CHAPTER 1

RETURNING TO THE CLASSICAL TRADITION: THE RELEVANCE AND APPLICATION OF INFRAMARGINAL ANALYSIS TO DEVELOPMENT ECONOMICS

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1. Why Consider the Inframarginal Approach to Economic Development?

Economic development is an observable phenomenon, improvement in the well-being of people, while development economics is the study of that phenomenon. A relatively new sub-discipline of economics known alternatively as "inframarginal economics", "new classical economics" or "the economics of the division of labour," may offer its deepest insights in the study of economic development. This reason alone justifies compiling a collection of essays relating to economic development from the perspective of inframarginal economics, which differs in important ways from more traditional frameworks.

We do not expect that inframarginal economics will be readily embraced by all people interested in the field of development. Arndt[1] provides a fascinating account of the history of the idea of economic development, though it concentrates especially on the 20th century. It shows just how much recent debate there has been about how to define development. For the most part, until the collapse of the Soviet Union, economic development as practiced has been part of a political response from the West to counter the spread of communism to developing countries. Yet, as convincing and detailed as Arndt's story sounds, it does not seem likely that the idea of development only emerged within the last one hundred years. For instance, Arndt makes little mention of Adam Smith.

♣ We thank Xiaokai Yang for useful discussions.

As Yang and Ng[2] note in the introductory chapter of their well known book, neoclassical economics has focused primarily on the problem of resource allocation, while inframarginal economics, or the economics of the division of labour, gives primary attention, just like Adam Smith, to issues of economic organisation. Economic development is much less about a simple allocation of resources, and much more about explaining first the type of economic organisation that emerges, and only then analysing the resource allocation problem. Put another way, economic organisation puts boundaries on how resources are allocated, and therefore, the underlying reason for variations in economic development are ultimately related to organisational issues about economic activity.

This line of reasoning is also present in the new institutional economics (NIE) view of economic development, including Bates[3] and North[4], among other efforts prior to and since then (see http://coase.org for more references). The motivations are different though, as work in the NIE tradition frequently begins with observations on economic history, while the new classical economics begins from the history of economic thought. Both approaches share common criticisms of standard neoclassical economics. Yet, work among practitioners of the former often make minor adjustments of neoclassical models to fit the historical fact that transaction costs matter for economic performance. Practitioners of the latter typically begin by attempting to mathematically formalise certain aspects of Smith's framework, and then search for evidence to verify inframarginal, and hence, Smithean views of economic performance. So while the issues and explanations of economic performance are often the same, the approaches are different, but it is important to bear in mind that neither approach fully embodies what Smith actually said about economic development.

2. Smith's View of Economics and Economic Development

Many economists today would certainly point to Adam Smith as an early contributor to, if not the founder of, economics. Smith was also preoccupied with where improvements in economic performance, or growth, come from. Hence, he might also be viewed as the first development economist. Economic ideas had, of course, been circulating

before him. Levy[5] even claims that the anti-economic content of Plato's Republic was aimed at the economic ideas found in Homer's Illiad. There, the Gods are perfect rational agents, and understand the benefits of positive sum trade, as they make deals with each other, while humans are primitive, and understand only negative sum trade, or war. What Plato's Republic did was to establish an elitist view, that the division of labour for all occupations must be planned, and the agents needed to do so were Philosopher Kings. This view was dominant for roughly the next two thousand years.

In *The Wealth of Nations*[6], Smith challenged this view by appealing to our egalitarian sensibilities. In short, he suggested that the division of labour, which was constrained by market size and population, could arise if each person were left to choose their own occupation. If transaction costs are not prohibitive, a larger market and population makes it possible for people to reap the returns to specialisation.

However, he was a great synthesizer of economic ideas, and to appreciate his contribution, it is necessary to consider his three works, *The Theory of Moral Sentiments* (TMS)[7], *Lectures on Jurisprudence* (LJ)[8], and *An Enquiry into the Nature and Consequences of the Wealth of Nations* (TWN)[6]. Smith's interest in development has its origins in his work on moral philosophy. As Levy[9, 10] puts it:

> It seems to me that Smith is relying on a belief that modestly informed spectators would reach a common judgment about the level of well-being of the median member of different societies to defend economic growth. Smith has told us three things. First, he tells us that the as-if well-being of children is easy for everyone to impute. Second, he has told us that the children of the median member of society will do best in a rapidly growing society. Third, he has told us that one and two suffice for us to conclude that rapid growth is good (see page 313).

