RISC – Rural Infrastructure & Services Commons

A Model For Implementing the "Bicycle Commute Economy"

Vinod Khosla[1]
&
Atanu Dey[2]

[1] Mr. Vinod Khosla (vkhosla@kpcb.com) is a General Partner at **Kleiner Perkins Caufield & Byers** (www.kpcb.com).
[2] Dr. Atanu Dey (atanu@deeshaa.com) is an economist. He is Executive Director of **Deeshaa Ventures** (www.deeshaa.com).

Executive Summary

The RISC Paradigm

The economic development of India's 600 million strong rural population presents formidable challenges and also great opportunities. A model called **RISC – Rural Infrastructural & Services Commons** – is presented that has the potential for achieving the multi-faceted goals of sustainable economic development through more efficient utilization of available resources by focusing them into a minimum viable economic size. Five thousand such rural centers, built around existing infrastructure like railway stations, "haats" (informal weekly markets currently in operation in rural India), or Tier III/IV towns could place most of the rural population within a bicycle commute of ACCESS to many modern resources (like power, communications and education). The model calls for concentrating existing and ongoing investments into critical mass population chunks rather than spreading them out into individual villages in uneconomic sizes and at exorbitant cost. Then it allows the "invisible hand" of markets, not planned activities or industries, to drive growth, and direct resource usage on an economic basis.

The basic premise of this model is that markets can be "enabled" or made far more efficient in rural India. The set of activities for these markets and the capabilities are different from those of the national or global economies. Local development matched to the skills, resources, capabilities and infrastructure of rural India and it's local markets is the first stepping stone to participation in the national and global economies.

Fundamentally, the model focuses on all investments in critical mass chunks (minimum economic size) in scale and diversity, and allows for the use of these resources by the highest economic use, while providing most rural Indians with ACCESS to facilities they need rather than spreading them out into individual villages in uneconomic sizes and at exorbitant cost. It essentially acts as a catalyst that starts off a virtuous cycle of introducing efficient modern technology and aggregating demand to create markets and to improve product diversity, competitiveness and productivity that increases incomes and thus the ability of users to pay for the services. It creates a mechanism that reduces product costs, *transaction costs, improves information and knowledge* and therefore improves the functions of markets. An efficient market with sufficient scale and product and services diversity will make the economic system "autocatalytic".

Revolutions in the information and communications technologies have the potential to remove the barriers to information asymmetries that were impeding the working of markets that are critical for economic growth. The forces of globalization have created opportunities for the integration of rural populations in a larger marketplace than was ever available to them before, and more

importantly, in the rural context of local markets, local product needs, using local skills. In this context it allows for a gradual increase in skills and market and production efficiency mechanisms like information, knowledge, education, specialization, scale etc. Full participation in the global economy is not required or necessary in our view, in one step. Rural economic activity can access and make selective contributions to the global economic products and services.

Economic development is both the cause and consequence of urbanization. RISC achieves the **urbanization of the rural population** without requiring the massive and unsustainable rural-urban migration. It brings urbanization to the rural population by making available to them the full set of services and amenities that are normally available only in urban locations. It works within the constraints of limited resources by concentrating them in specific locations to obtain economies of scale, scope, and agglomeration. It helps lift the population out of a development trap by making available to them the benefits of technological advances and the increased access to local and national markets, when and as it becomes economically justified..

Conceptually and operationally, a RISC has two levels: the lower one is the **infrastructure level** (henceforth, the **I-level**) which consists of power, broadband telecommunications, and the physical plant (building, water, air-conditioning, sanitation, security); and above that the **user services level** (henceforth, the **S-level**) which consists of all services that are relevant to rural economic activity such as market making, credit, financial intermediation, education and library, health, social services, governmental services, and so on.

The I-level provides a reliable, standardized, competitively-priced infrastructure platform. This is achieved by the coordinated and cooperative actions of firms that specialize in the component activities, whether they be private, public, NGO or governmental. Ongoing investment gets a higher rate of return through better economic use. Co-located on the S-level are all kinds of firms and individuals that provide user services. The presence of the I-level, the economic scale of activity and hence competition, as well as better information and knowledge reduces the cost of products and services and therefore the prices that the users face, while at the same time increasing the diversity of products, services and providers. **Economies of scope and agglomeration** are obtained by the presence of a critical mass of consumers. Fundamentally the notion says small cities within a bicycle commute of most rural Indians are a better investment than making the same infrastructure and services investment in each village, EVEN for the VILLAGERS themselves as it generates a higher rate of return for their benefit. The highest economic use of resources based on economic justification of each use, shared use of resources to increase capital efficiency, an agglomeration of consumers and diversity of services (to enable an autocatalytic economy and hence increased rates of growth) increases the rate of return and hence rural wealth for any given level of investment.

The following document presents an outline of the RISC model. As will become clear, RISC is not an attempt at social engineering through centralized planning.

Neither is it another model of internet kiosk or telecenter. It aims to solve a problem by appealing to the profit motives of all participants, be they private sector, NGOs, or the public sector, mostly by creating and facilitating efficient market mechanisms and resources. The good that will surely come out of it can only be attributed to Adam Smith's invisible hand. The model does not require additional investment by the government, but rather proposes mechanisms for better economic use of the money currently being spent. The model minimizes the social dislocation being caused by the rural-urban migration and gives most rural Indians ACCESS to facilities and infrastructure that they have an economic use for.

We argue that today's paradigm of power, health, education, communication and other services in every home in every village is misguided investment, uneconomic and not in the best interest of the villagers. Their share of the national money is being channeled into lower return investments. A more sustainable and regenerative avenue for the investment is possible and will better serve the rural population.

This paper is not intended to be comprehensive. For example, it does not cover other important areas like credit. Microcredit is an important area whose impact we believe will be facilitated by this model. We believe that the model is necessary but not sufficient for accelerating economic growth and that specific innovations like microcredit are essential to complete the picture. Social, educational, and other services are also only touched in a cursory fashion. Technology in general can also be a great facilitator, though not an essential requirement, if we can direct development of appropriate technology for the rural context. In addition to information and communication technologies (ICT) appropriate technology can provide a significant multiplier affect when it comes to power, education, healthcare, manufacturing, building materials and many other areas. These subjects are also not addressed here.

INTRODUCTION

India's Economic Development

India's economic development presents an enormous challenge and consequently presents an equally enormous opportunity for making a positive difference in the lives of hundreds of millions of people. Meeting this challenge will impact the future trajectory of not just India but also the global economic order. Rapid progress in GDP growth in the last decade has primarily impacted the urban economy. Rural Indians are relatively unimpacted by globalization. While software exports, business process outsourcing and other exports help general economic growth it does relatively little for the rural masses.

