Why Do People Work So Hard?

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Abstract

Basic economic theory, coupled with standard preference parameters, predicts that labor supply should fall steadily over time. Yet this contradicts the fact that labor hours fall as an economy develops, but subsequently tend to stabilize. I present a model that explains long-run trends in labor supply by the interaction of two opposing forces: a rising real wage, which lowers labor supply, and increasing product variety, which raises it. Both forces arise from the same source—innovation—and, on a balanced growth path, their interaction can sustain stable labor hours.

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Introduction

Although GDP per capita in the U.S. more than trebled over the past fifty years, Figure 1 shows that labor hours per capita remained roughly stable. Especially given the rise in real wages over time, this is surprising: according to standard preference parameters, rising consumption causes marginal utility to fall quickly, leading to a steady *decline* in labor hours. Using such reasoning, Keynes (1931) predicted a vastly different workplace by this stage: "a fifteen hour week"; a world where "needs are satisfied"; and where Man faced his "permanent problem" of too much leisure. Yet these predictions have failed to materialize. To address this issue, this paper proposes a theory of labor supply consistent with standard preference parameters and observed trends in labor hours over time. Despite their importance for growth and welfare, such trends have received little attention in the literature.

According to the standard labor-leisure model, people supply labor to purchase consumption goods. Underlying the model's prediction of falling labor hours is the assumption that all goods are perfect substitutes. For this reason, consumers quickly become satiated in the face of diminishing marginal utility. Introspection leads one to the same conclusion: would people continue to supply similar labor hours, as consumption of the same good rose over time? Although this seems unlikely, this is what standard models predict: labor supply is independent of what you can buy.

In this paper, I endogenize labor supply as a function of product variety. By product variety, I mean distinct product groups—such as cars—and relatively similar brands within each group—such as Volvos and Fords. As we shall see, the growth of product groups increases labor supply, while brand growth reduces it. But with a sufficiently high taste for new product groups over brands, greater product variety raises labor hours. By increasing marginal utility, more product variety attenuates the income effect of a rising real wage, and raises the incentive to supply labor. Moreover, real wage and variety growth arise from the same underlying force: innovation.

To see the basic idea, consider a simple static model, where the real wage is W, consumption is C, labor hours are l, and standard utility is $U(C, l) = u(Wl) - h(l)$.

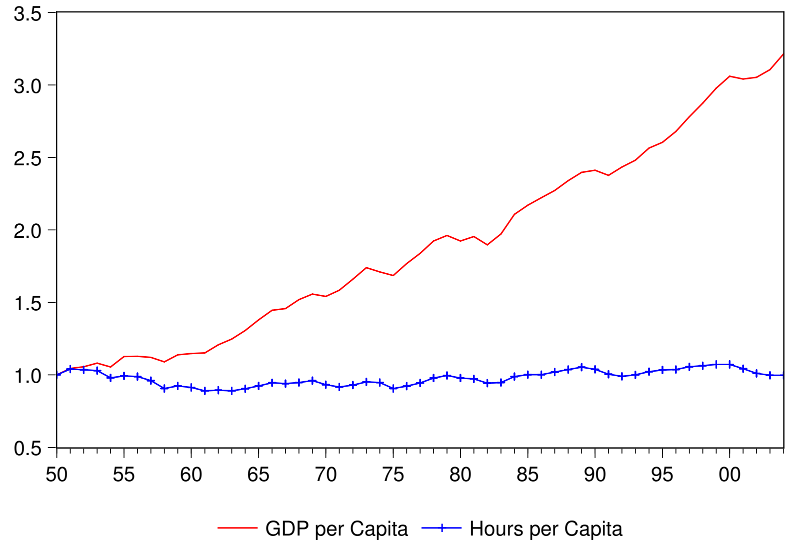

Figure 1: INDICES OF REAL GDP PER CAPITA AND HOURS PER CAPITA: U.S., 1950-2004
Source: Penn World Tables and Francis and Ramey (2006)

With a dominant income effect, a rise in W causes marginal utility to fall quickly, reducing labor supply. By contrast, if there are n independent goods, utility reduces to $U(C,l) = nu(\frac{Wl}{n}) - h(l)$. Faced with greater variety, people spread expenditure over more goods, causing a rise in marginal utility. Not only can this dynamic sustain stable labor hours, but the rising earnings accruing to this labor supply raises the market for more innovation—leading to further wage and variety growth, and so on. As a result, new consumer goods can drive growth.

I proceed as follows. After reviewing current approaches to modeling labor supply in Section 1, I introduce a partial equilibrium model in Section 2. The goal of the model is twofold. First, it shows the main insight of the paper: how increasing product variety affects labor hours. Second, it introduces a utility function consistent with the empirical evidence of real wage growth, a dominant income effect, and stable long-run labor hours. Following this, Section 3 presents a model of long-run growth. Although labor supply is the fundamental source of growth, the labor-leisure margin has received little attention in the growth literature. To address this gap, I incorporate labor supply into a New Growth model. By focusing on the returns to innovation, the model shows how greater labor supply expands the size of the market and raises the incentive to innovate. In turn, this innovation leads to further wage and variety growth, and on a balanced growth path, both forces maintain stable labor hours. Having presented the theory, in Section 4 I show how the model can explain the rise in labor hours prior to the Industrial Revolution—the "Industrious Revolution." Finally, Section 5 concludes.

1 Review of Labor Supply Modeling

In this section, I briefly review common macroeconomic approaches to modeling labor supply.

1.1 Neoclassical Labor–Leisure Theory

Central to the trend in labor supply is the elasticity of marginal utility with respect to consumption—here denoted $\sigma > 0$. This governs how fast the marginal utility of consumption declines as consumption rises. To see the role of σ, consider the standard labor-leisure optimality condition with an interior solution and consumption-labor separability:

$$W_t u'(C_t) = h'(l_t), \tag{1}$$

where $u' > 0$, $u'' < 0$, $h' > 0$, and $h'' > 0$. The level of labor supply depends on the interaction of the real wage W and the marginal utility of consumption, $u'(C)$. For concreteness, consider the standard case of isoelastic, time-separable utility where $u(C) = \frac{C^{1-\sigma}}{1-\sigma}$ and $h(l) = \frac{l^{1+\theta}}{1+\theta}$, $\theta > 0$. Taking growth rates of (1) then yields

$$\theta \frac{\dot{l}}{l} = \frac{\dot{W}}{W} - \sigma \frac{\dot{C}}{C}. \tag{2}$$

Over the long run, $\frac{\dot{W}}{W} \approx \frac{\dot{C}}{C} \approx 2$ percent. Therefore, if $\sigma > 1$, the model predicts labor hours fall over time; in this case, the income effect of a rising wage dominates and people quickly become satiated as consumption rises. By contrast, if $\sigma < 1$, the substitution effect dominates, and labor supply rises over time. Only the case of $\sigma = 1$ ensures stable labor hours. Irrespective of the magnitude of σ, the model predicts labor hours will either rise or fall steadily, or remain stable over time. Yet, as shown in Figures 2–4, labor hours tend to fall as an economy develops, but subsequently tend to stabilize.

What is the magnitude of σ? Reviewing empirical research, Campbell (2001) notes that "direct evidence on the elasticity of intertemporal substitution [i.e., $\frac{1}{\sigma}$] suggests that it is fairly low, certainly well below one." Examining trends in savings rates as economies develop, Barro (2005) shows how time series estimates restrict σ to lie between two and four. Hall (1988) and Campbell and Mankiw (1990) estimate the elasticity to be close to zero.[1] Although empirical evidence suggests $\sigma > 1$, this is inconsistent with standard preferences and a stable long-run labor supply.[2] For standard values of $\sigma = 3$ and $\theta \approx 1.3$, for example, labor hours would fall by three percent a year.[3]

1.2 Common Approaches to Modeling Stable Labor Supply

Below I review three models, all consistent with stable long-run labor hours.

1.2.1 Cobb-Douglas Utility

Most growth and real business cycle models assume Cobb-Douglas utility; i.e., $\sigma = 1$. Although this is the only standard function with consumption-labor separability that is consistent with stable long-run labor hours, most empirical evidence suggests $\sigma > 1$.