So, herein lies the justification for growth. In order to understand where growth comes from, it is first necessary to point out that for Smith, it is man's inherent desire to trade that drives the division of labour, and volume of trade that determines the extent of the division of labour. Furthermore, trade is possible because people share language; whether it's Chinese, French, Jamaican, English, or Swahili. As long as people

can communicate, it is language (see Smith TWN I. ii par. 2[6], Levy[11] for an extensive interpretation of Smith's views). Thus, a larger market size with lots of commercial activity means a greater division of labour (see Smith TWN I. iii par. 1[6]). The division of labour increases worker productivity because of improvements to human capital ("dexterity") and physical capital ("the invention of a great number of machines"), as each factor becomes more specialised, and because specialisation itself implies time is no longer lost in switching from one task to another (see Smith TWN I. i par. 5[6]). Rising productivity is of course an indicator of a growing economy. *Lectures on Jurisprudence*[8] includes an early draft of *the Wealth of Nations* that discusses the role of specialisation in economic growth. It also includes a noteworthy discussion of the impediments to growth. Specifically, any factor that drives a wedge between the natural (distortion-free) price, and the observed market price, slows down commercial activity, and hence, the potential for economic growth. These wedges might be caused by monopoly, by taxes or tariffs, or by prices or risk due to various forms of uncertainty including property rights (see Juris-Prudence Part II. Of Police in Smith[8] where he discusses among other things, the relationship between the division of labour and growth, as well as retardants to growth.).

3. Where has the Division of Labour Gone?

Stigler[12] observes that specialisation is the key facet of Smith's explanation of economic growth and development that is surprisingly missing from all of neoclassical economics. For instance, it is notably absent from the neoclassical framework of Marshall and Jevons. Reasons for this anomaly have been offered by a number of authors. Buchanan and Yoon[13] speculate that the neoclassical thinkers sidestepped the issue of the division of labour because they considered it irreconcilable with their theory of distribution. This theory depends critically on constant returns. Yet, division of labour, and the benefits of specialisation, suggest increasing returns to scale.

Others, including Houthakker (p.62)[14] and Yang (p.8)[15], add technical hurdles to what may have discouraged the founders of marginalist economics from addressing issues relevant to the division of labour.

These hurdles originate from the fact that division of labour ultimately boils down to a binary decision of whether or not to produce a particular good. Mathematically, such outcomes are represented by corner solutions and require models that can accommodate such discontinuities. Yet, the marginal revolution relied on calculus that, in turn, requires smooth and continuous functions. Such functions can investigate interior outcomes, but are not suitable to study the discontinuities that characterise the division of labour.

Clearly, nineteenth century mathematical formalism represented a genuine hurdle in reconciling the theory of distribution with classical questions of economic organisation. However, Buchanan and Yoon[13] have recently argued that Marshall's decision to banish division of labour from the core preoccupations of the marginal revolution on the basis that it would undermine the requirement of constant returns was unnecessary. As these authors explain, improvements in the division of labour are in fact consistent with constant returns to scale. This is so because enhancements in the division of labour are generally realised when agents switch from self-production to market production. Hence, as the division of labour intensifies, the economy-wide value of the final output relative to the total value of all inputs increases. This leads to what Buchanan and Yoon refer to as "generalised increasing returns". Still, given any particular pattern of the division of labour, as the quantity of inputs employed *by any one firm* expands, output increases proportionally. It is the reorganisation of the economy that redefines what is produced and exchanged in the market that generates generalised increasing (economy-wide) returns, not the increase in inputs used by any given firm in the absence of any change in the economy-wide division of labour. In other words, generalised increasing returns and constant returns to scale can happily coexist.

Applications of corner solutions and discontinuities to economic models can be traced to Coase[16] and Koopmans[17]. Following Stigler[12], a number of papers from faculty and students at the University of Chicago, including Rosen[18, 19], Becker and Murphy[20], and Tamura[21, 22], among others, began to explore the economics of specialisation. Just as this research was beginning at the University of Chicago, Xiaokai Yang, imprisoned in China as a dissenter to the ideas that defined the Cultural

Revolution, began a remarkable journey to recreate economic theory using a framework that establishes a bridge between modern economics and Smith (see Yang[15] for an excellent summary of relevant contributions).