In very broad terms, India's economic development is inextricably linked to that of India's rural economic development. Rural India has around 70% of India's billion plus population. An astonishing one out of every 10 people on the earth lives in rural India. Without rural economic development, India has little chance of achieving economic growth rates required for it to become a developed nation. We need fifty years of double digit growth in per capita income for Indians to catch up to today's western standards. This may be possible in the urban economy but the rural economy needs significant help to approach these growth rates. In the following, we present a vision of how rural economic development can be facilitated.

There are a number of critical factors it is important to acknowledge at the outset.

- First, entrepreneurship coupled with technology has the power to impact our lives dramatically. The power of ideas fueled by entrepreneurial energy may be the most important resource in this resource scarce part of the world. Enablement of market mechanisims and access to resources may be both necessary and sufficient to accelerate growth.

- Second, human capital is the scarce resource in the global economy. In this regard, fortunately India is lavishly endowed with immense human capital. To enable and empower the human capital requires physical capital which in India's case is in relatively short supply. Therefore it is imperative that physical capital be used efficiently. The RISC model directly focuses on this.

- Third, it is likely that "in context" local products for local people using local skills in a nationally connected (even globally connected world) may be the appropriate stepping stone to true global participation for rural Indians. Peasants may not be in a position to directly participate in globalization, but can nevertheless, benefit significantly from what it may offer them. Whatever the "truth" here, efficient market mechanisms and free consumer choice are the rights goals to facilitate.

- Fourth, there are not enough resources to provide power in every village home, communication, education, access to information and sufficient healthcare (atleast in the near term) to every rural India. But ACCESS to these facilities are essential to leverage the power of their human capital. We can create the conditions that can let that motivated, entrepreneurial 5% of the population do the things, leverage the ideas and skills they have to help create jobs, benefits, growth for most of the remaining population. In some sense they can be, properly facilitated, the engines of growth for rural India. These 5% of the people must have ACCESS to facilities, and these 5% don't come from any particular economic, religious or social segment but are in fact equally distributed throughout the population. The contention is that the available resources should be used to provide the most entrepreneurial segment of the population with tools that will enable them to radically change the economy and pull the remaining 95% of the rural population up. The 5% number is somewhat arbitrary but not essential to this hypothesis.

- Fifth, The dual economy, at the microeconomic level causes a migration of the workforce to cities. Ill-equipped to participate in the urban economy, they become part of the mega slums in the mega cities. They come part of the social problem of drinking, drugs, HIV, crime. They raise the per capita cost of providing basic services like police, education and housing. Theft rates for power are high, enforcement difficult, housing unavailable, sanitation and clean water an explosive problem. Our (yet unproven) hypotheses is that the value delivered per capita spend decreases as the cost for each service increases in the larger cities, above a certain size. Megacities become uneconomic for the provision of basic infrastructure like housing, police protection, sanitation, power etc. More on this later.

- Finally, at the macro level as the economy moves from an agricultural to an industrial economy there will be a massive dislocation of the population. In a modern society like the US some 3% of the population can supply all the agricultural needs of the society. In India, as the number moves from about half the population to less than 5%, an overwhelming majority of the rural population will face dislocation to new areas. The trend towards cities with populations of tens of millions will accelerate. The per capita cost of services will increase even more and become less affordable unless something is done to dramatically change this trajectory.

India's Dual Economy

India's economy has a dual nature: a large rural agrarian economy with a below average per capita income, extremely poor infrastructure, high illiteracy, and low human development indicators. Compared to that, the urban Indian economy is much smaller in terms of population (about 30 percent of total) but has a higher GDP and ranks higher along every dimension of economic and social development.

Table 2: Comparison between Rural and Urban India[3]

	Rural	Urban
Population	700 million	300 million
GDP	$140 billion	$300 billion
Per Capita GDP	$200	$1000
Literacy rate		
Incidence of poverty	45%	36%
Teledensity (tel/100 population)	0.5	6.1

Clearly economic liberalization has positively impacted India's growth rate but the growth has been arrested by the weight of the rural economy. Large-scale participatory growth is a must for India to achieve its potential and that means that India's rural economy must be facilitated in the same way as the national economy, till such time that it becomes integrated with the national economy.

Poverty as a consequence of 'ideas and objects' gaps

At a certain level of abstraction, the proximate causes of poverty can be seen as two gaps: the *ideas* gap and the *objects* gap. The objects gap is the lack of physical resources – too little land, too little capital stock, etc – that contribute to persistent poverty. The ideas gap is the lack of knowledge about how to make the best use of the resources available. Poor people generally don't have access to know-how regarding the best way to combine their scarce resources. Rural India is therefore poor because of the two gaps. Fortunately for the ideas gap, the cost of knowledge goods has dropped precipitously due to the revolution in information and communications technologies. Bridging the ideas gap is a much easier task than ever before.

Development Trap

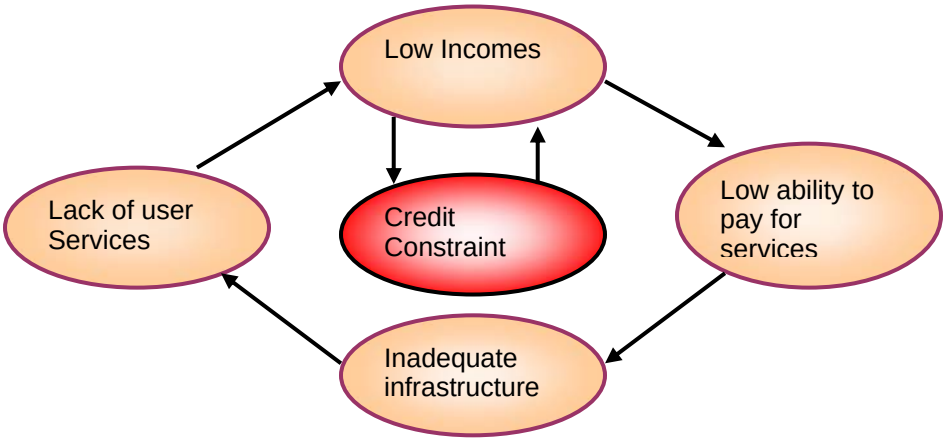
An operative analysis of the poverty of rural India would be to consider the low-level equilibrium that it is trapped in. Rural people are poor because their incomes are low. The incomes are low because of lack of economic opportunities. This leads to low effective demand for goods and services, which feeds back to low incomes. The core problem is that there is a **development trap** in which the rural population finds itself.

Consider the vicious circle: adequate levels of services are not provided in rural areas because of problems on both the demand and the supply side. On the demand side, the population has a low ability to pay for them. The aggregate

[3] Data derived from *India: Economic Development and Social Opportunity* Jean Dreze and Amartya Sen. Oxford University Press 1996

demand for services is therefore low. On the supply side, because of lack of adequate infrastructure, the cost of service provision is high. Besides, the average cost of the service is high because the quantity demanded is low. Thus, the low level of services demanded and supplied leads to high cost of services and often a total non-provision of these services.