1.2.2 King-Plosser-Rebelo Utility

Assuming a time endowment of unity, the King-Plosser-Rebelo utility function is

[1] Hall's (1988) value is representative, and Cochrane (2005) observes that "more recent macro literature has tended to side with Hall." Carroll and Summers (1989) note that "most estimates" lie below 0.25. Using micro data, Attanasio and Weber (1995) report estimates in the range $[0.48, 0.67]$.

[2] To ensure constant interest rates and risk premia in the face of rising consumption, steady-state analysis requires isoelastic preferences.

[3] For representative agent macroeconomic models, Chetty et al. (2011) recommend a Frisch elasticity of .75, corresponding to $\theta = 1.3$.

$$u(C,l) = \begin{cases} \frac{C^{1-\sigma}g(1-l)-1}{1-\sigma} & \text{if } \sigma \neq 1 \\ \log C + g(1-l) & \text{if } \sigma = 1, \end{cases}$$

where $g' < 0$, $g'' > 0$, when $\sigma > 1$, and $g' > 0$, $g'' < 0$ otherwise. To ensure stable labor hours when $\sigma > 1$, this function posits that consumption and labor are complements. Because a higher level of labor supply raises the marginal utility of consumption, it is optimal to supply more labor as real wages rise. This dynamic works against the income effect of rising wages and, with certain restrictions, permanent wage changes have no effect on labor supply. Yet whether the marginal utility of consumption is *increasing* in labor supply is unclear. Long hours at work mean less time to enjoy consumption goods; a vacation is an obvious example. Reviewing research on consumption patterns when a person becomes unemployed or experiences poor health, Chetty (2006) reports that consumption only falls marginally for those with liquid wealth or higher unemployment benefits. This finding suggests optimal consumption levels are similar regardless of the level of labor supply, indicating little complementarity. Consistent with this, Campbell and Ludvigson (1998) report that "aggregate data offers no evidence of any important nonseparability."

1.2.3 Home Production Models

Another explanation for stable hours focuses on differential productivity trends in market and home production (see e.g., Benhabib et al., 1991). To produce consumption goods, consumers allocate time between home and market activity. As the relative productivities of these activities change, consumers substitute between them. Yet with equal productivity growth, there is no reason for substitution, and market hours remain stable. Implicit in this approach, however, is a relatively high degree of substitution between home and market-produced goods.

2 Partial Equilibrium Model of Labor Hours and Variety

Empirical evidence suggests three facts about long-run trends in labor supply: (1) there is a dominant income effect to wage growth; i.e., $\sigma > 1$; (2) consumption-labor separability; and (3) declining hours at the outset of development, which subsequently stabilize. In this section I present a model where expanding product variety affects labor supply, and show how it is consistent with these facts. For now, I take variety growth as exogenous. In Section 3, I present a general equilibrium model which illustrates the other side of the dynamic: how a higher labor supply raises market size and, in turn, the returns to innovation.

2.1 The Economic Environment

There is a single representative consumer who lives for T periods. The consumer has preferences over a continuum of existing and potential goods, including leisure. Each period, there is a time endowment of unity. There is latent demand for all potential goods, and no good is essential. The consumer receives interest and wage income. My main concern is labor supply per capita over the long run, so what I mean by "labor supply" is broad: it captures labor effort and intensity, and generally encompasses any activity directed to supplying labor in the marketplace. As such, because it is a means of raising one's *effective* or quality-adjusted labor supply, it also incorporates human capital accumulation and training. By contrast, leisure incorporates any nonmarket-oriented activity; e.g., home production, child rearing, idleness, and so on.

Consumption consists of different components, and there are two margins of differentiation: product groups and brands. Product groups represent broad categories of goods without close substitutes, for which demand is relatively inelastic; e.g., medicines, cars, laptops, cell phones, and so on. There is a continuum of differentiated product groups, indexed along the interval $(0, \infty)$, but at any time t, only a measure $n_t < \infty$ is available for purchase. There is a common elasticity of substitution between all groups, and since groups are imperfect substitutes, this is less than one. New goods on this margin represent "breakthrough" innovations.

Associated with each group is a continuum of brands, also indexed on $(0, \infty)$. Brands constitute different varieties or characteristics of goods within a given group—in terms of attributes like style, flavor, color, and so on. Brand growth also incorporates quality improvements within each group; for example, the release of a safer car would represent a quality increase embodied in a new brand. At time t, there is a measure $m_t < \infty$ of brands available in each group.[4] Because brands are relatively good substitutes, demand on this margin is elastic, and the common elasticity of substitution between brands exceeds one.

Brands, groups, and real wages grow at rates g_m, g_n, and g_w respectively. I index groups by $j \in [0, n_t]$ and brands by $i \in [0, m_t]$. Thus $c_{jit} \geq 0$ denotes the consumption service flow from brand i in group j at time t; c_{jt} denotes the service flow from group j at time t. Finally, all existing goods have a price of unity, while non-existent goods have infinite prices.

The consumer has a love of variety for groups and brands. For groups, one can explain this by the welfare improvement associated with significant innovations: new groups satisfy previously unmet needs. Broadly, one can explain a love of variety for brands in two ways. First, with diminishing marginal utility to each good, there is a welfare gain to smoothing consumption over more brands. Faced with a variety of yoghurts, for example, the consumer might prefer to consume a little of each flavor; this is the Dixit and Stiglitz (1977) setup. Second, more variety enables consumers to attain their ideal brand or bundle of characteristics; this is the Lancaster (1979) formulation. Either way, welfare of the representative consumer rises as the number of brands increases. Mostly for simplicity, I use the more tractable Dixit-Stiglitz formulation.

[4]For convenience, I ignore indivisibilities and the non-integral nature of the variables n and m, and from now on refer to them loosely as numbers. More generally, it is convenient to view m and n as continuous indices of brand and group variety.

2.2 Consumer Preferences

Utility each period is a function of consumption services from product groups, c_{jt}, and labor supply $l_t \in [0,1]$. Consumption services from group $j \in [0,n]$ are given by the constant elasticity of substitution index:

$$c_{jt} \equiv \mathfrak{m}_t^{v+1-\frac{1}{\alpha}} \left(\int_0^{m_t} c_{jit}^{\alpha} \, di \right)^{\frac{1}{\alpha}}, \tag{3}$$

where $c_{jit} \geq 0$, $v \in (0,\infty)$, $\alpha \in (0,1)$, and $\mathfrak{m}_t > 0$ denotes the measure of brands actually consumed. Distinguishing between the number of *available* brands, m_t, and the number actually consumed, $\mathfrak{m}_t$, ensures that only goods consumed affect welfare. For clarity, I set the upper integral limit to m_t and not to infinity, but technically the consumer has preferences over a continuum of goods. Since there is a continuum of brands, the elasticity of substitution between brands within a group is $\frac{1}{1-\alpha} \in (1,\infty)$.

Following Benassy (1996), v mediates the taste for brand variety, and governs the elasticity of the marginal utility of consumption with respect to the number of brands consumed. This parameter disentangles the distinct concepts of elasticity of substitution between brands—which also equals the elasticity of demand for each brand—and love of variety.[5] As a result, this formulation can handle situations where the consumer might be highly responsive to price changes, but still have a large taste for variety; or cases where the consumer perceives goods as imperfect substitutes, but has little taste for variety.[6]

When the consumer purchases only a single group c_{jt}, utility is given by

$$u(c_{jt}) - u(0) = \frac{(c_{jt}+\epsilon)^{1-\sigma}}{1-\sigma} - \frac{\epsilon^{1-\sigma}}{1-\sigma} \geq 0,$$

where $\sigma > 1$, $\epsilon > 0$, and $c_{jt} \gg \epsilon \approx 0$. The constant ϵ is arbitrarily small and governs the

[5] To see why, suppose consumption expenditure on a group is C_t. Given symmetry and strict concavity, the consumer purchases all goods in equal quantities, so $\mathfrak{m}_t = m_t$ and $c_{jt} = m_t^{v+1-\frac{1}{\alpha}} m_t^{(\frac{1}{\alpha}-1)} C_t = m_t^v C_t$. It follows that v now mediates the marginal utility gain to consuming more brands.

