.1%, only 0.05% larger than the welfare gain under workweek regulations. Our analysis suggests that, in circumstances where the optimal fiscal policy is difficult to implement, workweek regulations or legally mandated vacation time can achieve the efficient steady-state allocation, incurring a surprisingly small welfare loss relative to the optimal course of action. Nonetheless, one should take this result with caution, since it is obtained under the assumption that households are identical. If households are homogeneous, the efficient level of labour supply is unique and a limitation on working hours induces this unique level with negligible welfare costs relative to the optimal fiscal package. On the other hand, if agents were heterogeneous, as in fact they are, the efficient level of labour supply varies with the agent's characteristics, and therefore an across-the-board working time regulation might be associated with important welfare costs relative to the first-best fiscal package.

6. Conclusions

We have presented a simple model of capital accumulation, where preferences are defined over leisure and absolute and relative consumption. Our specification captures the intuition that lies behind the growing body of empirical evidence that places interpersonal comparisons as a key determinant of well-being. Envious households ignore the negative effects that their consumption choices impose on the welfare of their neighbours; as a result, they consume, work, and accumulate capital above welfare-maximizing levels. Since envy increases the willingness to substitute from leisure towards consumption, a tax policy that increases the price of consumption relative to leisure is enough to induce the market economy to replicate the first-best outcome.

We use this framework to explore the size of the distortions introduced by envy. Our numerical results suggest that the welfare losses associated with envy are very large. In our benchmark calibration the welfare gain associated with the implementation of the optimal fiscal policy is equivalent to a permanent increase in consumption close to one fourth of the laissez faire level of consumption.

We compare the implications of our model for labour supply with cross-sectional and time series variation in working hours for the G-7 economies. We find that our simple framework is able to capture some of the basic features of the changes in labour supply through time and space. Under conservative estimates of the importance of envy, we evaluate the welfare gains associated with the introduction of the optimal fiscal policy in this group of developed economies. Our results suggest these gains are substantial, ranging from 4.5% for the U.S. to 1% for Germany. Furthermore, the welfare losses associated with the elimination of the present tax schemes are as large as 18% for Germany or France.

Finally, we turn our attention to an alternative policy instrument that might work as a coordination device in the presence of consumption externalities: restrictions on working hours. If the increases in taxes associated with the implementation of the optimal fiscal package are politically costly, our results suggest that workweek limitations or mandated vacation time provide the policy maker an additional tool to move the market outcome closer to the efficient one. In view of these results, it is possible that the French politicians who promoted the Aubry Law are like Friedman's (1953) billiard players: they know what to do but they cannot explain why they do it.

Appendix: Derivation of the system of differential equations for section 2.1

Log-differentiating (4a) and combining the result with (4c) and (6), we obtain,

$$-[\varepsilon + \gamma(1-\varepsilon)]\hat{C}_i + (1-\varepsilon)\theta\hat{l} = \beta + \delta + n - (1-\tau_K)(1-\sigma)\frac{Y}{K}. \tag{A1}$$

Log-differentiating (5) and (7c), where we use the fact that $c/y = C/Y$ and $C_i = C/N$, we reach

$$\hat{Y} = \sigma\left(g + n - \frac{\dot{l}}{1-l}\right) + (1-\sigma)\hat{K} \tag{A2}$$

$$\hat{C}_i = \hat{Y} + \frac{\dot{l}}{l(1-l)} - n. \tag{A3}$$

Finally, the aggregated budget constraint implies that

$$\hat{K} = \frac{Y}{K} - \delta - \frac{C}{K}. \tag{A4}$$

Combining these four equations, we find equations (7b). Equation (7a) results from expressing (A4) in units of effective labour.