Figure 1: Low Level Equilibrium Trap



Continuing further, the infrastructure providers don't provide their services because they cannot achieve a certain minimum scale. Lacking the infrastructure, user services are not provided.[4] Lacking user services, the population is unable to participate in profitable economic activity. This leads to low incomes and low investment and the cycle continues.

The hurdle for entrepreneurs and ideas is very high and the potential goes unrealized. Meanwhile investment makes little sense for private industry while governmental investment in infrastructure is scattered in uneconomic units at exorbitant cost. Rural electrification for example costs in excess of $10,000 per Kw and is made relatively independently of economic value to the recipient.

Communication infrastructure similarly costs far more per line, per megabit (for Internet access) or on any other metric, in rural India given the wide scattering of sites. The public sector telecommunications firm BSNL lost Rs. 90 billion (about $2 billion) in little over two years – between Oct 2000 and Dec 2002. We consider this an economic waste and a disservice to the very people it is intended to help. Road, police, education and other infrastructure costs similarly far exceed their value and the per capita cost to provide the same service in economically viable sizes. The very people who the money is being spent for realize smaller rates of return and low economic value for their share of governmental and other assistance dollars. There is no notion of a marketplace distribution or the "highest economic use" for that money or infrastructure.

[4] The proverbial 'chicken-and-egg' problem. Clearly, in this case, the infrastructure has to come first.

Clearly the rural economy has major inefficiencies in it which can and must be eliminated. That is the bad news. The good new is that, given such low levels of per capita economic activity, it should be relatively easy to make changes to the system so as to increase productivity. Even a modest 10% increase in economic productivity would mean $14 billion of additional income. This could potentially raise India's growth rate above 10%.[5] The primary focus of this monograph is to present a strategic vision of how to catalyze the growth of the rural economy.

Adam Smith's invisible hand – market mechanisms

It is easy to predict doom and gloom regarding rural India considering the sheer complexity of the development issues. But there are extremely positive factors about rural India that mitigate against the gloom. The most important among them is the rural population size. It can be convincingly argued that India's large population is its biggest liability. Paradoxically, it can also be argued that the very size admits the possibility of a bootstrapped solution for its development.

Using a chemistry analogy, we hypothesize that (see Stuart Kaufman and Brian Arthur)[6], a critical mass of consumers and producers, a "soup" with sufficient diversity of consumers, producers, ideas, skills, at a sufficient scale and critical mass will become autocatalytic. Economic activity, newly catalyzed business activity, and other surprise will emerge. Emergent behavior, surprising and unplanned, is a well known behavior of complex systems and a manifestation of the invisible hand of Adam Smith. We hypothesize that this complex system ("soup") is what is enabled in the model we propose here. The highly distributed village model is preserved but allowed to mix, via the bicycle commute of the most active ingredients (the entrepreneurs, the skilled, the ideas folk, the knowledge people, etc), so the autocatalytic economic system can emerge. The same resources, the same new investment generates disproportionately greater returns, and growth accelerates. Market mechanisms are at play, the people's needs are satisfied, diversity of demand and competition keeps innovation alive, and "appropriate" activity happens with no central planning or coordination. Given modern communication and education technology, any skills, knowledge or ingredients that can be economically leveraged from the global economy, be it tractors or genetically engineered corn, solar cells or wireless technologies, fuel cells or agricultural techniques, marketing or design help for handicrafts, the price of commodities or financial services, all automatically get pulled into the "soup" on an economic basis. It is the way, in our opinion, to leverage globalization, IN THE LOCAL CONTEXT of the rural economy, using market mechanisms.

---

[5] If the baseline growth rate is around 7%, then the additional $14 billion would add about 3% to the baseline.

[6] Brian Arthur, ``Positive feedbacks in the economy.'' Scientific American, pages 92-99, February 1990. See also
W. Brian Arthur, ``Urban Systems and Evolution'' in John Casti and Anders Karlqvist, editors, Cooperation and Conflict in General Evolutionary Processes, Wiley Interscience, 1994

People—the Ultimate Resource

People are the ultimate resource and given the right economic structure, economic development is inevitable. Endogenous economic growth is the only option for rural India. Fortunately, India has all the ingredients for success. Arguably the most important resource is trained human capital and in that respect too, India is among the best endowed. Though much of it is in urban India, it is available to be used in the rural context, if there is sufficient economic value in its use. There is a vast untapped reservoir of humanity in rural India ready to be integrated into the national (and therefore, stepwise, into the global) economy. Furthermore, that integration is urgently necessary for ethical and economic reasons[7]. Almost a million people[19] with exceptional intelligence are underutilized for lack of supporting infrastructure. It can be argued that it is possible to do well while doing good by addressing the needs of rural India. This fact would play a critical role in the proposed solution to the problem of India's economic development.

Urbanization

However, as we have noted, Urbanization of a country's population is both a cause and a consequence of economic development. The problem therefore is how can one urbanize the population of rural India without the attendant rural to urban migration? Clearly the solution is to urbanize the rural population in place. This urbanization can be achieved in place only by bringing to the rural population all the services and functionalities that are normally only available in cities to the rural area itself.

The above point bears stressing: If urbanization is inevitable and in some sense desirable, the question then is what can be done so as to retain the advantages of urbanization and at the same time avoid the problems of social dislocation and rural 'brain drain'. One obvious answer: instead of bringing the rural population to the city, bring the city to the rural population – in other words, ***in situ*** urbanization.

If resources were unlimited, it would be a simple exercise of providing every village with all the essential services and subsidizing their costs so that users could afford them. Given resource limitations, that is not feasible. Neither would a policy of evenly distributing the available limited resources amount to much because they would be stretched too thin to be of any practical use. Given the constraints, the solution clearly is to provide a **full range of essential services** to as much of the population as is optimal in some well-defined sense. The

[7] There must be outstanding scientists, teachers, musicians, innovators, poets, philosophers, reformers by the thousands in a population of over half a billion in rural India who would most likely never have the opportunity to fulfill their destiny. To neglect this fact is both ethically wrong and economically shortsighted. To seek a solution to rural economic development is almost a Kantian imperative.