[6] By comparison, the standard Dixit-Stiglitz function conflates the degree of love of variety with the elasticity of substitution (and elasticity of demand), and implies $v = \frac{1}{\alpha} - 1$.

utility gain from consuming a positive quantity of the group. Since $\epsilon \approx 0$, even a small amount of consumption on a new group raises utility significantly; that is, there is a sizable welfare gain to consuming distinct new innovations. Technically, since $\sigma > 1$, ϵ also ensures that the utility flow from consuming a group is positive, and that utility is well-defined when $c_{jt} = 0$.

Period utility from consumption services when n_t groups are available for purchase is

$$\mathfrak{n}_t^{\phi} \int_0^{n_t} \frac{(c_{jt} + \epsilon)^{1-\sigma}}{1-\sigma} - \frac{\epsilon^{1-\sigma}}{1-\sigma}\, dj, \tag{4}$$

where $\phi > -1$, and $\mathfrak{n}_t$ denotes the number of groups actually consumed. The constant $\frac{1}{\sigma} < 1$ is the elasticity of intertemporal substitution of consumption services from each group across time.[7] Because groups are separable in utility, $\frac{1}{\sigma}$ is also the elasticity of substitution between groups. As a result, consumption services in different periods and consumption services between different groups are equally substitutable. Because groups are imperfect substitutes, while most empirical evidence indicates that the intertemporal elasticity of substitution is below one, this is a reasonable simplification.[8]

Here, ϕ plays a role similar to that of v in the discussion of brands: it disentangles the degree of love of variety for groups from the elasticity of substitution between groups. To see this, let $\bar{c}_{jt}$ denote the equilibrium level of consumption services in each group at time t. If the consumer purchases $\mathfrak{n}_t$ product groups, then by symmetry the equilibrium level of utility from consumption in period t is given by $\mathfrak{n}_t^{\phi+1}\big(u(\bar{c}_{jt}) - u(0)\big)$. Holding $\bar{c}_{jt}$ in each group constant, $\phi > -1$ now mediates the marginal utility gain to consuming additional groups; the restriction, $\phi > -1$, ensures that utility in this case is increasing in the number of groups consumed.

Keeping c_{jt} on other groups fixed, if $-1 < \phi < 0$, there is decreasing marginal

[7] Strictly speaking, this is an approximation and is only true as $c_{jt} \to \infty$. The elasticity of intertemporal substitution of c_{jt} is $\frac{c_{jt}+\epsilon}{\sigma c_{jt}}$, but since $\epsilon \approx 0$, $\frac{c_{jt}+\epsilon}{\sigma c_{jt}} \approx \frac{1}{\sigma}$.

[8] In equilibrium, the term $\frac{1}{\sigma}$ equals the elasticity of intertemporal substitution of real consumption expenditure.

utility to the number of groups consumed. When $\phi = 0$, groups are independent and additively separable in utility. In contrast, if $\phi > 0$, there is increasing marginal utility to the number of groups consumed: new goods now supplement the usefulness of existing ones. As an example, suppose there are only two groups: food and recreation. Keeping expenditure on all groups fixed, the introduction of a third group—cars—now has two effects. Because the consumer can now travel to nice restaurants, the marginal utility of food rises. Since the consumer can now easily travel, the marginal utility of recreation also rises. Thus the consumption of a new group can have a positive effect on the marginal utility of other groups.

2.3 The Complete Problem

The consumer has assets of b_t each period, an elasticity of labor supply of $\frac{1}{\theta} > 0$, and a rate of time preference of $\rho > 0$. Labor and consumption are separable in utility. The parameter β mediates the taste for leisure. The consumer takes the paths of r_t, W_t, n_t, m_t, and the initial level of assets, b_0, as given and solves:

$$\max_{(0<l_t\leq 1,\, b_t,\, \{c_{jit}\geq 0\})_{t=0}^{t=\infty}} \int_0^\infty \left(\mathfrak{n}_t^{\phi} \int_0^{n_t} u(c_{jt}) - u(0)\, dj - \beta \frac{l_t^{1+\theta}}{1+\theta} \right) e^{-\rho t}\, dt,$$

subject to:

$$\dot{b}_t \leq r_t b_t + W_t l_t - \int_0^{n_t} \int_0^{m_t} c_{jit}\, di\, dj, \tag{5}$$

$$\lim_{t\to\infty} b_t e^{-\int_0^t r_s\, ds} = 0 \tag{6}$$

2.4 The Solution to the Intratemporal Problem

I solve the problem by two-stage budgeting. First I find the optimal allocation of goods within each period, subject to some given level of consumption expenditure C_t at time t. Following this, I turn to the intertemporal problem and find the optimal path of C_t.

Given equal prices and the form of utility, it is optimal to allocate expenditure equally across consumed groups and to consume an equal amount of each brand. Noting equal prices of unity, the quantity demanded of each existing good is then $c_{jit} = \frac{C_t}{m_t \mathfrak{n}_t}$ for all $j \in [0, n_t]$ and $i \in [0, m_t]$. Plugging these demands into (3) gives the optimal level of consumption services from group j at time t:

$$\max_{\{c_{jit} \geq 0\}} \left\{ c_{jt} : \int_0^{m_t} c_{jit} \, di = \frac{C_t}{\mathfrak{n}_t} \right\} = m_t^{v} \frac{C_t}{\mathfrak{n}_t}. \tag{7}$$

After substituting the optimal c_{jt} into Eq. (4), the period indirect utility function for consumption reduces to

$$V(C_t, m_t, n_t) = \frac{\mathfrak{n}_t^{\phi+1} (m_t^{v} \frac{C_t}{\mathfrak{n}_t} + \epsilon)^{1-\sigma}}{1-\sigma} + \frac{\mathfrak{n}_t^{\phi+1}}{(\sigma-1)\epsilon^{\sigma-1}}.$$

Provided the parameter restriction, $\epsilon < \left(\frac{\phi+\sigma}{\phi+1}\right)^{\frac{1}{1-\sigma}} \left(\frac{C_t m_t^{v}}{\mathfrak{n}_t}\right)$, holds, product groups raise utility, and hence $\mathfrak{n}_t = n_t$. Because ϵ is infinitesimally small by assumption, I assume it always satisfies this condition. For convenience, define $\zeta \equiv \phi + \sigma > 0$; then noting that $\frac{m_t^{v} C_t}{n_t} \gg \epsilon \approx 0$, I approximate V to get

$$V(C_t, m_t, n_t) \approx \frac{n_t^{\zeta} m_t^{v(1-\sigma)} {C_t}^{1-\sigma}}{1-\sigma} + \frac{n_t^{\phi+1}}{(\sigma-1)\epsilon^{\sigma-1}}. \tag{8}$$

Finally, reduced form lifetime utility is

$$\mathbb{U} = \int_0^{\infty} \left(\frac{n_t^{\zeta} m_t^{v(1-\sigma)} {C_t}^{1-\sigma}}{1-\sigma} + \frac{n_t^{\phi+1}}{(\sigma-1)\epsilon^{\sigma-1}} - \beta \frac{l_t^{1+\theta}}{1+\theta} \right) e^{-\rho t} \, dt. \tag{9}$$

2.5 Discussion of Intertemporal Problem

Two notable points follow from Eq. (8). First, in contrast to the standard model—where $V(C_t) = \frac{{C_t}^{1-\sigma}}{1-\sigma}$—the indirect utility function for consumption in a period now depends on the variety of goods consumed. Significantly, by setting $n_t = m_t = 1$, the resulting utility function represents the same preferences as in the standard one-good model. Thus, the standard model is a special case of a multi-good setup. Second, the intertemporal elasticity of substitution for real consumption *expenditure* is $\frac{1}{\sigma}$. All else constant, a high σ indicates sharp diminishing marginal utility to consumption expenditure at any given point in time. But because of product group growth, marginal utility does not necessarily fall this fast *over* time.