The dynamics of (7) can be approximated by the following second-order system, where without loss of generality we set $\tau_K = 0$:

$$\begin{pmatrix} \dot{k} \\ \dot{l} \end{pmatrix} = \begin{pmatrix} -\sigma(\delta + g + n) & -\left[\frac{c/y}{l} + \left(1 - \frac{c}{y}\right)\sigma\right]\frac{y}{(1-l)} \\ -F(l)\left[1 - \eta\left(1 - \frac{c}{y}\right)\right] & F(l)\frac{(1-\sigma)y}{k(1-l)} \\ \times(1-\sigma)\alpha\sigma\frac{y}{k^2} & \times\left[\eta\frac{c/y}{l} - \sigma + \eta\left(1 - \frac{c}{y}\right)\sigma\right] \end{pmatrix}_{\substack{k=\tilde{k} \\ l=\tilde{l}}} \times \begin{pmatrix} k - \tilde{k} \\ l - \tilde{l} \end{pmatrix}.$$

That under mild conditions – for instance, $\eta\tilde{s} < 1$, where $\tilde{s}$ is the steady-state saving rate – exhibits saddle path stability. All the simulations presented in the text are based on the previous linear approximation.

A1. Welfare analysis

Normalizing the initial level of technology to one, so that at time 0 variables per capita and variables per unit of effective labour coincide, the corresponding level of base welfare for a given set of initial conditions is given by

$$W_d \equiv \frac{1}{1-\varepsilon}\int_0^{\infty}\left(C_{i,d}(t)(\bar{C}_{i,d}(t))^{-\gamma}(l_{i,d}(t))^{\theta}\right)^{1-\varepsilon}e^{-\beta t}\,dt$$
$$= \frac{1}{1-\varepsilon}\int_0^{\infty}\left((c_d(t))^{(1-\gamma)}(l_d(t))^{\theta}\right)^{1-\varepsilon}e^{[(1-\varepsilon)(1-\gamma)g-\beta]t}\,dt.$$

Now consider the equilibrium transitional path from the same initial conditions chosen by the central planner. The level of welfare along such a path is given by,

$$W_p \equiv \frac{1}{1-\varepsilon}\int_0^{\infty}\left((C_{i,p}(t))^{1-\gamma}(l_{i,p}(t))^{\theta}\right)^{1-\varepsilon}e^{-\beta t}\,dt$$
$$= \frac{1}{1-\varepsilon}\int_0^{\infty}\left((c_p(t))^{1-\gamma}(l_p(t))^{\theta}\right)^{1-\varepsilon}e^{[(1-\varepsilon)(1-\gamma)g-\beta]t}\,dt.$$

As a means of comparing these two levels of utility, we determine the percentage change in the consumption (individual and average) flow over the entire base path such that an agent is indifferent between both solutions. That is, we seek to find ζ such that

$$W_d(\zeta c_d(t), l_d(t)) = W_p(c_p(t), l_p(t)).$$

The value reported as our measure of welfare change in tables 1 and 2 is given by $(\zeta - 1) * 100$.

The instantaneous welfare gain presented in figure 4e is calculated equivalently, but instead of considering the intertemporal welfare value, we consider the level of welfare at each point in time.

References

Abel, A. (1990) ‘Asset prices under habit formation and catching up with the joneses,’ *American Economic Review* 80, 38–42

Akerlof, G., and J. Yellen (1990) ‘The fair wage-effort hypothesis and unemployment,’ *Quarterly Journal of Economics* 105, 2, 255–83

Alesina, A., E. Glaeser, and B. Sacerdote (2005) ‘Work and leisure in the US and Europe: why so different?,’ in *NBER Macroeconomic Annual*, ed. M. Gertler and K. Rogoff (Massachusetts: MIT Press)

Alonso-Carrera, J., J. Caballé, and X. Raurich (2005) ‘Growth, habit formation and catching-up with the Joneses,’ *European Economic Review* 49 (6), 1665–91

Alonso-Carrera J., J. Caballé, and X. Raurich (2006) ‘Welfare implications of the interaction between habits and consumption externalities,’ *International Economic Review* 47, 557–71