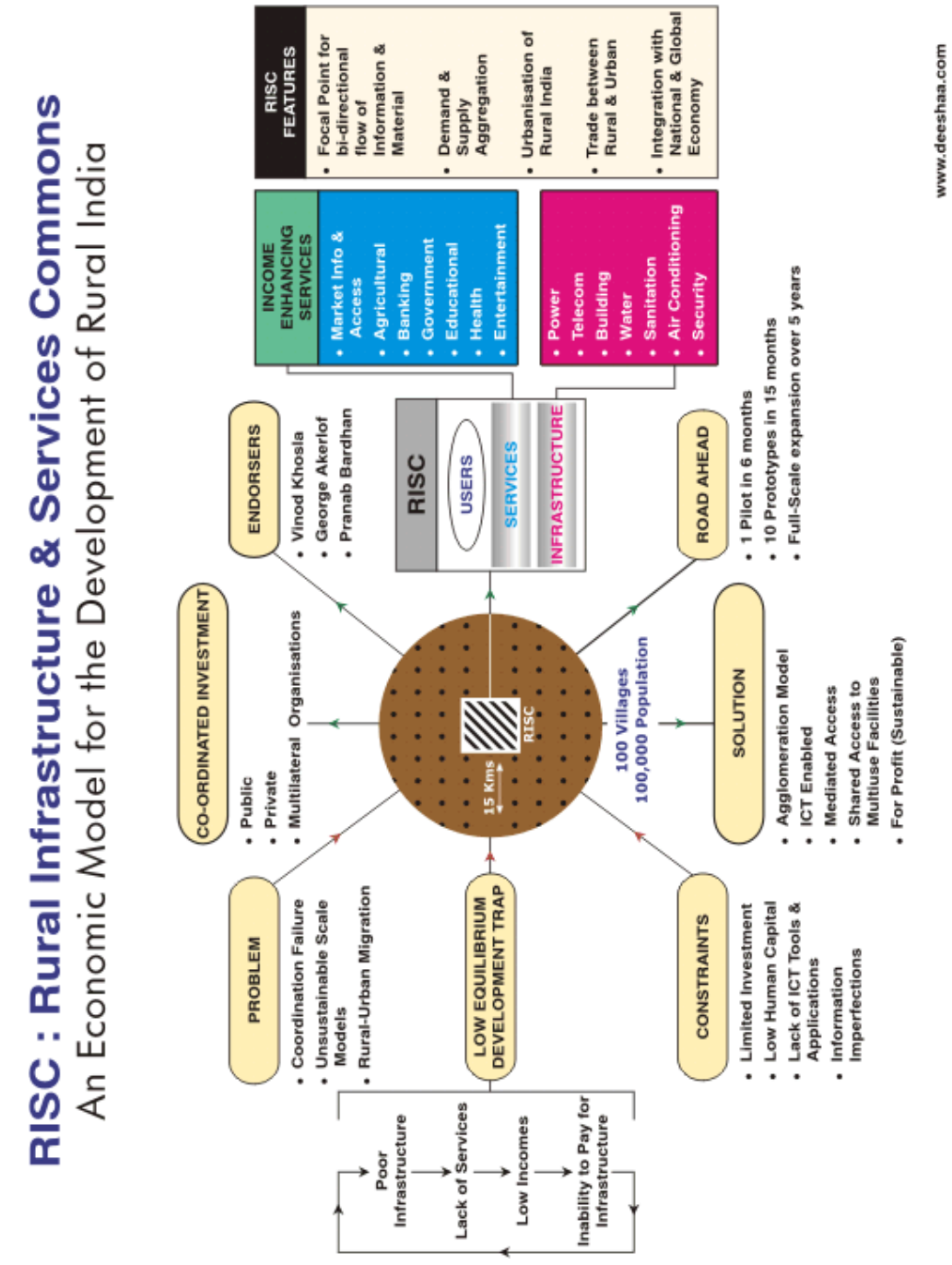
solution requires an institutional innovation, which can optimize the use of the resources , generate a high rate of return and hence guaranteeing sustainability.[8]

It is important to recognize that the problem we are addressing is multi-dimensional. There are many divides that separate haves from the have-nots, not just the digital divide.

In the following we outline an institutional innovation that holds the promise of achieving the multi-faceted goals of sustainable economic development, namely, reduced poverty, improved quality of life, enhanced opportunities for education and employment, health and well-being, for India's rural population through in-situ urbanization.
.

[8] Sustainability in this context is defined as the ability of the institution to be economically viable in the sense that the benefits must exceed the costs of the services finally rendered over a suitably defined time horizon.

RISC Schematic:



The Solution

The solution presented in this monograph in effect solves a constrained optimization problem where the constraints are:

- Limited resources
- Large population of 700 million people in 600,000 villages spread over a large subcontinent
- Very poor infrastructure in terms of power, roads, telecommunications
- Very low per capita income
- Very low literacy rates

RISC – Engines of Growth

With 700 million people in about 500,000+ villages, every cluster of 100 villages will have approximately 100,000 people. With 5000 such clusters one can cover most of the rural population. Geographically, if one was to draw 40kilometer circles one could cover the whole country with about 5000 circles. Most of the population in each circle would be about 20km from the cluster center, well within a bicycle commute of such a center. 5000 such cluster centers could provide the basis for small, but critical mass towns around which the rural economy could develop. They could provide the infrastructure for power, communication, healthcare, education and government, the services to kick start market economy, sufficient demand for a diversity of services to emerge, and in general be the catalyst, the mixing bowl for our "soup" so the system can become autocatalytic. The idea is to make available at the center of such a circle all the services and functions that are normally only available in a city. The services are available to the entire population just a **"bicycle commute"** away, with a majority of the population within 20 km, and most within 40 km of this center.

It should be noted that the exact number of such centers is not important and neither is their exact location. Much of this infrastructure exists around existing small Tier III/IV towns (about 4000 of them), the 5000 or so railway stations in the country, the 5000 "haats" or informal weekly markets that exist. The proposal here is to reinforce these sites with a focusing of most rural investment around these locations rather than scattering them in individual villages. The notion is that this focusing of the investment will result in a critical mass center for each cluster of 100 villages or 100,000 villagers rather than a larger number of sub-critical mass individual villages. The money will get a substantially higher rate of return, spurring economic growth, relative to an even more distributed model. We are in essence proposing that between the village and the megacity, there is an optimal size around 100,000 people (actually a range from 50,000 to less than 1,000,000) where current investment should be directed.

The cost of providing basic governmental and non-governmental services like housing, police protection, legal, education, information, communication, regulatory, are much lower and easier than in villages. Most people can have access to these services but they are available at a scale where if demand is small enough resources are not wasted as they would be in the context of the individual village.

A partial list of essential services (henceforth referred to as **user services**) would include

- Market making and access to markets
- Supply aggregation of agricultural and non-agricultural outputs
- Demand aggregation of agricultural and non-agricultural inputs
- Diversity of services to make an autocatalytic "soup"
- Education and library[9]
- Health care
- Banking and financial intermediation
- Telecommunications and internet access
- Governance
- Entertainment
- Legal
- Charity and social services
- Market information
- Weather and agricultural information

A common feature of these services is that they are all dependant to a large extent on information and communications technologies (ICT). The revolution in ICT has made it possible for the first time for these services to be provided at reasonable costs due to economies of scale. ICT is therefore the enabling technology that empowers the model. We want to reiterate that this model only requires a focusing of these investments away from villages to centers with sufficient critical scale, not an increase of investment or invention of new models.