2.6 The Effect of Variety on Marginal Utility

From Eq. (8), marginal utility is

$$V'(C_t) = \frac{n_t^{\zeta}}{m_t^{v(\sigma-1)} C_t^{\sigma}}. \tag{10}$$

Therefore, noting $\sigma > 1$, $\frac{\partial^2 V}{\partial m_t \partial C_t} < 0$ and $\frac{\partial^2 V}{\partial n_t \partial C_t} > 0$. To understand these results, recall that the optimal value of c_{jt} is $m_t^v \frac{C_t}{n_t}$. Expressed this way, one can view $\frac{C_t}{n_t}$ and m_t as distinct substitutable inputs, combining to produce consumption services, c_{jt}.[9] Because these inputs enter in Cobb-Douglas form, the intratemporal elasticity of substitution between them is unity. Now setting $\epsilon = 0$ for simplicity, utility from $u(c_{jt})$ becomes

$$u(c_{jt}) = \frac{n_t^{\phi}(m_t^v \frac{C_t}{n_t})^{1-\sigma}}{1-\sigma}. \tag{11}$$

For expenditure allocation, the consumer has preferences defined over two margins. The first margin relates to the composition of each group; i.e., allocating inputs—$\frac{C_t}{n_t}$ and m_t^v—to produce consumption services from each group. The second relates to the allocation of the level of consumption services, c_{jt}, across time and groups. Given that $\sigma > 1$, the elasticity of substitution between m_t^v and $\frac{C_t}{n_t}$—i.e., 1—exceeds the elasticity of substitution of consumption services across time and groups, $\frac{1}{\sigma}$. Therefore, compared to consumption services in each period and group, m_t and $\frac{C_t}{n_t}$ are relatively good substitutes. For this reason, consumers are more concerned about attaining similar levels

[9] By contrast, in the standard one-good model, $c_{jt} = C_t$; that is, there is one group and utility derives solely from real consumption expenditure.

of c_{jt} per group across time than with equating the level of each input within groups.[10]

Because they raise the level of consumption services from a given amount of expenditure on each existing group in a period, increases in m_t lead to consumption "deepening." And since consumers prioritize the smoothing of c_{jt} over j and time, they quickly become satiated as consumption services rise in a given period. Intuitively, since m_t and $\frac{C_t}{n_t}$ are relatively good substitutes, increases in m_t act as a substitute for consumption expenditure, and this tends to satiate the consumer.[11] Rather than wanting to consume more, consumers now desire to shift real consumption resources, C_t, to other periods. As a result, a rise in m_t in a period reduces marginal utility that period.

A rise in the number of groups, n_t, in a period has two effects on marginal utility. First, since consumers smooth expenditure C_t over groups, notice from Eq. (11) that a rise in n_t reduces the consumption of each group, $\frac{C_t}{n_t}$. Because consumers strongly desire to smooth the level of consumption services across groups and time, this consumption "widening" raises the marginal utility of consumption for each group in period t. Second, there is a direct effect due to ϕ, capturing the degree of complementarity across groups. Holding expenditure on all groups fixed, increasing the number of groups consumed affects the marginal utility of consuming existing groups. To summarize, we have the following propositions:

Proposition 1 *: A rise in the number of brands, m_t, in a period reduces the marginal utility of consumption in that period; i.e., $\frac{\partial^2 V}{\partial m_t \partial C_t} < 0$.*

Proposition 2 *: A rise in the number of groups, n_t, in a period raises the marginal utility of consumption in that period; i.e., $\frac{\partial^2 V}{\partial n_t \partial C_t} > 0$.*

[10]Because consumers always spread expenditure equally across all goods in each period, the relative magnitudes of the elasticities of substitution between brands, groups and time have no bearing on the analysis (apart from the issue of whether the elasticity is above or below unity.) Instead, the chief tension is the difference between the elasticity of substitution between inputs of the Cobb-Douglas index and the elasticity of substitution of product groups c_{jt} over time.

[11]Equivalently, when m rises in a period, the price of consumption services that period falls; i.e., the "welfare-based" price index falls. Because $\sigma > 1$, the income effect of this price fall dominates, inducing consumers to smooth the welfare gain and shift consumption services—specifically, real consumption—to other periods. As a result, when m rises in a given period, the marginal utility of consumption falls in that period.

2.7 Solution: Long-Run Trends in Labor Supply

Substituting the expression for marginal utility, Eq. (10), into the labor optimality condition,

$$W_t V'(C_t) = \beta l_t^{\theta}, \tag{12}$$

and taking growth rates yields

$$\theta \frac{\dot{l}_t}{l_t} = \zeta \frac{\dot{n}_t}{n_t} + v(1-\sigma)\frac{\dot{m}_t}{m_t} - \sigma \frac{\dot{C}_t}{C_t} + \frac{\dot{W}_t}{W_t} \tag{13}$$

Whether labor supply rises or falls depends on the interaction of four forces. First, by reducing marginal utility, growth in the number of brands causes labor supply to fall. By contrast, growth in product groups raises marginal utility, causing a rise in labor supply. The tastes for variety, ζ and v, govern the size of these effects. Because of the income effect, consumption growth lowers labor supply. Finally, because of the substitution effect, real wage growth raises labor supply. Absent variety growth, labor hours would fall over time.

Households devote resources of $C_t = \int_0^{n_t} \int_0^{m_t} c_{jit}\, di\, dj = n_t m_t \overline{c_t}$, to consumption, where $\overline{c_t}$ denotes the consumption of each good in period t. The standard one-good model treats these $n_t m_t \overline{c_t}$ units of consumption as perfect substitutes, which combine to yield aggregate consumption C_t. Faced with a rising real wage, and strong diminishing marginal utility, people reduce labor supply over time in this one-good world. By contrast, while there is diminishing marginal utility to each *individual* group in the multi-good model, new groups raise marginal utility. For this reason, *aggregate* consumption does not necessarily face diminishing marginal utility.

2.7.1 Condition for Stable Labor Hours

To place structure on the model, I assume now that over the long run, consumption and wage growth are equal.[12] For stable labor hours, Eq. (13) then implies:

$$\frac{\dot{W}_t}{W_t} = \frac{\zeta}{\sigma - 1}\frac{\dot{n}_t}{n_t} - v\frac{\dot{m}_t}{m_t}. \tag{14}$$

According to this condition, product group growth is the force sustaining stable labor hours. Because brand growth is almost surely higher than group growth, the taste for groups, ζ, must therefore be relatively high. Such a high value is plausible: compared to the past, the most striking feature of consumption today is the number of new groups. Because of their nature, new groups almost surely have a greater effect on marginal utility than new brands. For ease of exposition, therefore, and because my main concern are labor trends over the long run, I will assume from now on that a rise in product variety raises labor hours.

Accompanying technological progress are rises in both real wages and product variety. For this reason, wages and product variety grow together over the long run. Yet there is no reason for this condition to always hold: depending on the magnitudes of wage and variety growth, labor hours could rise, fall, or remain stable.

2.8 Discussion of Model and Empirical Evidence

The model makes two main predictions. First, holding variety constant, a permanent rise in the real wage reduces labor supply. Second, holding wages constant, an increase in the number of distinct products raises labor supply. Below I discuss evidence for these predictions. Because of the limited data on product variety changes, any evidence is necessarily suggestive.

[12] The model in Section 3 will confirm this holds in equilibrium.

2.8.1 Micro Evidence

Reviewing a vast literature on how labor supply changes in response to a permanent rise in the real wage, Borjas (2004) cites a "consensus estimate" of the labor supply elasticity of prime-age males of $-.1$. Recently, Ashenfelter et al. (2010) examine how a legislated rise in the fares of some New York taxi drivers subsequently reduced their hours worked. They document an elasticity of $-.2$.

Rempel (2010) investigates how the work patterns of male teenagers change upon the release of new video games. Because the study effectively controls for changes in the macroeconomic environment, while teenagers have flexible labor hours, it provides a useful test of the model. The empirical findings support the theory: confronted with the release of a new video game, 16-17 year old males increase their labor supply relative to females by five percent.