Unlike Smith, inframarginal economics makes no claims about the relationship between language and trade, nor does it ask what the theoretical justifications for growth are. Instead, it begins with the idea that there are gains from specialisation, that are possible in market economic activity, but there are also transaction costs from using the market. People are consumer-producers. They choose how much of their waking hours to allocate to a specific activity. As the division of labour evolves, individuals move away from self-producing all of their consumption towards producing only one good, which earns income that is used to purchase a wide variety of consumption goods. If transaction costs are high, people are unlikely to find it worthwhile to engage in market activity, and will instead self-produce their consumption in autarky. If, on the other hand, transaction efficiency is high enough, people who otherwise start off identical, will become increasingly specialised in particular occupations, thereby capturing the benefits of specialisation.

Table 1 below compares some aspects of inframarginal and neoclassical models with Smith's theory of economic growth. Clearly, the inframarginal literature is closer than neoclassical theory in capturing Smith's thoughts on development, notwithstanding the absence of any moral content. The aim of this volume therefore is to bring together a number of recent articles on this topic in an effort to summarise the inframarginal explanation of the origins of economic development.

As illustrated by the articles included in this anthology, inframarginal analysis has profound implications on the study of economic development. To assist the non-specialist reader with these contributions, the remaining of this article serves as an introduction to the practical implementation of inframarginal analysis. In particular, the next section outlines the key "steps" of inframarginal analysis, and section 5 implements these steps in the context of a simple model.

Table 1: Classical, Inframarginal, and Neoclassical Perspectives

	Classical (Adam Smith)	Inframarginal (New Classical)	Neoclassical
Use of models is necessary	Not explicitly	Yes	Yes
Moral justifications for growth	Yes	Not Yet	Not Yet
Firms are collections of people	Yes	Yes	No
Assume people start off identical and choose to be different in their occupation	Yes	Yes	No
Growth occurs by realising gains from specialisation	Yes	Yes	No
Transaction costs determine the level of specialisation and hence growth	Yes	Yes	No?
Trade, and hence growth can occur even without exogenous differences	Yes	Yes	No
Population growth adversely affects economic performance	No	No	Yes?

4. The "Steps" of Inframarginal Analysis

Commonly, inframarginal analysis of economic models involves the following steps:

i. Design the model [important features of any model include items such as: types of agents, dimensions, production and consumption characteristics, and institutional structure (in particular: rules of exchange — e.g. presence of transaction costs, tariffs, etc.)]

ii. Identify the *prime configurations* and *market structures* (*note: prime configurations* are patterns of production and consumption that may characterise individual agents within countries, and which may be consistent with meaningful frameworks of

exchange — or *market structures*). Autarky is viewed as meaningful "pattern of exchange" — i.e. a pattern of exchange with zero flows

iii. For each configuration, within each structure, employ marginal analysis to optimise for each agent's objective function

iv. Using demand and supply from previous step, solve for the *market clearing conditions*, which determine the price that would prevail if the *corner equilibrium* that is represented in each *structure* is in fact the *general equilibrium*. Of course, depending on the production function, prices may be determined prior to evaluation of market clearing conditions (as per the *nonsubstitution theorem*)

Still, step (iv) may facilitate the determination of necessary conditions for the structure at hand to prevail

v. Undertake a demarcation of parameter space in parameter value subsets within each of which the *local* corner equilibrium is the *general equilibrium*. The general equilibrium requires that under the relative price that prevails in any given corner or interior equilibrium, all individuals in all countries prefer the configurations consistent with the structure at hand, than any other possible *shadow configurations*. (Note that *shadow configurations* include all possible configurations other than the configuration prevalent in the structure and for the agent under examination)

vi. The final step entails examination of the resulting inframarginal comparative statics

5. Even a Simple Inframarginal Model has Much to Say About Development

The two good inframarginal model has been summarised in a number of contributions (Yang and Ng[2], Yang[15]), but typically the purpose is to provide an intuition for more complicated models. Here, the two good inframarginal model is presented to summarise its implications for economics development. The context in which it is used here is to highlight the differences between an economy based on subsistence agriculture, and one that is more specialised, and hence developed.

