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**KANT'S ENDOGENOUS GROWTH MECHANISM**

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# Kant's Endogenous Growth Mechanism

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## Abstract

Despite the modern origins of endogenous growth theory, we argue that the 'Idea for a Universal History with a Cosmopolitan Aim' written by Immanuel Kant in 1784 provides an early and coherent example of such a theory. Kant's endogenous growth mechanism is driven by the inherent rivalry that exists between agents which increases effort and strengthens the accumulation of knowledge, which in turn is carried through generations. In an exercise in rational reconstruction, we present a mathematical model of Kant's mechanism. We use the model to contribute to the contemporary policy debate as to whether "keeping up with the Joneses" leads to excessive effort.

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**Keywords:** Kant, endogenous growth, knowledge, habit, guiding thread, unsocial sociability, institutions.

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*The human species is supposed to bring out, little by little, humanity's entire natural predisposition by means of its own effort. One generation educates the next.* **Kant (2007c)**, 9:441

*If lives are too short or too dull, sustained growth at a positive rate is impossible.* **Lucas (2009)**, p. 9

## 1 Introduction

Growth theory received a significant push in the mid-1980s with the work of Romer (1986) and Lucas (1988). Theirs and related work stressed that the forces of economic growth were *internal* to the economic system. These forces reflected phenomena such as human capital, research and development, technology diffusion, learning and expanding product varieties. This literature in turn highlighted that institutional policies related to competition, education, property rights, taxation etc. mattered for sustained growth.<sup>1</sup>

Long before the emergence of modern endogenous growth theory (or the antecedent Solow-Swan model), matters were less clear cut. Writers such as Malthus formulated seemingly apocalyptic visions of scarcity. Adam Smith, by contrast, in *The Wealth of Nations* (Smith (1977)) famously took a more affirmative view whereby an “invisible hand” was assumed to align private and social welfare through the pursuit of individual self interest.<sup>2</sup>

This paper seeks to extend our understanding of the antecedents of en-

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<sup>1</sup>Modern overviews of the development of growth theory can be found in, for instance, Acemoglu (2009). Solow (2007) discusses the subsequent development of the canonical Solow-Swan model.

<sup>2</sup>See La Grandville (2011) for a mathematical formulation of Smith’s invisible hand.

dogenous growth theory by focusing on another important thinker, Immanuel Kant and, in particular, his work *Idea for a Universal History with a Cosmopolitan Aim* (hereinafter the *Idea*)<sup>3</sup> (Kant (2007b)). In this remarkable work, Kant sets out a general theory to explain the mechanism by which society progresses to higher levels of knowledge, living standards and civilization.

Thus far, the influence of Kant in economics has largely been limited to social contract theory and social justice, e.g., Vallentyne (2008) and Hayek (1978). This is surprising since, aside from the *Idea*, Kant's work covered many important economic themes.<sup>4</sup> However, we concentrate on Kant's *Idea* since we believe it contains the most relevant and mature expression of his views on economic progress; a full discussion of the Kantian canon is beyond our purpose.

The idea of progress emerged prominently in XVIII century culture. It features in the work of, for example, Condorcet, Diderot, Ferguson, Holbach and Voltaire. Kant, like other Enlightenment figures, believed that progress derived from the unintended consequences of actions from purposeful indi-

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<sup>3</sup>All quotations from Kant's works are from the Cambridge Edition of the Works of Immanuel Kant, which includes a reference to the standard German edition, *Kant's Gesammelte Schriften*.

<sup>4</sup>In *Groundwork of the Metaphysics of Morals*, (Kant (1999)), he discusses the benefits of the division of labor. And in *Conjectural Beginning of Human History* (Kant (2007a)) Kant argues that the development of human history followed three phases - from hunter-gatherer to pastoral to private agriculture. The final phase represented the true and highest revolution in human history since it required civil society, property rights and division of labor; by creating an economic surplus, the pursuit of productive private farming prompted people to plan their lives, forgo immediate consumption, build institutions to protect property and promote social virtues.

viduals. This aspect of Kant’s work is often neglected - his contributions to the study of human affairs and history often considered lesser pieces. Nonetheless, a number of distinguished scholars, including Louden (2000), Felicitas Munzel (2000) and Wood (1999) have recently stressed the importance of this facet of Kant’s work. Kersting (1993) goes as far as calling Kant’s interpretation of nature “the sister’s of Adam Smith’s invisible hand”. What therefore is the Kantian growth mechanism? Although Kant’s mechanism stresses *individual* creativity and competitiveness, it also highlights the key role of *common* accumulation of knowledge across generations. Kant sees human nature as competitive, permanently striving for recognition and *rank* but inclined towards peace and leisure. Rivalry provides incentives to carry out effort, which, though individually motivated, is essential for common development. Given that human beings have short lives, progress grows cumulatively across generations – *each generation educates the next*. Through these assumptions, Kant arrives at a theory of human progress which has striking parallels with contemporary endogenous growth theory.