2.8.2 Macro Evidence

Although the model can explain stable labor hours, the theory permits changes in hours, and is consistent with what Ngai and Pissarides (2008) describe as a "U-shape for market hours" in the United States over the twentieth century. As Figure 2 shows, labor hours in the United States fell markedly in the first half of the century, but started to rise around 1970. Vandenbroucke (2005) attributes the initial fall to a dominant income effect arising from wage growth. In a discussion of post-war trends, Hall (1997) identifies movements in tastes—what he calls MRS or preference shifts—as an important feature of the U.S. labor market in recent decades. Examining labor hours at medium frequencies, he concludes that "the only possible explanation of the large movement in hours per member of the population at medium frequencies is the MRS shift."[13] By affecting one's taste for consumption over leisure, variety growth is a natural candidate for such a taste shift. For example, Brack and Cowling (1983) and Fraser and Paton (2003) find a positive relationship between labor hours and advertizing.

[13] Hall downplays the role of other factors—such as taxation—that affect the marginal rate of substitution between consumption and leisure.

Consistent with Figure 5, the model predicts higher labor hours in poorer countries: while trade ensures many product groups are available worldwide, poorer countries have lower wage rates. Yet despite the overall negative relationship, Figure 5 shows little evidence of a systematic relationship between income and labor hours across richer countries. Within the framework of the model, this could be explained in two ways. First, the nontradable sector affects the level of product variety, and this sector increases in importance as an economy develops; for example, there are marked differences in the nature of European and American nontradable sectors (see e.g., Freeman and Schettkat, 2002). In particular, the relatively deregulated U.S. nontradable sector offers a greater variety of products. Second, different policies and institutions across countries affect wage rates. For example, unionization and social welfare systems reduce within country disparities in wage rates, thus affecting average hours worked.

Within countries, the model predicts that higher wage earners work less. While this has been the case for most of economic history—the "working class" having lower incomes—there has been a rise in labor hours by higher paid workers in the U.S. economy since the late seventies. Recognizing that "it is the higher educated group in the United Kingdom that has tended to work fewer weekly hours on average," Blundell and MaCurdy (1998) also report an upward trend in the labor hours of higher paid workers in Britain over the same period. Kuhn and Lozano (2006) attribute this recent phenomenon to relatively new incentive mechanisms in the service sector, which motivate high income workers to work more. Especially for these workers at the start of their careers, human capital accumulation, tournaments and signalling all contribute to raising labor hours. As such, recent trends could reflect the intertemporal substitution of labor over the life-cycle.

In developing and primitive economies, low levels of labor input and a backward bending labor supply curve are commonplace. Describing the labor market in such economies, Friedman (1962) observes that "in a primitive society, the initial low wage rate at which the income effect becomes dominant reflects a lack of familiarity with market goods." Confirming this in a study of African labor markets, Berg (1961) notes that "when knowledge of the outside is widespread in the villages, many men no longer quit their jobs sooner when wages rise; they stay as long as they had planned to and are happy to bring back to the villages a richer collection of goods." Relatedly, Clark (2007) describes how males in tribal communities work fewer hours than males in modern America; Voth (2001) documents an average of 4.9 daily labor hours per person in such societies. With developing economies and tribal communities offering limited consumption opportunities, such observations are consistent with the model. Section 4 discusses related evidence on the rise in hours prior to the Industrial Revolution.

3 Labor Supply and Long-Run Growth

In this section, I present a general equilibrium model. In contrast to the previous model, this shows how greater labor supply increases the size of the market and raises the incentive to innovate. This innovation in turn leads to wage and variety growth, and both of these forces sustain a stable labor supply in equilibrium. On the balanced growth path, there is steady growth, and the level of labor supply is a function of the consumption technology: how efficient is the economy at creating new consumer products?

In the model, there is a representative household, a competitive R&D sector, and an expanding range of monopolistically competitive input firms. Using goods purchased from input firms, the R&D sector produces blueprints for the creation of new input firms. There are no profits in this sector: free entry ensures the price of a patent equals its production cost.

Each period the representative household chooses consumption and leisure, and supplies labor to all input firms. The household's income comprises wage income and dividends from the input firms. Using a home production technology, it transforms inputs purchased from firms into consumer goods.[14] As the number of input firms rises,

[14] Inputs replace what were previously called brands.

knowledge spillovers permit the continual growth of new consumer goods. For simplicity, I assume new groups have no direct effect on the utility derived from existing ones.

Facing aggregate demand from the household and the R&D sector, input firms hire labor in a competitive labor market. They set price as a markup over marginal cost, and infinitely lived patents secure their profits. To finance the upfront cost of a blueprint, the firms issue debt to the household. In equilibrium, the cost of a blueprint exhausts all profits accruing to it. Because of economic growth and rising investment, the number of input firms rises over time. More broadly, new input firms represent an increase in the stock of knowledge. As a result of knowledge spillovers, labor productivity and the real wage increase along with the number of input firms.

On the balanced growth path, the number of input firms and the real wage increase, along with the number of consumer products. For certain parameter restrictions, the interaction of real wage growth and increasing consumption variety sustains stable labor hours. The deep parameters of the model determine the steady-state level of labor supply. Throughout, I subscript input firms by i, consumer products by j, and denote the price of input i at time t by p_{it}. I solve the model for a balanced growth path.

3.1 The Economic Environment

An imperfectly competitive equilibrium in this economy is an allocation,

$\{b_t, l_t^s, \{x_{jit}\}_{i=0,j=0}^{i=A_t,j=n_t}, n_t, A_t, \{l_{it}^d\}, \{\pi_{it}\}_{i=0}^{A_t}, \{x_{it}^R\}_{i=0}^{A_t}, Y_t\}_{t=0}^{t=\infty}$,

and a price system, $\{W_t, r_t, p_{At}, \{p_{it}\}_{i=0}^{A_t}\}_{t=0}^{t=\infty}$, where the quantities and prices derive from the following problems:

The Consumer: There is an infinitely lived representative consumer who supplies labor to all firms and takes the path of $\{W_t, r_t, \{p_{it}\}, A_t\}_{t=0}^{\infty}$, and the production technology for new consumption products as given. The variable $A_t \in [0, \infty)$ denotes the number of input firms that exist at time t. The consumer solves:

$$\max_{\{x_{jit}\geq 0,\ b_t,\ 0<l_t\leq 1\}} \int_0^\infty \left(\int_0^{n_t} \big(u(c_{jt}) - u(0)\big)\, dj - \beta \frac{l_t^{1+\theta}}{1+\theta} \right) e^{-\rho t}\, dt,$$

where

$$u(c_{jt}) = \frac{(c_{jt}+\epsilon)^{1-\sigma}}{1-\sigma}, \quad \epsilon > 0, \quad c_{jt} \gg \epsilon, \qquad c_{jt} = A_t^{1-\frac{1}{\alpha}} \left(\int_0^{A_t} x_{jit}^\alpha\, di \right)^{\frac{1}{\alpha}},$$

$0 < \alpha < 1$, and $\sigma > 1$. To produce c_{jt}, where $j \in [0, n_t]$, the consumer purchases inputs, x_{jit}, at price p_{it} from firms $i \in [0, A_t]$.

The consumer's budget constraint is

$$\dot{b}_t \leq r_t b_t + W_t l_t^s - \int_0^{n_t} \int_0^{A_t} p_{it} x_{jit}\, di\, dj. \tag{15}$$

The boundary conditions are:

$$\lim_{t\to\infty} b_t e^{-\int_0^t r_s\, ds} \geq 0, \qquad b_0 \quad \text{given.} \tag{16}$$

The household consumption technology gives the number of consumer goods the household can produce at time t:

$$n_t = \phi A_t^\gamma, \qquad \phi, \gamma > 0; \qquad A_0 \quad \text{given.}$$

Therefore, A_t also represents the level of nonrival knowledge available to consumers to produce consumer products. The parameters, ϕ and γ, govern the efficiency with which the household can create new consumption goods.

The solution to the household problem gives the time path: $\{\{x_{jit}\}, n_t, l_t^s, b_t\}_{t=0}^{t=\infty}$.