Just as Adam Smith pointed out that the difference between the philosopher and the common porter is really much smaller than the philosopher would lead us to believe, the model begins with Smith's inherent assumption that each person starts of the same. Differences arise from individual choices about how to specialise in productive activities. What follows represents a simple implementation of the steps outlined in section 4.

Step i — Model design:

- There is a continuum of identical consumers-producers that has mass M
- Agents *ex ante* identical, and have the following utility function for food (denoted f) and non-food (n) commodities:

$$\max_{l_f, l_n} u_i = \left(f + kf^d\right)\left(n + kn^d\right)$$

  f, n: goods that are self provided
  f^d, n^d: goods bought (demanded) from the market
  $0 \le k \le 1$ is the trading efficiency coefficient (the lower k is, the higher the transaction cost)
- Each consumer-producer has an allocation of labour-time (l) and land (t) that is exhausted across the two goods:

$$l_f + l_n = 1$$
$$t_f + t_n = 1$$

- The production functions for food and non-food for a consumer-producer are variants of the Cobb–Douglas production function, in terms of labour (l_i) and land (t_i):

$$f + f^s = \max\left[0, \left(l_f - \alpha\right)^a t_f^b\right]$$

$$n + n^s = \max\left[0, \left(l_n - \alpha\right)^a t_n^b\right]$$

  where the term α is a fixed learning cost.
- Finally there is a budget constraint such that in general:

$$p_f f^s + p_n n^s = \left[p_f f^d + p_n n^d\right]$$

The idea behind inframarginal models is typically that the efficiency of transactions, often denoted by *k*, determines the extent of the division of labour, which in turn, determines income levels. The lower the efficiency of transactions (the higher the costs of transacting), the more expensive it is to rely on the market, and hence, people find self-production makes them better off. This is depicted below:

$$\left\{\begin{matrix} k \text{ is low} \\ \downarrow \\ \text{Autarky} \end{matrix}\right\} \left\{\begin{matrix} k \text{ is medium range} \\ \downarrow \\ \text{Partial specialisation} \end{matrix}\right\} \left\{\begin{matrix} k \text{ is high} \\ \downarrow \\ \text{Complete specialisation} \end{matrix}\right\}$$

The inframarginal approach typically calls for backing out the transaction efficiency parameter, to find the point at which the economy switches between configurations. These range from autarky, when each individual self-produces its consumption, to extreme specialisation, when each individual produces one-good, from which the proceeds are used to finance consumption of all other goods. To back out those transaction efficiency thresholds (the points at which the model switches behaviour), the first required step is to find the optimal supply and demand for each, initially identical, consumer-producer under autarky, under partial

specialisation (for more complicated models), and complete specialisation.

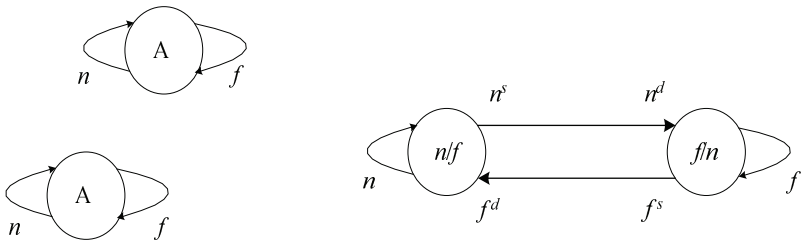
$$\left\{\begin{array}{c} Autarky \\ \downarrow \\ Optimal \\ S\ \&\ D \end{array}\right\}\left\{\begin{array}{c} Partial\ specialisation \\ \text{L}\downarrow\text{L} \\ Optimal \\ S\ \&\ D \end{array}\right\}\left\{\begin{array}{c} Complete\ specialisation \\ \downarrow \\ Optimal \\ S\ \&\ D \end{array}\right\}$$

Hence, there is an optimal supply and demand for each person in each configuration, which corresponds to a different extent of the division of labour. These optimal supply and demand conditions are then used to get an indirect or real utility/welfare function for each individual in each configuration:

$$\left\{\begin{array}{c} Autarky \\ \downarrow \\ Welfare \end{array}\right\}\left\{\begin{array}{c} Partial\ specialisation \\ \text{L}\downarrow\text{L} \\ Welfare \end{array}\right\}\left\{\begin{array}{c} Complete\ specialisation \\ \downarrow \\ Welfare \end{array}\right\}$$

Once the real utility is known for each individual, it is then possible to determine the thresholds of transaction efficiency at which people in the economy find themselves in autarky, partial specialisation and complete specialisation. With this overview in mind, the model can be analysed in different configurations (in this case two).