Here we engage in an exercise in “rational reconstruction” of Kant’s growth mechanism. We develop a compact mathematical model which, in our view, encapsulates the fundamentals of the mechanism of endogenous progress contained in Kant’s *Idea* (see Waterman (2003) for a comprehensive discussion of this approach to the history of economic thought). Our framework focuses on the interaction between interpersonal comparisons, learning by doing, the non-rivalry of knowledge and the transmission of knowledge across genera-

tions. The formal modeling shows that the assumptions made by Kant indeed deliver sustained growth, consistent with his verbal argument.

We also demonstrate that the resulting model has much in common with the contemporary endogenous growth literature. This mirrors the argument by Kurz (2003) that many aspects of contemporary endogenous growth theory were anticipated by writers such as Smith, Ricardo and other classical economists. As in all such rational reconstruction exercises there are two limitations which may be noted. First, our framework focuses on a specific aspect of the Kant's analysis as set out specifically in the *Idea*. Naturally, we do not claim to encapsulate the full span of his thoughts in this important work, which were not confined to economic growth per se. For example, we assume the existence of an appropriate institutional framework rather than attempting to explain how institutions evolve over time. Second, we do not attempt to provide a detailed account of the extent to which Kant's ideas were influenced by other thinkers.

Though distinct, the Kant's mechanism turns out to share several features with modern growth theory (such as learning-by-doing, the non-rival nature of knowledge, the importance of incentives and effort, and the primacy of institutions). Kant's mechanism also includes a less widely explored feature, namely the key role social comparisons or social norms play in encouraging growth. Juxtaposed with the modern literature, the Kantian growth mechanism seems remarkably prescient. We believe it is (and should be acknowledged as) the earliest example of an endogenous growth theory.

Moreover, the model which we have formalized is not just a matter of historical curiosity. It can provide some new insights in contemporary policy debates. The example we explore focuses on whether the presence of consumption externalities leads to a socially inefficient equilibrium of excessive labor effort. Some commentators have suggested corrective taxes to rectify this distortion. Our model of Kant's growth mechanism suggests that such proposals should be treated with caution. While consumption externalities lead to higher effort, reducing welfare, this higher effort in turn gives rise to a more rapid growth of knowledge, which benefits future generations.

The paper is organized as follows. In section 2 we provide an overview of Kant's endogenous growth mechanism, following a close reading of original sources. This is followed by a simple formalization of what a Kantian endogenous growth model would comprise. There we make plain the importance of social comparisons between agents, the contribution of each generation's labor efforts to the stock of knowledge and the impact of institutions on growth. In section 4, we address the issue of the socially optimal level of effort. Finally, we conclude.

## **2 An Overview of Kant's Mechanism**

In this paper we concentrate on Kant's paper *Idea for a Universal History with a Cosmopolitan Aim*, published in the *Berlinische Monatsschrift* IV (November 11, 1784). It is important to stress that we focus only on the first

part of this short piece. Specifically we cover the Introduction and the first four propositions (8:17 to 8:22), corresponding to a text of about five pages. By doing so, we perforce abstract from discussions on civil society and on the international relations among nations. Kant explains the purpose of the essay in the Introductory section (8:17):

*History ... can discover within it a regular course; and that in this way what meets the eye in the individual subjects as confused and irregular yet in the whole species can be recognized as a steadily progressing through slow development of its original predispositions.*

And a few lines down the text continues :

*Individual human beings, and even whole nations think little about the fact, since while each pursues its own aims in its own way and one often contrary to another, they are proceeding unnoticed, as by a guiding thread, according to an aim of nature, which is unknown to them, and are laboring at its promotion, although even if it were to become known to them it would matter little to them.*

The reference to a guiding thread by Kant is not unlike the use that Adam Smith famously makes of the invisible hand. As in Smith, Kant is aiming here to uncover a rational trend emerging from the interaction of self-interested individuals.

Kant's argument develops as follows. In his first proposition, he writes that any creature's natural predispositions are destined to eventually develop



fully in accordance with their purpose. Kant is following a teleological approach to history. He argues that such approach is crucial in order to make historical processes intelligible to us.

In the second proposition Kant postulates that the human being is the only rational creature on earth. Hence, the natural predispositions aimed at the use of reason can develop fully only in the species and not in the individual. The gradual development of the rational predispositions of humanity is reflected in the accumulation of culture. Kant is particularly clear about this in *Lectures on Pedagogy* (9:449)

*The human being must be cultivated. Culture includes instruction and teaching. It is the procurement of skillfulness. The latter is the possession of a faculty which is sufficient for carrying out whatever purpose. Thus skillfulness determines no ends at all, but leaves this to the later circumstances.*

The parallel text in the *Idea* reads: “reason is the ability of a creature to extend the rules and ends of the use of all its powers far beyond its natural instincts, and reason knows no limits to the scope of its projects.” For Kant culture determines the limits of what is feasible. As culture accumulates the expansion of opportunities may be used for whatever purpose. In the discussion of the second proposition Kant formulates a number of very important ideas:

*Reason itself does not function according to instinct, but rather requires experimentation, practice and instruction in order to advance gradually from one stage of insight to the next. For this*

*reason any individual person would have to live an inordinately long period in order to learn how to make use of all his natural predispositions. Or, if nature has limited the span of his life (as has in fact happened), it requires a perhaps incalculable number of generations, of which each passes its enlightenment to the next, in order to eventually bring the seeds in our species to the stage of development which fully corresponds to nature's purpose.*

The development of reason requires individual effort and individual action. There is an element of learning-by-doing. At the same time in order for progress to be sustained it is crucial for knowledge to be passed on to others. In particular each generation passes the accumulated culture on to the next. That puts education at the center of the process.