Research and Development: The R&D sector is perfectly competitive, and there is free entry into blueprint production. The representative firm takes $\{A_t, p_{At}, \{p_{it}\}\}_{t=0}^{t=\infty}$

as given and chooses $\{x_{it}^R\}_{t=0}^{t=\infty}$ to create blueprints. The constant returns to scale technology for blueprint manufacture is

$$\dot{A}_t = \frac{A_t^{1-\frac{1}{\alpha}}}{\alpha\eta}\left(\int_0^{A_t}(x_{it}^R)^\alpha\, di\right)^{\frac{1}{\alpha}}.$$

For blueprint production, an increase in A makes it both easier and harder to develop new innovations; these are the respective "standing on shoulders" and "stepping on toes" effects. Here, both effects offset. In a symmetric equilibrium, the use of $\frac{\alpha\eta}{A_t}$ units of each input produces a single blueprint, and η therefore governs the size of the startup cost. Competitive entrepreneurs solve:

$$\max_{\{x_{it}^R\}} \; p_{At}\dot{A}_t - \int_0^{A_t} p_{it}x_{it}^R\, di,$$

where p_{At} denotes the price of a patent at time t. This gives $\{x_{it}^R\}_{t=0}^{t=\infty}$ for all i, and free entry determines p_{At}.

Monopolistically Competitive Input Firms: Input firms are monopolistically competitive, hire labor in a competitive market, and take $\{W_t, A_t, p_{At}, \{p_{it}\}, x_{it}(p_{it})\}_{t=0}^{\infty}$ as given. They sell inputs to consumers and to the R&D sector, and purchase patents from the R&D sector. The constant returns to scale production function for firm $i \in [0, A_t]$ is $y_{it} = A_t l_{it}$. Worker efficiency is A_t, and the nominal wage is W_t. Each firm $i \in [0, A_t]$ ignores its impact on the average price level and chooses p_{it} each period to solve:

$$\max_{p_{it}} \pi_{it} = x_{it}(p_{it})\Big(p_{it} - \frac{W_t}{A_t}\Big),$$

where total demand faced by firm i, $x_{it}(p_{it}) = x_{it}^R + \int_0^{n_t} x_{jit}\, dj$, is given from the consumer and R&D problems. Derived demand for labor is then $l_{it}^d = \frac{x_{it}}{A_t}$. This solution gives $\{p_{it}, l_{it}^d, \pi_{it}\}$ for all t and $i \in [0, A_t]$.

Market Clearing:

- The labor market clears: $\int_0^{A_t} l_{it}^d \, di = l_t^s$, where $l_{it}^d = \frac{x_{it}}{A_t}$. This gives the real wage.
- The capital market clears: capital market equilibrium ensures $b_t = p_{At} A_t$.
- The economy's income constraint is: $Y_t = C_t + p_{At} \dot{A}_t$, where $Y_t = \int_0^{A_t} p_{it} y_{it} \, di$, and $C_t = \int_0^{n_t} \int_0^{A_t} p_{it} x_{it} \, di \, dj$.

3.2 Solving for the Equilibrium Allocation

3.2.1 Budget Constraint

The economy's income constraint is

$$Y_t = W_t l_t + r_t b_t = C_t + \dot{A}_t p_{At}.$$

That is, income derives from labor and capital and finances consumption and investment in blueprints. On the balanced growth path, the patent price, the interest rate, profits, and labor supply are all constant. (I will confirm this later.) Dividing across by A_t above shows that Y_t, C_t, W_t, b_t, and A_t all grow at the same rate on a balanced growth path.

3.2.2 Input Firm Optimization

Each firm faces the same demand elasticity from consumers and the R&D sector. Setting marginal cost, $\frac{W_t}{A_t}$, as numeraire, the firm's optimal price is a fixed markup over marginal cost:

$$p_{it} = \frac{1}{\alpha} \frac{W_t}{A_t} = \frac{1}{\alpha} \equiv p,$$

which is constant and the same for all firms. By symmetry, therefore, each firm $i \in [0, A_t]$ will produce the same quantity x and will demand the same amount of labor.

From above, the real wage is $\frac{W_t}{p} = \alpha A_t$. Assuming an equilibrium labor supply of l, and noting the form of the production function, each firm produces

$$x = l.$$

As a result, firms produce constant quantities over time, and firm expansion represents an increase in the number of firms, not more existing firms. Because $\frac{1}{\alpha} - 1$ is the profit per unit of output, profits on the balanced growth path are constant for each firm over time and are equal to

$$\pi = \left(\frac{1-\alpha}{\alpha}\right) l.$$

3.2.3 R&D Sector Equilibrium

Substituting $p = \frac{1}{\alpha}$ into the equation for the price of a patent implies that the production cost of a patent is $\frac{\alpha\eta}{A_t} \int_0^{A_t} p\, di = \eta$. Free entry into patent production ensures the constant patent price

$$p_{At} = \eta.$$

3.2.4 Consumer Optimality

Combining the standard Euler equation $\frac{V'(\dot{C}_t)}{V'(C_t)} = \rho - r_t$ with the labor-leisure condition, $\frac{W_t}{p} V'(C_t) = \beta l_t^{\theta}$, noting that $\frac{\dot{W}}{W} = \frac{\dot{C}}{C}$, and imposing constant labor supply gives

$$\frac{\dot{C}_t}{C_t} = r_t - \rho.$$

Confirming our initial assumption, r_t is therefore constant on a balanced growth path. Taking growth rates of the labor-leisure condition and noting that $\frac{\dot{W}_t}{W_t} = \frac{\dot{A}_t}{A_t} = \frac{\dot{C}_t}{C_t}$, a condition for labor stability is:

$$\frac{\dot{n}_t}{n_t} = \frac{\sigma - 1}{\sigma}\frac{\dot{A}_t}{A_t}. \tag{17}$$

Then, recalling the form of the household technology, $n_t = \phi A_t^{\gamma}$, γ must satisfy the parameter restriction, $\gamma = \frac{\sigma-1}{\sigma}$.

3.2.5 Capital Market Equilibrium

The value of a blueprint equals the present discounted value of the profits accruing to it. Denoting this value at time t by $V(t)$, capital market equilibrium ensures that

$$p_{At} = \eta = V(t).$$

Noting that V is constant, this implies $V = \frac{\pi}{r}$ and hence

$$r = \frac{\pi}{\eta} = \frac{(1-\alpha)}{\alpha}\frac{l}{\eta}.$$

Consumption growth now reduces to

$$\frac{\dot{C}_t}{C_t} = r - \rho = \frac{(1-\alpha)}{\alpha}\frac{l}{\eta} - \rho, \tag{18}$$

where the restriction $\frac{(1-\alpha)}{\alpha}\frac{l}{\eta} > \rho$ is necessary for positive growth.[15]

3.2.6 Labor Market Equilibrium

To solve for equilibrium labor supply, l^*, I restrict the analysis to linear disutility, setting $\theta = 0$. Substituting the equation for the real wage into the consumer's labor-leisure condition yields

$$l^* = \frac{\phi}{\beta^{\frac{1}{\sigma}}\alpha^{1-\frac{1}{\sigma}}} - \eta\rho.$$

[15] To ensure utility is bounded, the condition, $\rho > \frac{\sigma-1}{\sigma}g$, must also hold. The parameter ρ trivially always satisfies the transversality condition, which reduces to $\rho > 0$.

Overall, therefore:

$$\frac{\dot{C}_t}{C_t} = \frac{\dot{A}_t}{A_t} = \frac{\dot{Y}_t}{Y_t} = \frac{\dot{W}_t}{W_t} = \frac{\sigma}{\sigma - 1}\frac{\dot{n}_t}{n_t} = \frac{\phi(1-\alpha)}{\beta^{\frac{1}{\sigma}}\eta\alpha^{2-\frac{1}{\sigma}}} - \frac{\rho}{\alpha} \equiv g.$$

At any point, $Y_t = \frac{A_t l^*}{\alpha}$, where $A_t = A_0 \exp(gt)$ and $A_0 = \eta b_0$.

3.2.7 Discussion of Model Implications

According to the model, economic growth is an increasing function of *market*-oriented labor hours per household. Analogous to the scale effect in New Growth models, a higher labor supply raises the size of the market and increases the incentive to innovate. As a result, economic growth rises. Although this scale effect is a strong result, the model applies properly to the world: considering the very long run, market-oriented labor activity is a relatively recent phenomenon and coincides with sustained growth. In Section 4, I return to the Industrial Revolution, where this model seems especially relevant.