Steps ii — Configurations and market structures



(a) Structure A, autarky (b) Structure D, division of labour

Figure 1: Configurations and Structures

Step iii — Marginal solutions

From the general problem, it is easy to see that autarky is a much simpler world because there are no markets, and hence, there are no prices and there is no budget constraint. Hence, human behaviour is not governed by relative price changes. People don't respond to what is not observable. Still, they have preferences so that opportunity cost is still very much in their minds.

Structure A (Autarky):

The general problem simplifies to:

$$\max_{l_f, l_n} u_A = f \cdot n$$

$$f = \left(l_f - \alpha\right)^a t_f^b$$

$$n = \left(l_n - \alpha\right)^a t_n^b$$

$$l_f + l_n = 1$$

$$t_f + t_n = 1$$

This constrained maximisation problem can be simplified to an unconstrained optimisation problem, in this case solved for the non-food crop by substituting in all the constraints:

$$\max_{l_n} u_A = \left(\left(1 - l_n\right) - \alpha\right)^a \left(1 - t_n\right)^b \cdot \left(l_n - \alpha\right)^a t_n^b$$

The four first order necessary Kuhn–Tucker conditions are:

$$\frac{\partial u_A}{\partial l_n} = -a \cdot \left(\left(1 - l_n\right) - \alpha\right)^{a-1} \left(1 - t_n\right)^b \cdot \left(l_n - \alpha\right)^a t_n^b +$$

$$a \cdot \left(\left(1 - l_n\right) - \alpha\right)^a \left(1 - t_n\right)^b \cdot \left(l_n - \alpha\right)^{a-1} t_n^b \leq 0$$

$$l_n \cdot \frac{\partial u_A}{\partial l_n} = 0$$

$$\frac{\partial u_A}{\partial t_n} = -b \cdot \left(\left(1-l_n\right)-\alpha\right)^a \left(1-t_n\right)^{b-1} \cdot \left(l_n-\alpha\right)^a t_n^b +$$

$$b \cdot \left(\left(1-l_n\right)-\alpha\right)^a \left(1-t_n\right)^b \cdot \left(l_n-\alpha\right)^a t_n^{b-1} \leq 0$$

$$t_n \cdot \frac{\partial u_A}{\partial t_n} = 0$$

In autarky, because of the Cobb–Douglas utility specification, both goods must be consumed, and hence, both goods must be produced, as there is no market for goods that the household decides not to produce. Looked at another way, if either l_n or t_n is either zero or one, then the first order condition is not satisfied. Hence, an interior solution must exist in autarky, such that the household produces all goods that it consumes. Rearranging and simplifying the first order necessary condition for labour yields:

$$\frac{\partial u_A}{\partial l_n} : \left(\left(1-l_n\right)-\alpha\right)^{a-1} \cdot \left(l_n-\alpha\right)^a = \left(\left(1-l_n\right)-\alpha\right)^a \cdot \left(l_n-\alpha\right)^{a-1}$$

$$\Rightarrow l_n = 1/2$$

From the labour constraint, this implies that:

$$l_f = 1-l_n = 1/2$$

Since the consumption shares are equal in this specification, the model implies that labour is therefore allocated equally to both food and non-food goods. Hence, half of each person's labour is devoted to each good, but less than half of that labour is actually used in producing the goods, because there are learning costs, which are incurred twice, once for each good. Turning now to the land first order necessary condition:

$$\frac{\partial u_A}{\partial t_n} : \left(1-t_n\right)^{b-1} \cdot t_n^b = \left(1-t_n\right)^b \cdot t_n^{b-1}$$

$$\Rightarrow t_n = 1/2$$

From the land constraint, this implies that:

$$t_f = 1 - t_n = 1/2$$

Inserting the optimal solution, $l_n = t_n = l_n = t_n = 0.5$, into the utility function yields a real-income/utility function that will be used to judge welfare of the consumer-producers under autarky:

$$u_A = \left(\left(1 - l_n\right) - \alpha\right)^a \left(1 - t_n\right)^b \cdot \left(l_n - \alpha\right)^a t_n^b = \left(0.5 - \alpha\right)^{2a}$$

What is interesting to note about this real utility function is that, in addition to the absence of prices (since markets are not used), well-being is, marginally, independent of transaction efficiencies. This condition will be recalled later so that the threshold at which the economy switches from autarky to the complete division of labour can be determined.