Alpizar, F., F. Carlsson, and O. Johansson-Stenman (2005) ‘How much do we care about absolute versus relative income and consumption?,’ *Journal of Economic Behavior and Organization* 56, 405–21

Altonji, J.G. (1986) 'Intertemporal substitution in labor supply: evidence from micro data' *Journal of Political Economy* 91, 3, 176–215

Alvarez-Cuadrado, F., G. Monteiro, and S.J. Turnovsky (2004) 'Habit formation, catching up with the joneses, and economic growth,' *Journal of Economic Growth* 9, 47–80

Alvarez-Cuadrado, F., and D. Sutthiphisal (2006) 'Envy and consumption behavior: A panel data approach,' McGill University Working Paper

Argyle, M. (1989) *The Psycology of Happiness* (London: Routledge)

Aristotle (1941) *The Basic Works of Aristotle*, ed. R. McKeon (New York: Random House)

Blundell, R., and T. MaCurdy (1999) 'Labour supply: a review of alternative approaches,' *The Institute For Fiscal Studies Working Paper*s No. W98/18.

Cantril, H. (1965) *The Pattern of Human Concerns* (New Brunswick: Rutgers University Press)

Campbell, J.Y., and J.H. Cochrane (1999) 'By force of habit: a consumption-based explanation of aggregate stock market behavior,' *Journal of Political Economy* 107, 205–51

Carroll, C.D., J.R. Overland, and D.N. Weil (1997) 'Comparison utility in a growth model,' *Journal of Economic Growth* 2, 339–67

Cho, J., and T.F. Cooley (1994) 'Employment and hours over the business cycle,' *Journal of Economic Dynamics and Control* 18, 411–32

Clark, A.E., and A.J. Oswald (1996) 'Satisfaction and comparison income,' *Journal of Public Economics* 61, 359–81

Cooley and Prescott (1995) 'Economic growth and business cycles, in *Frontiers of Business Cycle Research*, ed. T.F. Cooley (Princeton: Princeton University Press)

Dupor, B., and W-F. Liu (2003) 'Jealousy and equilibrium overconsumption,' *American Economic Review* 93, 423–28

Dusenberry, J.S. (1949) *Income, Saving and the Theory of Consumer Behavior* (Cambridge: Harvard University Press)

Easterlin, R.A. (1995) 'Will raising the incomes of all increase the happiness of all?,' *Journal of Economic Behavior and Organization* 27, 35–47

Eaton, B.C., and M. Eswaran (2003) 'The evolution of preferences and competition: a rationalization of Veblen's theory of invidious consumption,' *Canadian Economic Review* 36, 832–59

Fisher, W., and F. Hof (2000) 'Relative consumption and endogenous labour supply in the ramsey model: Do status-conscious people work too much?,' *Institute for Advance Studies, Vienna.*

Frank, R.H. (1985) *Choosing the Right Pond* (New York and Oxford: Oxford University Press)

Frey, B.S., and A. Stutzer (2002) 'What can economists learn from happiness research?,' *Journal of Economic Literature* 40, 402–35

Friedman, M. (1953) *Essays in Positive Economics* (Chicago: University of Chicago Press)

Gali, J. (1994) 'Keeping up with the joneses: consumption externalities, portfolio choice, and asset prices,' *Journal of Money, Credit, and Banking* 26, 1–8

Glaeser, E., B. Sacerdote, and J. Scheinkman (2003) 'The social multiplier,' *Journal of the European Economic Association* 1, 2, 345–53

Gollin, D. (2002) 'Getting income shares right,' *Journal of Political Economy* 110, 458–74

GGDC (2006) The Conference Board and Groningen Growth and Development Centre, Total Economy Database, May 2006

Heckman, J.J., and T.E. MaCurdy (1980) 'A life-cycle model of female labour supply,' *Review of Economic Studies* 47, 47–74