In the third proposition, Kant clarifies that Nature aims human beings to progress fully on the basis of their exercise of reason. He explains, in particular, that in the process it is not important that people attain their well-being. Instead, the measure of progress is the expansion of opportunities opened to later generations. In *Lectures in Pedagogy*, Kant offers a very succinct formulation:

*The human species is supposed to bring out, little by little, humanity's entire natural predispositions by means of its own effort. One generation educates the next.*

Finally, in proposition four, Kant stipulates that “the means that nature employs in order to bring about the development of all the predispositions of humans is their antagonism in society”. He clarifies that, by antagonism, he means unsociable sociability. In the concluding lines of the explanation of the

fourth proposition Kant argues that unsociable sociability is the force leading to continued effort necessary for the steady progress of culture. Hence, this reveals “the plan of a wise creator.”

In the above reading we argue that Kant outlines an argument according to which social interaction of competitive, self-regarding individuals sustains progress. For Kant there are at least two crucial social dimensions involved in the process: civil society and education. In different parts of his work Kant states about each that it is the most difficult and last to be solved by the human species. Improvement in these dimensions may be caused by international competition. For the purpose of this paper, however, we bracket these aspects and assume that both civil society and education are sufficiently well-ordered so that they can sustain progress. Making these crucial assumptions we are able to formalize Kant’s argument using the language of modern growth theory.

### **3 A Formal Model of Kant’s Endogenous Growth Mechanism**

We now propose a compact model, which we believe captures the essential features of the mechanism put forward by Kant. We assume that the economy is populated by a continuum of yeoman farmer households of unit mass. Reflecting Kant’s emphasis on the shortness of life, we assume they live for one period and leave no bequests (apart from accumulated knowledge

passed on un-depreciated to subsequent generations). They are replaced by a new generation in the next period and the economy goes on forever. Since preferences and technology are the same for all agents alive at time  $t$ , they will choose the same level of labor effort and consumption. The agents produce output using a production function which depends on their own effort and the inherited stock of knowledge.

Each individual maximizes his own individual utility which is increasing in own consumption ( $c_t$ ). We also incorporate into the utility function Kant's idea of unsociable sociability - that the individual forever makes relative comparisons in consumption and income and seeks *to obtain himself a rank among his fellows*. This idea predates Kant and can be found, for example, in Adam Smith's classic work (Smith (1977)). It also finds an echo in the contemporary literature on consumption externalities, in particular the idea of keeping-up-with-the-Joneses utility (also referred to as external habit formation). This concept, in turn, can be traced back to Veblen (1965) and the relative income hypothesis of Duesenberry (1949). More recent formulations are found in Gali (1994) and Abel (1990).

Following the latter paper, we formalize Kant's idea by assuming that utility is decreasing in a reference level ( $H_t$ ) of consumption, which we will assume to be given by average per capita consumption of the respective generation. Finally, utility depends negatively on effort, since Kant assumes that individuals are intrinsically lazy (man's *propensity to indolence*). Since agents live for only one period and do not face an intertemporal allocation

problem, we assume, in the interest of simplicity, that utility can be represented by a function of the form:<sup>5</sup>

$$U(c, H, l) = \log(c_t - \gamma H_t) + \omega(l_t) \quad (1)$$

This choice of functional form also has the advantage that it guarantees that the economy will evolve along a balanced growth path (see Barro and Sala-i-Martin (2004)), with effort constant in equilibrium. We further assume that  $\omega'(l)$ ,  $\omega''(l) \leq 0$  and  $\gamma \in (0, 1)$ . The parameter  $\gamma$ , which captures the importance of the consumption externality, will play a key role in our analysis.

During its lifetime the household produces output in accordance with the following production function:<sup>6</sup>

$$y_t \equiv c_t = f(l_t)\mathbb{k}_t \quad (2)$$

where  $l_t \in (0, 1)$  is an index of labor effort, and  $\mathbb{k}_t$  represents inherited knowledge at time  $t$ . The function  $f(l_t)$  represents how effort maps into usable productive inputs, where we assume  $f'(l_t) > 0$  and  $f''(l_t) < 0$ . In contrast, the marginal return on knowledge does not decline as knowledge accumulates.<sup>7</sup> In line with the endogenous growth literature the absence of

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<sup>5</sup>Our results also hold for the more general constant relative risk aversion utility function, of which the log formulation is a special case.