Structure D (division of labour): Food producers

Under division of labour, everything changes. Now households face a budget constraint, and they face transaction costs in purchasing consumption goods. Now households specialise in producing one crop (food or non-food), such that all labour is allocated to a single activity, the proceeds from which are used to purchase all other goods (in multiple good models), in this case one. Now, labour shares are no longer the choice variable, instead the choice is how much of the good produced to supply to the market, and how much to keep for domestic consumption. The model in this configuration also makes room for Adam Smith's brilliant insight, that you can still have trade (within a country) between people who start off identical. The driving force behind this is that people now choose to be different in their occupations, because there are gains from specialising, a feature that is not inherent to the typical neoclassical model.

Under specialisation there are two cases, the food crop and the non-food crop producers. The mathematics for multiple good models can quickly become cumbersome (for the model with m goods there are 2^m possible zero/non-zero combinations to consider). Fortunately, there is a so-called Wen theorem, proven by Wen (1998), which holds that no individual buys and self-provides the same good. This simplifies the mathematics of the model significantly. Applying this theorem to the

food crop specialist, since a food producer would not buy that same food crop, but would instead purchase all other goods, the general problem simplifies to:

$$\max_{f} u_D = \left(f + (0)\right)\left((0) + kn^d\right) = f \cdot kn^d$$

$$f = \left(l_f - \alpha\right)^a t_f^b - f^s$$

$$l_f + (0) = 1 \qquad t_f + (0) = 1$$

$$p_f f^s + (0) = (0) + p_n n^d$$

The next step is to substitute the second and third constraints for labour and land, into the production function. So now $f = \left(1-\alpha\right)^a - f^s$, since all labour and land is allocated to food production. This can be substituted into the utility function. Additionally, the budget constraint can be solved for non-food purchased from the market $n^d = \frac{p_f f^s}{p_n}$ so that it too can be substituted into the utility function. After making these substitutions, the problem is now to maximise the following utility function.

$$\max_{f^s} u_{D,f} = \left(\left(1-\alpha\right)^a - f^s\right) \cdot k \cdot \left(\frac{p_f f^s}{p_n}\right)$$

This problem calls for maximising utility in terms of food supplied. Hence,

$$\frac{\partial u_{D,f}}{\partial f^s} = -k \cdot \left(\frac{p_f f^s}{p_n}\right) + \frac{p_f}{p_n} \cdot \left(\left(1-\alpha\right)^a - f^s\right) \cdot k \le 0$$

$$f^s \cdot \frac{\partial u_{D,f}}{\partial f^s} = 0$$

In autarky, the marginal cost of producing more of one good entails consuming less of the other. Here the marginal cost of supplying more to the market requires having less of that good to consume at home (since the Wen theorem implies that no person buys and self-provides the same good). Applying the Kuhn–Tucker theorem to these two first order

necessary conditions reveals that food supplied to market must be positive. If it were zero, then $\frac{p_f}{p_n} \cdot ((1-\alpha)^a) \cdot k \leq 0$, which is infeasible if prices, transaction efficiency, and the learning costs are all positive. Hence, the individual's optimal food supply to the market is:

$$\frac{\partial u_{D,f}}{\partial f^s} : f^s = \frac{(1-\alpha)^a}{2}$$

The greater the returns to specialisation (a), or the lower the learning cost of producing food, the greater amount of food is supplied. When combined with the budget constraint, this implies that the amount of food demanded is:

$$n^d = \frac{p_f f^s}{p_n} = \frac{p_f}{p_n} \frac{(1-\alpha)^a}{2}$$

As in neoclassical economics, the first law of demand, that generally requires the quantity of the good demanded to be negatively related to its relative price, is satisfied. Also, as under autarky, the point here is to find the real utility function, in terms of prices, for food crop producers. Inserting the optimal supply and demand into the utility function yields,

$$u_{D,f} = f \cdot kn^d = k \cdot \frac{p_f}{p_n} \cdot \frac{(1-\alpha)^{2a}}{4}$$

Points to observe about this measure of well-being is that, *ceteris paribus*, food producers are better off as the relative price of food rises, as the transaction efficiency rises, as the returns to specialisation (a) rises, or as the learning cost for producing food crops falls.