The expansion of input firms leads to more variety and real wage growth and, on a balanced growth path, both effects combine to yield a constant labor supply. The level of labor supply is a function of the deep parameters of the model. Most importantly, labor supply is increasing in ϕ, which governs the number of consumer goods: a higher ϕ implies greater consumption variety and a higher marginal utility for any given level of consumption. While the exogeneity of ϕ seems arbitrary, it is easy to conceive of ways to raise it; for example, opening up to trade; urbanization; a shift from home production to market-oriented production. By contrast, a higher start-up cost for firms, η, reduces labor supply. This is a standard income effect: a higher start-up cost raises the equilibrium value of a firm, thereby increasing non-labor income and depressing labor supply.

Although labor supply is constant, the household shifts labor hours to new input firms as productivity rises. This corresponds to the kind of sectoral change and labor reallocation that occurs as economies develop. The rising consumption variety that accompanies these changes raises welfare. Introducing capital accumulation would lead to conditional convergence in the model. Because a higher labor supply raises the marginal product of capital, greater product variety growth would induce faster capital accumulation.

4 Model Application: The Industrious Revolution

Compared to existing growth models, which emphasize the sources of total factor productivity, the model in Section 3 stresses the role of consumer demand and labor supply. In this section, I discuss one prominent application of the model: the rise in market-oriented labor hours prior to the Industrial Revolution in Britain and the subsequent growth.

In the pre-industrial economy, market activity was highly regulated, while there were few property rights to protect those engaged in commerce. For these reasons, most production took place in the home, and there was little formal labor market activity. Because this environment stifled the development of a market economy, there was little variety in the goods available to purchase. Clark (2007), for example, reports how "for most of human history. . . the bulk of material consumption has been food, shelter, and clothing."

In these economies, the labor market was well described by the backward-bending supply curve. For example, Weber (1958) notes: "For centuries it was an article of faith that low wages....increased the material results of labor." Rest days and religious holidays were also common, with "Saint Monday" being a regular weekly holiday. Describing early forager societies, Clark refers to what one anthropologist, Sahlins (1974), calls the "primitive affluence"—i.e., abundance of leisure—of such communities. The scant consumption variety, low levels of labor input, and backward-bending supply curve are consistent with the model outlined earlier.

After the Glorious Revolution in Britain in 1688, the economic environment changed.

As a result of greater property rights and deregulation, merchants enjoyed more freedom to engage in commerce. Shops opened, imports increased, and the degree of urbanization rose. These changes led to an increase in product variety. De Vries (1994) reports how many literary works dating from this period convey impressions of a rise in commercial activity and desire for material goods. McCracken (1991) documents "an explosion of consumer choices," and describes how "the world of goods expanded dramatically to include…furniture, pottery, silver, mirrors, cutlery, gardens, pets, and fabric." Similarly, McKendrick et al. (1982) emphasize a new concern with fashion and social emulation; they describe a "consumer revolution," "rampant consumer behavior," and "an orgy of spending." Evidence from bequests confirms these reports and indicates large rises in the variety of goods consumed over this period. King (1997) reports that the number of goods in inventories rose by seventy two percent from the period 1711-1769 to 1770-1812, and finds consumption variety rose for all classes. Facilitating these dynamics was a relatively more equal distribution of income in Britain, which made emulation possible.

According to De Vries, the desire to purchase new products motivated people to move away from self-sufficiency and into the production of market-oriented goods. Most importantly, he stresses that the new desire to consume promoted work effort and "unleash[ed] a beneficial industriousness"; this, he claims, laid the ground for the Industrial Revolution. Writers from the period support this view. Steuart (1767), for instance, observes: "Men are forced to labor now because they are slaves to their own wants."[16] According to estimates by Voth (2001), work hours per year rose by almost five hundred over the period 1750 to 1800; particularly important was a sharp fall in the number of observed religious holidays over this period. Significantly, the greatest increase in labor hours took place in London, where variety rose most; over the period

[16]Commenting on how consumer goods promoted work effort, Malthus (1803) observes "a decided taste for the conveniences and comforts of life…, and, in consequence a most laudable industry and foresight." Likewise, Hume (1752) notes that "it is a violent method and in most cases impracticable to oblige the labourer to toil in order to raise from the land more than what subsists himself and his family. Furnish him with manufactures and commodities and he will do it himself."

1750-1830, annual hours of labor in London rose by forty percent. Controlling for other factors in his empirical work—such as real wages and the dependency rate—he finds that most of the increase in hours remains unexplained; he attributes the increase to a rising desire to consume. The Industrious Revolution and the associated rise in the market economy changed the economic environment in Britain, and enabled the British government establish a robust system of taxation. Mokyr (2010) maintains that "the fiscal revolution was made possible by the Industrious Revolution."

Lindert and Williamson (1983) estimate that wages remained roughly unchanged between 1755-1819 and indeed fell for full-time blue collar workers. The combination of higher labor supply and consumption, coupled with stagnant wages, is consistent with a greater taste for consumption goods and a shift outwards in the labor supply curve. But once wages started to grow steadily after 1830, labor hours fell, and women and children began to leave the workforce. Figure 6 shows labor hours in the U.K. over the period 1750–2000. Overall, therefore, the historical accounts are broadly consistent with the model presented here. That is, product variety increased markedly around 1750, thereby raising labor supply. But once wages rose around 1830, labor supply subsequently fell. Together with showing how new consumer goods raise labor supply, this episode also shows how new goods promote growth. Ogilvie (2009) finds similar dynamics in Germany over the same period.

5 Conclusion

Compared to cyclical changes, long-run trends in labor supply have received little attention in the macroeconomics literature. This paper presents a model that explains these trends by the interaction of two forces: variety growth, which raises labor supply, and wage growth, which reduces it. According to the model, the interaction of both forces can maintain stable labor hours over time. Incorporating the idea into a general equilibrium growth model shows how the introduction of new goods raises economic growth. In the model, greater product variety raises marginal utility and in turn labor supply. This higher labor supply increases the size of the market, inducing more innovation and raising the economy's growth rate. The associated scale effect to higher labor supply is broadly consistent with the coincidence of higher market-oriented labor hours and world growth over the very long run.

The model is consistent with hours variation in Britain over the period of the Industrial Revolution. From 1750 to 1830, the combination of a rise in product variety and stagnant wage growth was associated with a rise in labor hours—the "Industrious Revolution"—while in the period after 1830, wages rose and labor hours fell. In addition, the model is consistent with cross-sectional variation in hours: because trade ensures similar product variety across countries, the model predicts a higher labor supply in poorer countries.

The framework makes two methodological contributions. First, it introduces a utility function that can reconcile a dominant income effect to wage growth with stable labor hours over time. Having a model that can explain long-run trends is important for steady-state analysis and for calibrating, for example, the effects of tax policy. Second, the framework introduces variety growth into a model of intertemporal choice, and more generally has implications for dynamic macroeconomics.

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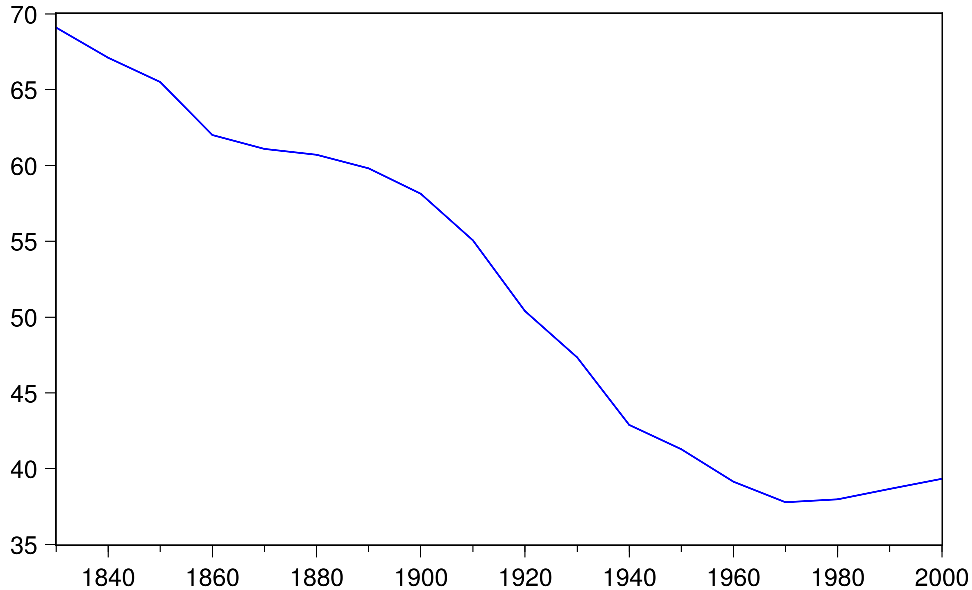