<sup>6</sup>The general properties of production functions are reviewed in León-Ledesma et al. (2010).

<sup>7</sup>Though straightforward, this is clearly not the only way to capture Kant's mechanism.

diminishing returns in the factors that accumulate over time is crucial to permit sustained growth. In solving its optimization problem, the household takes the aggregate stock of knowledge as given.

Moreover, Kant’s idea that *reason itself does not operate instinctively, but rather needs attempts, practice and instruction in order to gradually progress from one stage of insight to another* seems to be a remarkable antecedent of the learning-by-doing mechanism explicitly formulated by Arrow (1962)<sup>8</sup>. Again, this is an idea which predates Kant and can be found in the writings of Adam Smith and David Hume (Smith (1977) and Hume (1889)). To capture this idea we assume that effort leads to increases in knowledge in accordance with the following law of motion (*each generation educates the next*):

$$g_k = \frac{\dot{k}_t}{k_t} = \phi(l_t) \quad (3)$$

where  $g_k$  is the growth rate of knowledge. The accumulation of knowledge is, in our set-up, purely an external effect. Hence we need make no particular assumptions about the functional form linking effort and knowledge accumu-

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Effort may, for instance, be a positive function of past knowledge accumulation (this recalls the “fishing out” .v. “standing on the shoulder of giants” arguments made in modern growth theory). Likewise, in a heterogeneous agent framework, the same level of effort put in by one individual may have a greater impact on growth compared to others. Also, agents closer to the reference consumption level may find it easier to accumulate knowledge than laggards; Kant may be hinting at that in his references to the “ranking” of individuals. Notions of backward and frontier agents finds an echo in recent work on innovation and competition, Aghion et al. (2005).

<sup>8</sup>Arrow writes (p. 156): *I advance the hypothesis here that technical change in general can be ascribed to experience, that it is the very activity of production which gives rise to problems for which favorable responses are selected over time.*

lation other than that the growth of knowledge increases with the level of effort,  $\phi' > 0$ , but at a decreasing pace,  $\phi'' \leq 0$

With these assumptions, the household budget constraint is:

$$c_t = f(l_t)\mathbb{k}_t \quad (4)$$

Households maximize utility function (1) subject to (4) taking the reference value of consumption ( $H_t$ ) and the aggregate stock of knowledge ( $\mathbb{k}_t$ ) as given. Substituting (4) into the utility function, the first order condition for effort is:

$$(c_t - \gamma H_t)\omega'(l_t) = -f'(l_t)\mathbb{k}_t \quad (5)$$

To derive the equilibrium, recall that since all individuals are alike they will all choose the same level of consumption and effort (since they have common preferences and the same budget constraint). Thus, given our assumption of external habit formation,  $H_t = c_t$ , we have:

$$(1 - \gamma)\omega'(l_t)c_t = -f'(l_t)\mathbb{k}_t \quad (6)$$

Now we use the individual's budget constraint (4) to eliminate  $c_t$  from (6):

$$(1 - \gamma)\omega'(l_t)f(l_t) = -f'(l_t) \quad (7)$$

Equation (7) makes it clear that if the functions  $f$  and  $\omega$  and parameter

$\gamma$  is constant over time then (with our regularity assumptions)  $l_t$  will be constant over time. Given a constant level of effort across generations, the production function (2) implies that the growth rate of output ( $g_y$ ) will be equal to the growth rate of knowledge ( $g_k$ ). With a constant labor effort across generations, (3) implies that the accumulation of knowledge will be continuing at a constant and sustained pace over time.

We are now in a position to state the following:

**Proposition 1:** *The growth rate of the economy is an increasing function of importance of the consumption externality( $\gamma$ )<sup>9</sup>,*

$$\frac{dg_y}{d\gamma} > 0 \tag{8}$$

**Proof:** Apply the implicit function theorem to (7) and make use of the assumptions on the first and second derivatives of  $f(l_t)$  and  $\omega(l_t)$ . This establishes that  $\frac{dl}{d\gamma} > 0$ . Since growth is increasing in  $l$ , the proposition follows.

■

The proposition shows that growth is an increasing function of the importance of rivalry or “unsociable sociability” (as captured by the consumption externality). The mechanism leading to this result is straightforward. As the importance of the external consumption reference in utility rises, households are induced to increase their consumption. This requires higher levels

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<sup>9</sup>This result depends on the assumption that habit enters utility in an additive manner. If the ratio form is employed, then the level of effort, and thus the growth rate, would be independent of the importance of habit formation.



of effort. Since the growth of knowledge is increasing in effort (3) this leads to a higher rate of knowledge accumulation, which we have shown is in turn equal to the growth rate of output.