Structure D (division of labour): Non-food producers

Following the logic from above, after simplifying the general problem, the problem for non-food producers is symmetric:

$$\max_n u_{D,n} = \left((0) + f^d\right)\left(n + (0)\right) = kf^d \cdot n$$

$$n = (l_n - \alpha)^a t_n^b - n^s \qquad (0) + l_n = 1$$

$$(0) + t_n = 1$$

$$(0) + p_n n^s = p_f f^d + (0)$$

which, after substituting in the constraints, reduces to:

$$\max_{n^s} u_{D,n} = \left((1-\alpha)^a - n^s\right) \cdot k \cdot \left(\frac{p_n n^s}{p_f}\right)$$

By similar reasoning, the symmetry of the model implies that for non-food crop producers, their supply function is characterised by:

$$\frac{\partial u_D, n}{\partial n^s} : n^s = \frac{(1-\alpha)^a}{2}$$

and their demand for the food crop is:

$$f^d = \frac{p_n n^s}{p_f} = \frac{p_n}{p_f}\frac{(1-\alpha)^a}{2}$$

Substituting in the optimal supply and demand functions into the utility function yields:

$$u_{D,n} = k \cdot \frac{p_n}{p_f} \cdot \frac{(1-\alpha)^{2a}}{4}$$

As with the real utility function for food producers, *ceteris paribus*, non-food crop specialists are better off as the relative price of the crop they produce rises, as the transaction efficiency rises, as the returns to specialisation (a) rises, or as the learning cost for producing non-food crops falls.

Step iv — Market demand and supply

Compared to the neoclassical view, market demand and supply are defined in a slightly different, but consistent way. First, note that markets in this model only exist under complete specialisation. In the two good case, the market demand for one good actually equals the individual demands for that good multiplied by the mass of suppliers of the other

good, since no person buys and self-produces the same good. Hence for food, market demand is given by:

$$F^d \equiv M_n \cdot f^d = M_n \cdot \frac{p_n}{p_f} \cdot \frac{(1-\alpha)^a}{2}$$

where again, the first law of demand holds, and also, the quantity of food demanded is increasing in the population of consumers, the number of non-food producers.

Market supply is defined by:

$$F^s \equiv M_f \cdot f^s = M_f \cdot \frac{(1-\alpha)^a}{2}$$

From this, it is evident that market supply of food is increasing in the number of food producers, a reduction in fixed learning costs of producing food, and an increase in the returns to specialisation. While the first is due to the fact that more producers means more supply. The second is because a reduction in learning costs means more time per person is actually devoted to producing the crop. Finally, an increase in the returns to specialisation results from the fact that for each unit of time allocated, a higher amount of output is achieved. Equating demand and supply results in:

$$F^d = M_n \cdot \frac{p_n}{p_f} \cdot \frac{(1-\alpha)^a}{2} = M_f \cdot \frac{(1-\alpha)^a}{2} = F^s$$

which implies that:

$$\frac{M_n}{M_f} = \frac{p_f}{p_n}$$

Since Walras's Law holds, in the two-good case presented here, it is sufficient to consider only the market clearing conditions for food to determine equilibrium. However, just to be sure, with properties that are symmetric to food crops, market demand for non-food crops is given by:

$$N^d \equiv M_f \cdot n^d = M_f \cdot \frac{p_f}{p_n} \cdot \frac{(1-\alpha)^a}{2}$$

where again the first law of demand for non-food crops holds, and demand is once more increasing in the population of consumers, in this case food producers. Non-food crop supplies are defined by:

$$N^s \equiv M_n \cdot n^s = M_n \cdot \frac{(1-\alpha)^a}{2}$$

which is likewise increasing in the number of producers, declining in the costs of learning to produce the crop, and increasing in the returns to specialisation.