The cost of these services will depend on, among other things, the cost of the inputs to provide the services and on the total amount of the services supplied. The costs of the user services (and consequently their prices) depend on the cost of core **infrastructural services** such as

- Power
- Telecommunications
- The physical plant including building, water, sanitation, security, HVAC
- Transportation
- Finance

[9] Of all the services mentioned, education is the most critical for long-term economic development. We will explore this in a separate section.

If the core infrastructural services are reliably available at low prices, the user services will be correspondingly low.

The basic function of a RISC is to provide the core set of infrastructural services reliably and inexpensively so that user services that require these as part of their inputs can be efficiently provided and optimally priced. The contention is that reliable, ubiquitous, easily accessible infrastructural services form the platform that can support a full set of appropriate services critical for rural economic development. The critical mass of consumers and producers together with cost effective infrastructure which reduces the cost of services will achieve autocatalytic criticality and hence significantly enhanced economic growth.

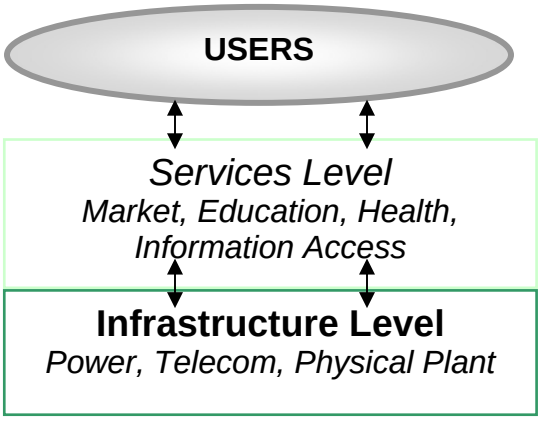
The Structure of a RISC

The world economy has seen a move away from a vertically integrated business model to one that is horizontally segmented[10]. The RISC model follows that trend. Specialization of activity is the key to the phenomenal increases in productivity of a modern economy. RISC employs the specialized services of providers to obtain scale efficiencies. It separates the infrastructural services from the user services. Enablement (and possibly standardization) of the underlying physical plant and the infrastructural services makes the services cheaper to develop and deliver.

Both for conceptual reasons as well as for operational reasons, we have separated RISC into two layers. The lower layer is the ***Infrastructure Level*** and the upper layer is the ***Services Level*** and they provide the respective services mentioned above. The two layers differ in the character of their 'industrial organization', but this differentiation is not essential to our argument.

The distinctive feature of the infrastructure level is that it requires coordination among the various firms that provide the components of this level. This layer is therefore a shared infrastructure platform and its main function is to present a standardized interface to the layer above it, the *User Services Level.*

Figure 2: The Structure of RISC



- **Infrastructure level** – This level is provided by a small set of very large providers. For instance, power is an essential service that can be economically provided only by a handful of large power corporations, or in rural India, by the government. RISC based investments, whoever the investor, will earn a higher rate of return or economic utility. Similarly, a few major firms can provide broadband telecommunications. Monopolistic or oligopolistic competition characterizes this level.

[10] For instance, in the past power utilities were vertically integrated in that the generation, transmission and distribution were all owned by one corporate entity. Horizontal segmentation has separated all those functions, mainly along the lines of whether the segments are competitive or not. The gains in efficiency from specialization usually translate into lower costs.

- **Services Level –** At this level are the user services. These services co-locate themselves on the common infrastructure platform. Market forces to a large extent dictate the kinds of services provided and who the service providers will be. Individuals, small business, larger commercial firms, governmental agencies, NGOs, and multinational agencies will provide services. This layer will be more competitive than the infrastructure layer below it, though it may be desirable, if possible, to make the infrastructure layer competitive too.

Thus the claim is that sustainable rural economic development can be achieved by providing a stable and reliable infrastructural platform upon which all essential service providers will be able to co-locate. The model is based on the recognition that providing these services to the rural population could be a commercially profitable venture. The model combines cooperation and competition amongst firms to achieve the goal of economic growth, services diversity and development efficiency. It is market-oriented and the motivating factor is competition for the rural market. It focuses the attention of corporations, NGOs, and government agencies so as to obtain economies of scale, scope, and agglomeration. These economies are fundamental to the RISC model as an engine of growth.

- **Economies of Scope:** A RISC provides a complete set of services and functions. Each service provider itself is a customer of other services co-located on the RISC. The banker uses the internet and postal services, and the internet service provider uses the banking and postal services, and so on. They make each other mutually viable and even possible.

- **Agglomeration Economies:** Benefits, savings or (average) cost reductions resulting from the clustering of activities.[11] RISC obtains *urbanization economies*, which arise from the agglomeration of populations and infrastructure facilities.

- **Scale Economies:** The average cost of a large number of RISCs could be significantly lower than the cost of implementing only a handful of RISCs. Scale economies would be significant at each level of the model. At the *infrastructure level*, there are transaction costs associated with the necessary coordination between the firms providing the core infrastructural services. At the *services level*, the cost of the services will be inversely proportional to the quantity demanded and supplied. (See Appendix A for further discussion on this point.)

  There is a fundamental assumption of appropriate scale where costs are low somewhere between the small village and the megacity. But we would argue

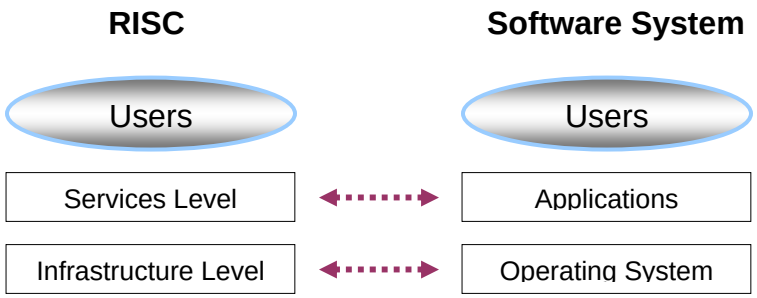
[11] Generally, the concept of agglomeration economies refers to savings or benefits derived from the clustering of activities external to the "firm" and are therefore part of "external economies". An important type of agglomeration economies is *industrialization economies*, which result from the clustering of industrial activities giving rise to clusters such as the Silicon Valley.

that independent of this assumption (and even if scale economics did not decrease above a certain size and the megacity was economically optimal), the socially optimal and feasible size is at the RISC scale with ACCESS for all villagers within a bicycle commute. We need to stop the rural urban migration and the megacity/megaslum phenomenon because of its significant costs.

The RISC model can be conceptualized in a variety of ways. We will explore some of these to better understand why it can be a suitable model of economic development.

RISC as an Operating System

The RISC model can be conceptualized as the software on a computer.