The proposition is a striking and relatively novel implication of the mechanism. The impact of various forms of habit formation on growth in the context of endogenous growth models was explored in a number of papers by Carroll et al. (Carroll et al. (2000), Carroll et al. (1997), Choudray et al. (2011)). Specifically, in the latter paper, they obtain a similar result. However, the underlying mechanism is different. In their setup, which includes infinitely lived agents and exogenous labor effort, a higher degree of external habit formation raises the growth rate because it increases the effective intertemporal rate of substitution in the steady-state. Our result, in contrast, stems from the impact of external habit formation on effort.<sup>10</sup>

## 4 A contemporary application: does unsocial sociability lead to excessive effort?

The finding that unsocial sociability - modeled here as external habit formation - leads to higher growth has wider interest. External habit formation is often viewed as a self-defeating phenomenon (e.g., Arrow and Dasgupta

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<sup>10</sup>Formulations in which rivalry plays a formal role in sustaining growth appear still relatively rare in the literature, see Choudray et al. (2011). Smith discusses men's drive for wealth as reflecting need for status several times in *Moral Sentiments* (e.g., I.iii.2.1, VI.1.11).

(2009), Choudhary and Levine (2006)): a “hedonic treadmill” of unnecessary consumption that inhibits welfare.<sup>11</sup> Accordingly, some (e.g. Layard (2006)) have advocated “corrective taxes” as a means of shifting social preferences towards increased leisure. However, this line of argument ignores the benefits to future generations which come from increased effort, via knowledge accumulation - a central insight of Kant’s mechanism.<sup>12</sup> In this section, we use the model developed in the previous section to address the issue of the socially optimal amount of effort and compare it with the outcome of the decentralized equilibrium with habit formation.

Using our model of Kant’s mechanism, we address this question by looking at the problem of a hypothetical benevolent social planner. The central planner’s problem (at time 0) is to maximize the discounted value of the utilities of current and all future generations. In solving this problem, the planner has to balance two externalities. The first, an intratemporal externality, stems from habit formation which leads to the excessive effort as discussed above. The second, an inter-generational externality, stems from

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<sup>11</sup>Furthermore, it is worth pointing out that habit formation - a mainstay of modern economics over diverse topics like the equity-premia puzzle and business-cycle dynamics - has arguably made limited impact in growth theory. Yet in the Kantian mechanism it is crucial. Wood comments “ ... No interpretation of Kant’s views on any aspect ... will get matters right as long as it ignores the theme of unsociable sociability.”

<sup>12</sup>This tension between unedifying hedonic drives for accumulation and the development of our intellectual and moral faculties, a common philosophical theme, is also discussed by Kant in *Critique of the Power of Judgment* (Kant (2000)). Moreover, despite Kant’s aversion to paternalistic government (“the greatest despotism thinkable”), Wood maintains that Kant’s overall philosophy would favor policies of wealth re-distribution to avoid absolute deprivation and servitude and ensure the substantive content to the rights of citizenship.

the fact that higher effort today - which lowers the welfare of the current generation - leads to a more rapid accumulation of knowledge, raising the welfare of future generations. As regards the intratemporal externality, the planner knows that  $(H_t = c_t)$ , so he can internalize the intratemporal externality. He thus solves:

$$\underset{\{l_t\}}{\text{Max}} \int_0^\infty e^{-\rho t} \left[ \log(1 - \gamma) + \underbrace{\log(\mathbb{k}_t) + \log(f(l_t))}_{\log(C_t)} + \omega(l_t) \right] dt \quad (9)$$

where  $\rho$  is the planner's discount rate and where consumption has been eliminated exploiting equation (2). Moreover, subsequent calculations are simplified considerably if we use the log of  $\mathbb{k}$  rather than  $\mathbb{k}$  itself. Accordingly,  $k = \log(\mathbb{k})$ .

The planner optimizes subject to the knowledge accumulation constraint (3) thereby internalizing the inter-generational externality.

The current-value Hamiltonian associated with this maximization is:

$$H_t = k_t + \log(f(l_t)) + \omega(l_t) + \lambda_t \phi(l_t) \quad (10)$$

where  $l_t$  is the control variable and  $k_t$  is the state variable which evolves

according to (3). The FOCs and transversality condition are:

$$\frac{f'(l_t)}{f(l_t)} + \omega'(l_t) + \lambda\phi'(l_t) = 0 \quad (11)$$

$$\frac{1 + \dot{\lambda}_t}{\lambda_t} = \rho \quad (12)$$

$$\lim_{t \rightarrow \infty} k_t \lambda_t e^{-\rho t} = 0 \quad (13)$$

Equation (12) tells us that the total rate of return to the planner of an extra unit of  $k_t$  (i.e. a 1% increase in  $k_t$ ) is equal to the planner's discount rate, comprising (i) the “dividend” yield from an extra unit of  $k_t$  (this is  $\frac{1}{\lambda_t}$  since a 1% rise in knowledge leads to the same rise in current utility) and (ii) the capital gain (the percentage change in the shadow price of knowledge).

Solving (12) subject to the transversality condition gives us,

$$\lambda = \frac{1}{\rho} \quad (14)$$

Thus, the shadow price is the discounted value of future returns from knowledge. Since the “dividend” from knowledge is constant over time (and equal to unity) this has the important implication that the shadow value of  $k_t$  is also constant over time.