Helliwell, J. (2003) 'How's life? combining individual and national variables to explain subjective well-being,' *Economic Modelling* 20, 2, 331–60

Huberman, M. (2004) 'Working hours of the world unite? New international evidence of worktime, 1870–1913,' *Journal of Economic History* 64, 964–1001

Hunt, J. (1998) 'Hours reductions as work-sharing,' *Brooking Papers on Economic Activity* 1, 339–69
ILO (2005). Key Indicators of the Labour Market, 4th Edition. CD version.
Johansson-Stenman, O., F. Carlsson, and D. Daruvala (2002) 'Measuring future grandparents' preferences for equality and relative standing,' *Economic Journal* 112, 362–83
Juster, F.T., and F.P. Stafford (1991) 'The allocation of time: empirical findings, behavioral models, and problems of measurement,' *Journal of Economic Literature* 39, 471–522
Kant, I. (1797) 'The metaphysics of morals,' in *The Cambridge Edition of the Works of Immanuel Kant: Practical Philosophy*, ed. M. Gregor (New York: Cambridge University Press)
Kapteyn, A., S. Van de Geer, H. Van de Stadt, and T. Wansbeek (1997) 'Interdependent preferences: an econometric analysis,' *Journal of Applied Econometrics* 12, 6, 665–86
Layard, R. (2005) *Happiness: Lessons from a New Science* (New York: Penguin Press)
Liu, W.-F., and S.J. Turnovsky (2005) 'Consumption externalities, production externalities, and long-run macroeconomic efficiency,' *Journal of Public Economics* 89, 1097–1129
Luttmer, E. (2005) 'Neighbors as negatives: relative earnings and well-being,' *Quarterly Journal of Economics* 120(3), 963–1002
Marchand, O., and C. Thelot (1991) *Deux Siecles de travail en France* (Paris: INSEE)
Marimon, R., and F. Zilibotti (2000) 'Employment and distributional effects of restricting working time,' *European Economic Review* 44, 1291–1326
Mendoza, E.G., A. Razin, and L.L. Tesar (1994) 'Effective tax rates in macroeconomics. Cross-country estimates of tax rates on factor incomes and consumption,' *Journal of Monetary Economics* 34, 297–323
Neumark, D., and A. Postlewaite (1998) 'Relative income concerns and the rise in married women's employment,' *Journal of Public Economics* 70, 157–83
OECD (1999) Revenue Statistics 1965–1998 (Paris: OECD)
Pollak, R.A. (1976) 'Interdependent preferences,' *American Economic Review* 66, 3, 309–20
Prescott, E. (2004) 'Why do americans work so much more than europeans?,' *Federal Reserve Bank of Minneapolis Quarterly Review* 28, 2–13
Ravina, E. (2005) 'Keeping up with the joneses: evidence from micro data,' *New York University Stern School of Business Working Paper*.
Ravn, M., S. Schmitt-Grohe, and M. Uribe (2006) 'Deep habits,' *Review of Economic Studies* 73, 195–218
Rawls, J. (1971) *A Theory of Justice* (Cambridge: Belknap Press)
Ramey, V, and N. Francis (2006) 'A century of work and leisure,' Unpublished manuscript
Schoeck, H. (1966) *Envy: A Theory of Social Behavior* (New York: Harcourt)
Smith, A. (1759) *The Theory of Moral Sentiments* (Oxford: Clarendon Press)
Solnick, S., and D. Hemenway (1998) 'Is more always better? A survey on positional concerns,' *Journal of Economic Behavior and Organization* 37, 373–83
Van de Stadt, H., A. Kapteyn, and S. van de Geer (1985) 'The relativity of utility: evidence from panel data,' *Review of Economics and Statistics* 67, 179–87
Veblen, T.B. (1899) *The Theory of the Leisure Class: An Economic Study of Institutions* (New York: Modern Library)
Woods, H.D., and S. Ostry (1962) *Labour Policy and Labour Economics in Canada* (Toronto: MacMillan)