In a computer system, the software enables the users to use the hardware effectively. There are two distinct layers within the software system: the lower layer is the operating system (OS) and the upper layer the applications software. The OS layer that presents a standardized interface to the application programs that the users interact with. In the absence of the OS, each application program would have to manage the hardware itself and thus the application programs would become very big and costly to produce. The OS thus relieves the applications from doing tasks that are common to all applications. Therefore more applications are available than would otherwise be if operating systems did not exist.

The RISC model similarly distinguishes the user services from the infrastructural services. User services in the absence of the infrastructure level would be expensive because the user service provider would have to themselves make provisions to obtain power, telecommunications, the physical plant, and so on. That would detract from the actual provision of the service and make it less likely to be provided. By providing a reliable standardized infrastructural platform, user service providers can concentrate on their core function and do so efficiently.

RISC is a Distributed Model

RISC is a distributed model of the economy. In the distant past (about 40 years ago), computing power was mainly concentrated in large main frames in computer centers. That changed with the advent of the microprocessor. The availability of personal computers gave way to distributed computing. Of course, computer centers with concentrated computing powers still exist. But in addition to that, PCs provide computing facilities close at hand and people have to access mainframes much less fro a given amount of work.

The other development was the networking of all these computers into the Internet and the worldwide web by integrating computing and communications

technology to yield distributed networked computing. The genius of worldwide web is that it is (a) distributed, and (b) standardized. The advantages of being distributed are that it is safe from single-point failures.

The RISC model can be understood analogically to consist of a large set of networked rural centers (the PC analog) that are also linked to the large cities (the mainframe analog). A similar revolution in the trajectory of urbanization could be engineered. Instead of continuing to enlarge the existing cities to accommodate the influx of rural migrants, the present proposal aims to 'distribute' a mega-city by creating 'micro-cities' in rural India. These micro-cities can be networked to create a virtual mega-city which would have many of the agglomeration economies that real mega-cities have.

The Economics of RISC

The objective of a RISC is to provide as complete set of services as possible sustainably. Sustainability essentially imposes the condition that user fees (demand) have to cover the cost of the services delivered. Given the low average income in rural India, per capita demand for many of the services can be expected to be low. However, rural populations are heterogeneous in their demographic characteristics. A small but significant section of the rural population would be able and willing to make use of the services. Besides, there is a significant **dynamic income effect.**[12]

The flow of incomes is straightforward in the model. Users pay for the services they need. The services are assumed to provide a net benefit to the users. The service providers in turn use infrastructural services and pay for them. The provision of services that are relevant to rural economic development, and do so efficiently, is the basic objective of a RISC.

The per capita demand for any single specific service in rural India has to be very low in keeping with the low per capita incomes. The RISC model derives its sustainability by aggregating the demand for a variety of services over a sufficiently large population. Thus the total amount of services required is a function of the aggregate income of the population rather than the per capita income.

If we assume an average daily per capita income of $1,[13] then the annual income of the 100,000 target population of a single RISC is about $36 million. Assuming that the presence of the RISC actually increases productivity and economic efficiency so that the economic output of the population goes up by 10%, the increase in economic output will be roughly $3.6 million. Assigning half of this

[12] The dynamic income effect is explored in a later section. It is the increase in income that accrue from the use of the services, and which increase would not be possible in the absence of these services. In other words, the consumer surplus is positive.
[13] The $1 a day per capita income is meant to be illustrative. Each region has a somewhat different number.

increased output as increased income to the population leaves nearly $2 million per year to pay for the services available at the RISC. The annual gross revenues per RISC will be around $2 million and the aggregate revenues for about 6,000 RISCs is approximately $12 billion per year.

The figures above only take into account the direct effect of RISC on the economy. This is only a partial analysis as there will obviously be a multiplier effect on the economy. Taking a conservative multiplier of about 2.5, the total effect of 6,000 RISCs will be about $30 billion in the initial years alone. However, realistically it may be that initially only a few states in the Indian union will be the early adopters. Assume that only about 2,000 RISCs are implemented in the first phase. Therefore the direct effect on the economy will be about $4 billion and the total effect on the GDP will be $10 billion.

Given annual gross revenues of $2 million per RISC, and assuming that profits account for 15% of gross, then given an interest rate below 15%, the investment per RISC can be up to $2 million. Given that land is relatively cheap in rural areas, that does amount to a lot of basic infrastructure in terms of investment in power, telecommunications, the physical plant and so on.

If we assume a conservative average annual per capita income of the rural population to be about Rs 8,000[14], then the annual income of the 100,000 target population of a single RISC is about Rs 80[15] crores. Assuming that the top 10% of the population account for around 30% of the income, and that the presence of a RISC increases their incomes by a modest 10%, then the direct impact of a RISC would be an increase in the output of about Rs 2.6 crores per year. Assigning half of this increased output as increased income to the population leaves about Rs 1.3 crores per year to pay for the services available at the RISC. The annual gross revenues per RISC would then be Rs 1.3 crores.

The cash flow (in Rs Crores) is illustrated in the following table. The infrastructure costs of the user service providers is the revenue of the infrastructure providers as shown in the table below.

	REVENUES	COSTS	PROFITS

[14] The current (June 2003) exchange rate is US$1 = Rs 47 approximately. For back-of-the-envelope calculations, Rs 10,000 is around $200.
[15] One crore = 100 lacs. One lac = 100,000. So one crore = 10 million. A useful approximation is that Rs 5 crores is $1 million.

SERVICES	Rs. 1.3		
Infrastructure		Rs. 0.6	
Salary etc		Rs. 0.5	
Profits			Rs. 0.2
INFRASTRUCTURE	Rs. 0.6		
Costs		Rs. 0.4	
Profits			Rs. 0.2

The table above shows that revenues to the S-level entities are a total of Rs. 1.3 crores. These service providers incur infrastructure costs (Rs 0.6 crores) and operational costs such as salaries (Rs 0.5 crores). Their profit is therefore Rs. 0.2 crores. For the I-level, the revenues are Rs 0.6 crores of which their costs are Rs 0.4 crores and their profits are Rs. 0.2 crores.

Sources for Investment in the Infrastructure Layer

The most critical question regarding the implementation of RISC is about the source of the investment required for the infrastructure layer. The costs are significant. Assuming the capital costs of each RISC to be $1 million, then 5000 centers, enough to entirely saturate rural India, would cost $5 billion. While it is a large number in absolute terms, it is only about a percent of the annual GDP of India. Much of this investment is already being made, and we contend, somewhat inefficiently.

The central concept of RISC is that it is a market-based approach that requires the participation of the government (at national, state, and local levels), the private sector, NGOs and multinational lending institutions. Each of these have different (albeit overlapping) interests in broad based rural economic growth and therefore have an incentive to participate in the implementation.