Substituting this into (11) we see the level of effort chosen by the planner,  $l$ , is *constant over time* and solves:

$$\frac{f'(l)}{f(l)} + \omega'(l) + \frac{1}{\rho}\phi'(l) = 0 \quad (15)$$

The discount rate chosen by the planner will thus play a crucial role in determining the level of effort and therefore output and growth. Which rate should the planner choose? In an infinitely-lived representative agent model there is a natural answer to this question: the planner's discount rate should equal the discount rate of the agents in the model.

Our setup, however, involves a series of disconnected generations, so this approach is not relevant. One solution, famously advocated by Ramsey (1928), is to set the discount rate to zero. In this setting the welfare of current and all future generations receive equal weight in the planner's objective function. Ramsey argued for this on the grounds that assigning a lower weight to future generations would be unethical. A polar case would be an extremely myopic planner who only cares about the welfare of the current generation, implying  $\rho \rightarrow \infty$ . We do not take a stand on the appropriate choice of  $\rho$ . Instead, we explore how the outcome of the planner's problem varies with the discount rate and how these outcomes compare with the decentralized equilibrium.

The simplest case is that of the myopic planner. In this case, the planner's FOC leads to a standard condition where the amount of effort is chosen to equate the marginal benefit from extra consumption today with the marginal disutility of extra effort today. If the future is not valued, the shadow value of future knowledge is zero and hence the externality associated with knowledge accumulation does not matter to the planner. It is interesting to note that the planner's FOC in this case is identical to that of a decentralized agent

(without habit formation,  $\gamma = 0$ ), see (7). It is easy to establish that the level of effort chosen by the planner in this case would be lower than in the decentralized equilibrium with non-zero habit formation. This is in line with the argument by Layard and others.

However, this is not the end of the story. As the planner becomes less myopic (i.e., as  $\rho \rightarrow 0$ ) the weight on knowledge accumulation becomes an increasingly dominant consideration. With a finite discount rate, the last term in (15) captures the fact that the planner, when choosing the level of effort, internalizes the benefits to future generations from knowledge accumulation. Since  $l$  is constant across generations, we can compare with the solution for  $l$  in the decentralized case given earlier (7). For this purpose the following proposition is useful.

**Proposition 2:** *The level of effort and the growth rate of the economy is a decreasing function of the social planner's discount rate:*

$$\frac{dg_y}{d\rho} < 0 \tag{16}$$

**Proof:** Totally differentiate (15) and make use of the assumptions on the first and second derivatives of  $f(l_t)$  and  $\omega(l_t)$ . This establishes that  $\frac{dl}{d\rho} < 0$ . Since growth is increasing in  $l$ , the proposition follows. ■

Proposition 2 is intuitive. The more the planner cares about the future, the more he will want to have a higher rate of knowledge accumulation (to benefit future generations), which, in turn, requires a higher level of effort

today. Thus the planner's choice of effort depends on the rate at which he discounts the future - although, we cannot unambiguously say whether a planner would necessarily choose a lower or higher level of effort than in the decentralized equilibrium.

We are now in a position to address the question raised at the start of this section, namely does external habit formation lead to excessive effort.

Our next proposition is the key result of this section.

**Proposition 3:** *For any given degree of habit formation ( $\gamma \in (0, 1)$ ), there exists a social discount rate,  $\rho_s \in (0, \infty)$ , such that the level of effort (and thus the growth rate) chosen by the planner is identical to the level of effort in the decentralized equilibrium.*

**Proof:** Equation (7) defines  $l$  as an implicit function of  $\gamma$  while (15) defines  $l$  as an implicit function of  $\rho$ . Equating these two functions implies, by the Implicit Function Theorem, that we can find an implicit function linking  $\rho$  to  $\gamma$ . ■

These results suggest a possibility very different from Layard's conclusion. In the decentralized equilibrium (without habit formation) agents will work *too little compared to the social optimum* because they do not take into account the inter-generational externality stemming from the fact that future generations' utility increases with the stock of knowledge. This conclusion holds for all finite values of the social planner's discount rate. The introduction of habit formation will reduce this distortion however - and in-

deed we can find configurations of  $\gamma$  and  $\rho$  where the social optimum and the decentralized equilibrium (with habit formation) are identical. All in all, we conclude that claims that keeping up with the Joneses utility leads to excessive effort should be treated with caution.

## 5 Conclusion

We presented a compact mathematical model which, we believe, captures key elements of Kant's endogenous growth mechanism. We established that Kant's assumptions do indeed imply sustained positive growth in line with his verbal arguments.

A rational reconstruction exercise such as ours can, of course, never do full justice to the rich diversity of Kant's ideas. For example, in our representation of Kant's mechanism, a sound institutional framework is taken as given. Kant, however, suggests that improvements in the institutional setup also play an important role. This mirrors findings in current research, where good institutions evolve precisely through knowledge accumulation and economic growth, Glaeser et al. (2004). Another limitation relates to the role of government, which is absent in our model.