Figure 2: WEEKLY LABOR HOURS: U.S., 1830-2000
Source: Vandenbroucke (2005)

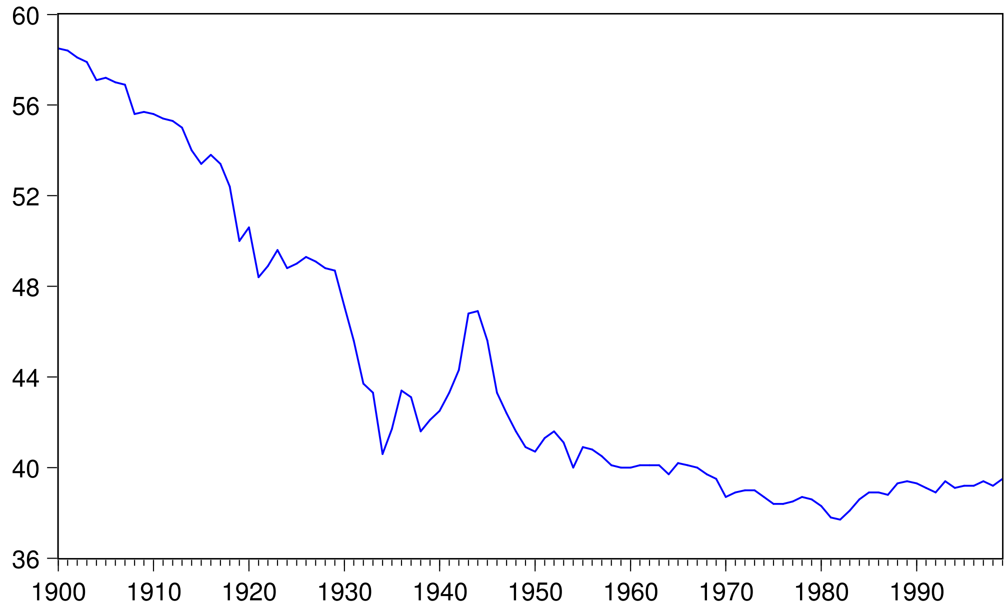

Figure 3: WEEKLY LABOR HOURS OF PRIVATE NONAGRICULTURAL WORKERS: U.K., 1900-2000
Source: Historical Statistics of the United States

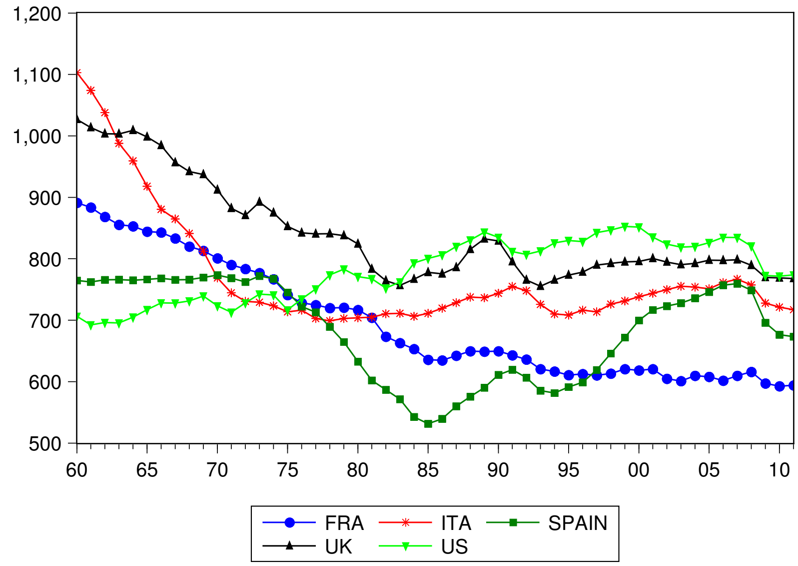

Figure 4: Annual Labor Hours Per Capita: 1960-2011
Source: Groningen Database

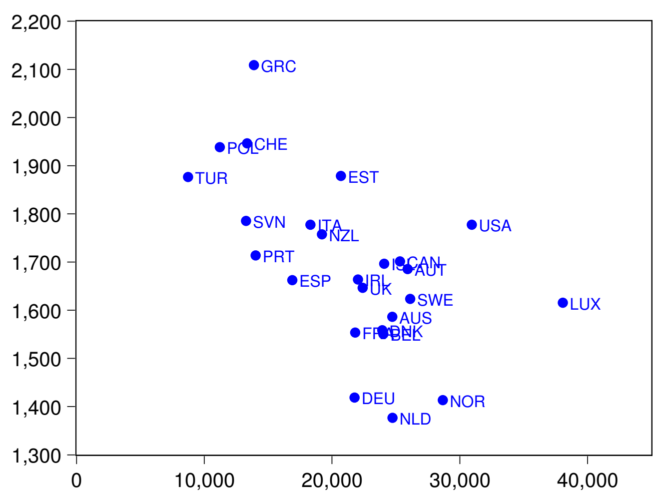

Figure 5: Labor Hours per Worker and GDP per Capita: OECD Countries in 2010
Source: OECD iLibrary

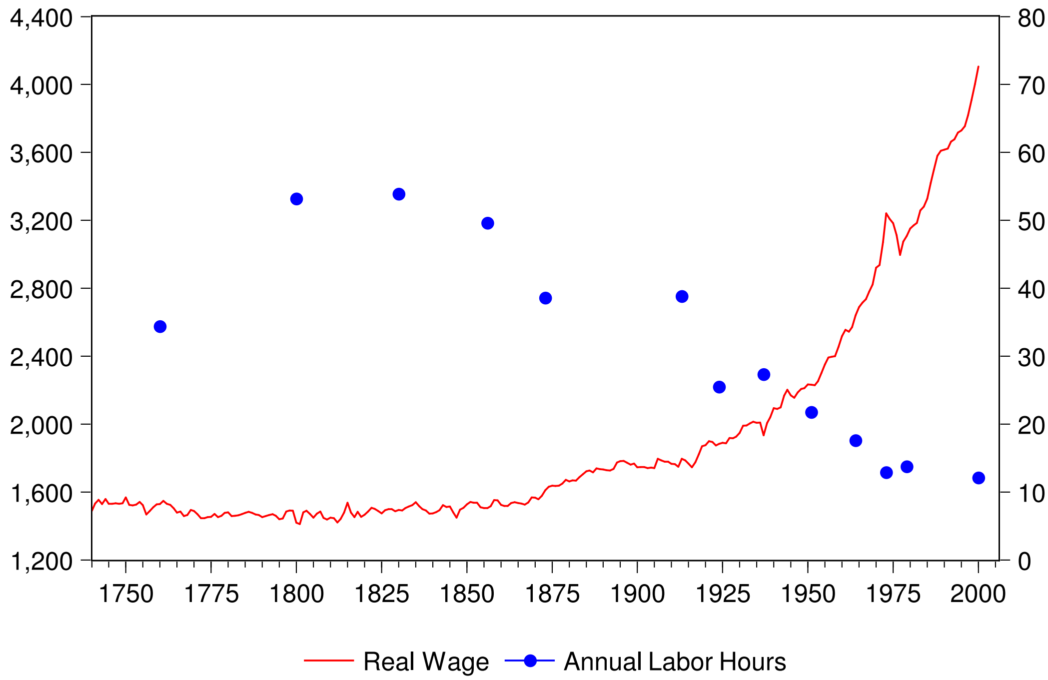

Figure 6: ANNUAL LABOR HOURS AND REAL WAGE INDEX: BRITAIN, 1750-2000
Source: Robert Allen's website and Scholliers and Zamagni (1995)