The government has an incentive to expand social and economic opportunities in rural India. To that end, it already invests significant amounts in rural development. At the central level, the government already spends nearly 3% of GDP for various subsidies. The solution we present operationalizes the efficient deployment of the resources that are already being spent. Infact only a partial redirection of the current spending would in our view have a significant impact. Further it would attract additional investment from non-governmental sources if criticality is achieved.

For instance, the universal service obligation (USO) funds that are generated internal to the telecommunications system are estimated to be around $350 million for the year 2002—2003.[16] These funds are meant to support telephony

[16] The Financial Express
http://www.financialexpress.com/fe_full_story.php?content_id=5544

in rural and remote areas of India. Clearly, if these funds were made available to provide reliable broadband telecommunications to the RISCs, it would go a long way towards bringing services to the rural areas.[17]

The private sector has also been investing in rural India. For instance, Mukesh Ambani of Reliance Industries has stated that bridging the digital divide is a corporate goal. Reliance Infocom plans to lay down a digital distribution system that will connect 1,500 cities and towns in 18 states and link half a million villages. Other private corporations are also investing in a wide variety of activities in rural India.

By focusing the investment of various actors around these RISC centers, it is possible to gain the economies of scale, scope, and agglomeration. This agglomeration will also serve to mitigate risk in the investment.

Macroeconomic Consequences of Implementing RISC

Conceptually India can be neatly divided into rural and urban India. Urban India is clearly better endowed compared to rural India with factors that are required for economic growth in terms of the levels of human capital, technology, administrative resources, access to capital, etc. Rural Inida is less well endowed. However, once the catalytic function of the initial investment is done, the process of rural economic development will be self-sustaining. There is a remarkable illustration of the benefits of catalyzing growth about half a century ago.

"Marshall Plan" for Rural India

The Marshall Plan for the reconstruction of Western Europe after the devastating effects of the Second World War was proposed by the US Secretary of State George Marshall in 1947 in a commencement address at Harvard College that many consider to be one of the most transforming speech of modern times. For the next four years, participating countries were gives grants and loans amounting to $17 billion (about $100 billion in current dollars) that were used to restore their industrial and agricultural production. The countries registered increases in their gross national product ranging from 15 to 25 percent.

While there was a component of humanitarianism in the Marshall Plan, the motivation was not entirely altruistic. The US had a compelling interest in the economic and political stability of Europe as a means to its own security and prosperity. People in the US feared the return of financial troubles and

[17] Of course, doing so could mean diverting resources from the plan to provide a phone to every village. The experience of the last few decades of providing village phones does not speak too convincingly about the efficacy of such spending. Nearly fifty percent of the villages don't have phones and for those that do have phones, the reliability is extremely low.

unemployment of the 1930s. The Marshall Plan was intended to increase US prosperity as well by boosting exports and thus increasing employment for Americans from bankers to farmers. Much of the money Europeans received was spent on goods produced by the US and so the US economy flourished. The Marshall Plan delivered gains through the trade links that were forged between the US and Europe.

In a sense, rural India requires a sort of Marshall Plan in which the resources of urban India are mobilized to the mutual benefit of both areas. Similarly gains can be anticipated from the implementation of RISC.

Sequencing of the Implementation of RISC

The whole of India can be theoretically covered by 5000 or so RISCs. However, for practical purposes, it would be most useful to implement RISC a few states at a time. Locating a few hundred in a few states could be the first phase. Although there would be considerable standardization in the implementation, there would be sufficient regional variations so that valuable lessons can be learnt that would help in the design and implementation of RISC in late adopting states.

Implementing RISC in a number of states would also induce a spirit of competition among them to see which state does the best.

The Benefits of RISC

Essentially the innovation that we present in this monograph arises from the recognition that there are a large number of very pressing problems that need to be urgently addressed. The solution to a comprehensive set of problems has to be equally comprehensive for it to be successful. We briefly outline a few of the problems that RISC solves.

Rural-urban Migration

RISC would slow down the rural-urban migration and could reverse it as well. People are forced to migrate in search of economic opportunities. It is often the most educated among rural populations that migrate to cities and thus are a drain to the rural economy. RISC would be a most attractive location for the educated rural people to look for employment. They will be able to facilitate and mediate the interactions between the services and the rural population.

Housing, Police, health, Education, Real Estate and other Services

Over the next 15 years, India would need something like 50 billion sq ft of new housing and billions of sq ft of commercial construction. Much of this will have to be located in currently rural areas. The required investments will be astronomical.

Therefore the need for coordination, allocation of capital, logistics etc. is critical. Since real estate requires inputs from various sectors of the economy, the features of RISC, such as economies of scale, scope and network are ideally suited to this end. Affordable housing will be a very big issue. RISC can help focus the efforts of providing affordable housing in rural India.

Multiple Use of Facilities

Because RISC would concentrate a lot of different services at the same location, it would be easy to share many common resources. For example, consider the computing facilities and internet facilities. They have multiple uses from education and training to conducting business and market access. Distance education classes on a wide range of topics could be delivered. At other times, the same computers connected to the internet could be used for business purposes.

Economies of Scale in Manpower Training

Training manpower is one of the most expensive activities in any enterprise. Fortunately, the average costs of this decrease the more people that need to be given some standardized training. Since every service will be provided over hundreds of locations, it will be possible to train people in large batches and thus reduce the cost of training. One can imagine private training firms such as NIIT providing these services. More training and education firms will become viable.

Retention of Manpower

Because a RISC concentrates a lot of different activities in one location, people would be more inclined to be located in the rural area. Thus a doctor serving in the health center of the RISC would find that he or she has access to most of the services that he would have expected in an urban area and so be more likely to be there. The same would go for school teachers, and bank employees, and so on.

Identifying and Encouraging Entrepreneurs

The fuel that powers any modern economy is the pool of entrepreneurs in it. Among the 700 million rural population of India, there must be *hundreds of thousands* of latent entrepreneurs.[18] Not just that, there must be potentially

[18] Statistically, in any normally distributed population, about 0.135% of the population is three standard deviations above the average. The most talented people in any profession or art are the ones that are in that small group. In a population of 700 million that represents 945,000 people.

world-class artists, doctors, scientists, engineers, economists, dramatists, film makers, philosophers, mathematicians, etc., in that huge population. It is an unimaginable loss to the nation and to the world at large that simply because we lack the resources to empower the proper tools and the training, they never achieve their potential.

RISC provides a simple cost-effective method of discovering this talent. Being just a bicycle commute away from every rural person, it draws those that are the most motivated to it and makes available the resources that they need to develop. It puts our limited resources in the hands of those best able to use them.

Market Access

The non-agricultural production of rural India is extremely diverse. The internet has lowered the barriers significantly for market access. Even small producers of handicrafts can reach consumers all the way across the world. Information about products and their characteristics that suit the market most will help in driving the rural economy to produce what is needed. This will generate employment and preserve traditional skills, while tuning them to national and global demand.