Notwithstanding, the mechanism outlined in this paper is still remarkable. Its importance lies in the fact that it is a notable and neglected precursor of contemporary endogenous growth theory. Certainly, many of the basic elements of the Kantian mechanism (such as learning by doing and the role



interpersonal comparisons) were already anticipated in the works of David Hume and Adam Smith before reappearing in the modern literature.<sup>13</sup> However, to our knowledge, Kant's essay is the first instance which brings all of these elements together to form a compact mechanism which explains how continuous progress can be sustained. Our mathematical modeling establishes the coherence and consistency of Kant's framework.

It is, moreover, notable that the Kantian and Smithian growth mechanisms are distinct. Smith's relied on three pillars: improvements through the division of labor; the extent to which that division is limited by market size; and the support of 'good government'. With the exception of the latter, none are central to Kant's guiding thread.<sup>14</sup>

Arguably, though, the modern comparison is the more interesting one; the Kantian mechanism shares themes at the heart of contemporary endogenous growth theory - e.g., the insight that knowledge is essentially non-rival and drives growth and social evolution, the necessity for open societies and institutions to support wealth creation and creativity. Interestingly, Romer

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<sup>13</sup>Many scholars have drawn parallels between the politics and moral philosophy of Kant and Smith (e.g., Fleischacker (1996), Fleischacker (1999), Harpham (2000)). Moreover, in his writings, Kant referred extensively to the works of David Hume

<sup>14</sup>Although, to repeat, Kant directly mentions the benefits of the division of labor in *Groundwork of the Metaphysics of Morals* (1785). Whilst Kant is understood to have read *The Theory of Moral Sentiments*, Smith (1982) before publishing the *Idea*, the case of the *The Wealth of Nations* is unclear. A German translation of the latter appeared within a year of its publication in Britain. However, it is now known that the influence of this now revered book was limited for many years afterwards, both at home and in Germany, see Teichgraeber (1987) and Fleischacker (1996); this inadvertence was also reflected in the London Times' obituary of Smith on the 24<sup>th</sup> July 1790: [http://en.wikisource.org/wiki/Times\\_Obituary\\_of\\_Adam\\_Smith](http://en.wikisource.org/wiki/Times_Obituary_of_Adam_Smith).

(1994) made a distinction between neoclassical and endogenous growth models in terms of two “growth facts” central to the latter but neglected by the former: (i) the incentive effects of technological advance and (ii) firms’ market power. Abstracting from (ii), growth and technical advance, viewed through the Kantian lens, proceed not as a black box, but because agents have an incentive to use, build upon and benefit from existing knowledge. Those incentives, in turn, are shaped by public policies and social characteristics.<sup>15</sup>

Our formal model of Kant’s mechanism also gives interesting insights into contemporary policy debates. For example, when considered alone, human rivalry appears to give rise to a “hedonic treadmill” of unnecessary effort. However, in the model it provides an incentive to generate the effort required for a more rapid accumulation of knowledge. The more far-sighted a social planner the more effort he will choose. Strong habit formation helps achieving such an outcome in the decentralized equilibrium.

To blend the non-rival aspect of knowledge accumulation with the rival nature of human interactions into a unity is striking. With these features in mind, we believe we can meaningfully speak of Kant as an important (and thus far neglected) precursor of endogenous growth theory.

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<sup>15</sup>In the absence of the incentives stemming from unsocial sociability (or if the rewards of effort were heavily redistributed), there appears to be a risk that mankind would settle down to a comfortable existence, characterized by minimal effort, low living standards and the absence of progress: “. . . *all talents would, in an Arcadian pastoral life of perfect concord, contentment and mutual love remain eternally hidden ... human beings, as good-natured as the sheep they tended, would give their existence hardly any greater worth than that of their domesticated beasts*” (8:21, p. 112).

## References

- Abel, A. B. (1990). Asset prices under habit formation and catching up with the joneses. *American Economic Review (Papers and Proceedings)*, 80(2):38–42.
- Acemoglu, D. (2009). *Introduction to Modern Economic Growth*. MIT Press.
- Aghion, P., Bloom, N., Blundell, R., Griffith, R., and Howitt, P. (2005). Competition and Innovation: An Inverted-U Relationship. *Quarterly Journal of Economics*, 120(2):701–728.
- Arrow, K. J. (1962). The economic implications of learning by doing. *Review of Economic Studies*, pages 155–173.
- Arrow, K. J. and Dasgupta, P. (2009). Conspicuous consumption, inconspicuous leisure. *Economic Journal*, 119(541):F497–F516.
- Barro, R. J. and Sala-i-Martin, X. (2004). *Economic Growth*. 2nd Edition, MIT Press, Cambridge, MA.
- Carroll, C. D., Overland, J., and Weil, D. N. (1997). Comparison utility in a growth model. *Journal of Economic Growth*, 2(2):339–367.
- Carroll, C. D., Overland, J., and Weil, D. N. (2000). Saving and growth with habit formation. *American Economic Review*, 90(3):341–355.
- Choudhary, A. M. and Levine, P. (2006). Idle worship. *Economics Letters*, 90(1):77–83.
- Choudray, A. M., Levine, P., McAdam, P., and Welz, P. (2011). Happiness Puzzles: Analytical Aspects of the Easterlin Paradox. *Oxford Economic Papers*, (forthcoming).
- Duesenberry, J. (1949). *Income, Saving and the Theory of Consumer Behavior*. Cambridge MA.
- Felicitas Munzel, G. (2000). *Kant's Conception of Moral Character, Anthropology and Reflective Judgment*. University of Chicago Press, Chicago.
- Fleischacker, S. (1996). Values behind the market. *History of Political Thought*, XVII(3):379–407.
- Fleischacker, S. (1999). *A Third Concept of Liberty*. Princeton University Press.