Market equilibrium for non-food crops is defined by:

$$N^d = M_f \cdot \frac{p_f}{p_n} \cdot \frac{(1-\alpha)^a}{2} = M_n \cdot \frac{(1-\alpha)^a}{2} = N^s$$

which yields an identical condition:

$$\frac{M_n}{M_f} = \frac{p_f}{p_n}$$

From this, it is possible to determine the relative price between food and non-food crops. Consider rearranging that condition as follows:

$$M_n p_n = M_f p_f$$

Since everyone is identical, and no two people are charged different prices, then it must be the case that this condition holds between any pair of food and non-food specialists, hence, the two prices are equal:

$$p_n = p_f$$

With market equilibrium defined, it is now possible to address the final step, which is to identify the point in transaction efficiency space at which the world shifts from autarky to the division of labour.

Step v–vi — Autarky vs specialisation

Recall that it is the indirect utility function that helps to determine in which configuration the individuals find themselves. The indirect utility functions for each subsistence farmers, food crop specialists, and non-food crop specialists are, respectively:

$$u_A = \left(0.5 - \alpha\right)^{2a}$$

$$u_{D,f} = k \cdot \frac{p_f}{p_n} \cdot \frac{\left(1-\alpha\right)^{2a}}{4}$$

$$u_{D,n} = k \cdot \frac{p_n}{p_f} \cdot \frac{\left(1-\alpha\right)^{2a}}{4}$$

The logic concerning how to interpret these results is simple. If the individual is "happier", that is, has a higher real income, in one configuration than in any other, she will choose that configuration. Also, within a particular configuration (the division of labour in this case), it must be the case that the utility of a particular occupation equals that of all others. Hence, for two goods and two configurations, there are only two conditions to check. Within the division of labour configuration it must be the case that utility across occupations is identical:

$$u_{D,f} = k \cdot \frac{\left(1-\alpha\right)^{2a}}{4} = k \cdot \frac{\left(1-\alpha\right)^{2a}}{4} = u_{D,n}$$

The more important case to consider entails a comparison between real utility under autarky with that under the division of labour. If the real income under autarky is greater than real income under specialisation, then autarky will be chosen:

$$u_A = \left(0.5 - \alpha\right)^{2a} \geq k \cdot \frac{\left(1-\alpha\right)^{2a}}{4} = u_{D,f} = u_{D,n}$$

Alternatively, division of labour chosen is:

$$u_A = \left(0.5 - \alpha\right)^{2a} < k \cdot \frac{\left(1-\alpha\right)^{2a}}{4} = u_{D,f} = u_{D,n}$$

Isolating both cases in terms of k, suggests that autarky is chosen over the division of labour if the transaction efficiency parameter k falls below:

$$4 \cdot \frac{\left(0.5-\alpha\right)^{2a}}{\left(1-\alpha\right)^{2a}}$$

and division of labour is chosen if:

$$4 \cdot \frac{\left(0.5-\alpha\right)^{2a}}{\left(1-\alpha\right)^{2a}} < k$$

Hence, the model implies that a fundamental problem in generating higher real income is to reduce transaction inefficiencies, which illustrates the similarity between the inframarginal and transaction cost approaches to economic development. So again, even this simple model can provide a more or less formal presentation of some of Smith's ideas about development:

1. Transaction inefficiencies are a key impediment to realising higher levels of well-being.
2. Higher levels of well-being are attainable if people make choices about their professional specialisation, as opposed to having that decision made for them by someone else.
3. Trade occurs even between *ex ante* identical individuals.

6. Concluding Remarks

As illustrated in the context of the simple model discussed in the previous sections, the inframarginal perspective facilitates a reconciliation between division of labour considerations and neoclassical frameworks of distribution. The resulting analysis sheds light on a host of topics relevant to development economics that have been largely neglected by marginalist orthodoxy. Examples include the benefits from specialisation when trading partners are *ex ante* identical, the interaction of technological comparative advantage, factor endowments, and economies of specialisation, the role of transaction costs in the organisation of the economy, and so forth.

Naturally, this field of research has generated considerable interest in recent years. However, little has been done by way of organising the

accumulated knowledge in a single volume. This anthology fills this gap by collecting key inframarginal contributions to development economics. As such, this volume serves both as an introduction of the field to the new researcher as well as a useful source of reference to those actively involved in this area.

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