- Gali, J. (1994). Keeping Up with the Joneses. Consumption Externalities, Portfolio Choice, and Asset Prices. *Journal of Money, Credit & Banking*, 26(1):1–8.
- Glaeser, E. L., Porta, R. L., de Silanes, F. L., and Shleifer, A. (2004). Do institutions cause growth? *Journal of Economic Growth*, 9(3):271–303.
- Hayek, F. A. (1978). *Law, Legislation and Liberty, Volume 2: The Mirage of Social Justice*. University Of Chicago Press.
- Hume, D. (1889). *Essays: Moral, Political and Literary*. Longmans Green.
- Kant, I. (1784; 2007b). *Idea for a Universal History with a Cosmopolitan Aim*. in Zöllner, G. and Loudon, R. (Op. cit).
- Kant, I. (1785; 1999). *Groundworks of the Metaphysics of Morals*. in M. J. Gregor and A. W. Wood (eds.), *The Cambridge Edition of the Works of Immanuel Kant: Practical Philosophy*, Cambridge: Cambridge University Press.
- Kant, I. (1786; 2007a). *Conjectural Beginning of Human History*. in Zöllner, G. and Loudon, R. (Op. cit).
- Kant, I. (1790; 2000). *Critique of the Power of Judgment*. in Guyer, P. and E. Mathews (eds.), *The Cambridge Edition of the Works of Immanuel Kant: Critique of the Power of Judgment*, Cambridge: Cambridge University Press.
- Kant, I. (1803; 2007c). *Lectures on Pedagogy*. in Zöllner, G. and Loudon, R. (Op. cit).
- Kersting, W. (1993). *Immanuel Kants Rechts - und Staatsphilosophie*. Mentis Verlag.
- Kurz, H. (2003). What could the new growth theory teach Smith or Ricardo? In Kurz, H. and Salvadori, N., editors, *Classical Economics and Modern Theory: Studies in Long-period Theory*, pages 137–162. Routledge.
- La Grandville, Olivier de. (2011). A Proof of Smith’s Conjecture, with an Application to the Optimal Savings Rate. *German Economic Review*, (forthcoming).
- Layard, R. (2006). Happiness and Public Policy: A Challenge to the Profession. *Economic Journal*, 116(510):C24–C33.

- León-Ledesma, M. A., McAdam, P., and Willman, A. (2010). Identifying the Elasticity of Substitution with Biased Technical Change. *American Economic Review*, 100(4):1330–1357.
- Louden, R. B. (2000). *Kant's Impure Ethics*. Oxford University Press, Oxford.
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22:3–42.
- Lucas, R. E. (2009). Ideas and Growth: The 2008 *Economica* Phillips Lecture. *Economica*, 76(301):1–19.
- Ramsey, F. (1928). A Mathematical Theory of Saving. *Economic Journal*, 38:543–59.
- Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(October):1002–1037.
- Romer, P. M. (1994). The Origins of Endogenous Growth. *Journal of Economic Perspectives*, 8(1):3–22.
- Smith, A. (1759; 1982). *The Theory of Moral Sentiments*. ed. D. D. Raphael and A. L. Macfie, vol. I of the Glasgow Edition of the Works and Correspondence of Adam Smith, Liberty Fund.
- Smith, A. (1776; 1977). *An Inquiry into the Nature and Causes of the Wealth of Nations*. University Of Chicago Press.
- Solow, R. (2007). The last 50 years in growth theory and the next 10. *Oxford Review of Economic Policy*, 23(1):3–14.
- Teichgraeber, R. (1987). Less Abused Than I Had Reason To Expect. The Reception of the Wealth of Nations in Britain, 1776-1790. *Historical Journal*, 30(2):337–366.
- Vallentyne, P. (2008). Social contract. In *The New Palgrave Dictionary of Economics. Second Edition*. Eds. Steven N. Durlauf and Lawrence E. Blume, Palgrave Macmillan.
- Veblen, T. (1899; 1965). *The Theory of the Leisure Class*. Aakar Books.
- Waterman, A. (2003). Mathematical modeling as an exegetical tool: Rational reconstruction. In Samuels, W., Biddle, J., and Davis, J., editors, *A Companion to the History of Economic Thought*, pages 553–570. Wiley-Blackwell.
- Wood, A. W. (1999). *Kant's Ethical Thought*. Cambridge University Press, Cambridge.