Conclusion

The Power of Emergent Systems

The problem of the economic development of large underdeveloped economies present unique challenges that require innovative solutions. Human societies are complex adaptive systems and any attempts to impose top down solutions on human societies has destructive consequences. As Nobel Laureate Murray Gell-Mann, the founder of the Santa Fe Institute wrote, “Only through education, participation, a measure of consensus, and the widespread perception by individual people that they have a personal stake in the outcome can lasting and satisfying change be accomplished.”[19] The end goal is a higher rate of return and the RISC model facilitates this.

In an age of increasing specialization, there is a critical need for integration to supplement the specialization. Economies are complex, nonlinear systems and just as they cannot be adequately described by partitioning them into subsystems and analyzing them piecemeal, so also their problems cannot be addresses by partial interventions. This is because the subsystems of complex non-linear systems interact strongly with one another, and even the most carefully thought through partial solution often fails to achieve its intended goal.

The aim of this monograph is to address the problems one such complex nonlinear system – the rural Indian economy – and to outline a solution that addresses the problem of economic growth comprehensively by accomplishing a set of interlinked transitions to a more efficient equilibrium. Economic development is multi-faceted – demographic, technological, social, political, military, institutional, informational, ideological, and so on. Given binding resource constraints, the optimal solution requires the power of ideas for it to be feasible. It requires a “soup” of sufficient diversity to be autocatalytic and using the power of local knowledge, self-interest, and micro-optimization to have positive “emergent” phenomenon.

Paul Romer has observed that:

> Economic growth occurs whenever people take resources and rearrange them in ways that are more valuable. ... Every generation has perceived the limits to growth that finite resources and undesirable side effects would pose if no new recipes or ideas were discovered. And every generation has underestimated the potential for finding new recipes and ideas. We consistently fail to grasp how many ideas remain to be discovered. [20]

[19] Murray Gell-Mann *The Quark and the Jaguar: Adventures in the Simple and the Comples* W H Freeman and Company 1994

[20] Paul Romer “Economic Growth” http://www.stanford.edu/~promer/Econgro.htm

Ideas matter and sufficiently large problems require sufficiently 'big' ideas. We intend to enable this power of ideas fueled by entrepreneurial energy. Resources will be used for their highest economic use, optimizing growth. To quote Romer again:

> We do not know what the next major idea about how to support ideas will be. Not do we know where it will emerge. There are, however, two safe predictions. First, the country that takes the lead in the twenty-first century will be the one that implements an innovation that supports the production of commercially relevant ideas in the private sector. Second, new meta-ideas of this kind will be found. … Only a failure of imagination, the same one that leads the man on the street to suppose that everything has already been invented, leads us to believe that all of the relevant institutions have been designed and that all of the policy levers have been found. For social scientists, every bit as much as for physical scientists, there are vast regions to explore and wonderful surprises to discover.[21]

The foundational idea upon which the proposed solution stands is that of the emergence of complex adaptive behavior from the interaction of agents following simple rules within a sufficiently rich environment. The solution provides a balance between the forces of cooperation and competition, between standardization and specialization, between private and public action, between generalization and particularization, between globalization and localization, between unity and diversity. It is an idea that is at once both blindingly obvious and fleetingly elusive.

[21] Paul Romer. *ibid*

Appendix A

Exploring the RISC model

In this section, we address a set of frequently asked questions in order to explore the concept in greater detail.

Coordination Failure of the Market

Question: *This is an intervention in the working of a free market. What is the market failure that justifies this intervention?*

Mainly it is coordination failure. The providers of each of the infrastructural services do not invest in the rural areas because they perceive very limited demand for them. The static demand analysis done in isolation with respect to any one specific infrastructure service would understandably conclude that sufficient demand does not exist. However, if across the board infrastructure were to be put in place, there would be sufficient demand for them all because of externalities. This market failure leads to an under-investment in infrastructure.

Consequently because of very poor infrastructure, it is very expensive to provide services that could be of use to the rural population. Conversely, if the infrastructural services were reliably available, then the provision of user services could be expected. These user services would increase economic opportunity and thereby increase incomes. With increased incomes, the population would be able to afford the services. The services in turn would support the provision of the infrastructural services.

The first move to initiate this virtuous circle is clearly to provide a reliable basic infrastructure. As there are different dimensions to basic infrastructure – power, telecommunications, the physical plant, and so on – there is the same possibility of a coordination failure as well. All the components have mutual dependencies. Therefore the providers have to commit to investing in these areas simultaneously.

The concept of RISC addresses this coordination failure by an institutional design that requires that the investment decision of the infrastructure providers be coordinated by some entity – perhaps the government or some consortium of private companies with the support of the government.

Once the investment in the infrastructure layer is made, service providers will co-locate on that platform to supply the services that the rural population needs. Most importantly we only propose a more efficient redirection of the investment currently being made in infrastructure.

Emergent Properties of the Market

Question: *Is this not the same old failed strategy of central planning?*

We do understand that centralized planning has never worked for large economies. There is sufficient evidence of the failure of centralized planning in India also. State intervention and central planning has been the problem and can hardly be recommended. However, RISC does depend on planning.

Planning is an indispensable prerequisite for any venture, however small. Even in the most liberal of market economies, there has to be planning at some level. For example, the San Francisco International Airport did not spontaneously arise fully formed out of the Bay like Athena from Zeus's head. It was planned for after due consideration of demand and supply of airports in the area. The infrastructure that the airport represents was fully planned. What was not planned and left totally to the market to determine is who will use the facilities and what the price of the service provided by the facilities will be. The market determined which airlines use the facilities and the routes that they fly.

Similarly, the building of the RISC infrastructure layer requires careful planning and coordination. It requires a great deal of investment. But the planning will be done by the stakeholders such as providers of the infrastructure level and not by some giant bureaucratic machinery. Market forces will determine who will be involved at each level of RISC and the primary goal of most of the firms will be profit oriented.

So in a sense there will be centralized planning but it would be done by the various stakeholders so that their investments can be coordinated. But it will be left entirely up to the market for services to determine the services that will be offered, the amount of services offered, who will be the providers and the price of the services.

Therefore the provision of the services will be an emergent phenomenon that does not require planning.

Altruistic and socially responsible investing may play a role but need not be the main motivation. Adam Smith’s invisible hand will be relied upon to do deliver the social benefits.

Initiating the Cycle

Question: *Who will be the prime mover to initiate the development? Who will invest initially and do the coordination? What sort of consortium will build the RISC?*

The prime mover has to be a consortium of a set of reasonably large private corporations. The first step would be for these corporations (basically the players at the infrastructure layer) to credibly commit to their part of the investment. Noting the credibility of the investment plans, other private and public firms that are providers of the user services will move to set up shop on the RISC locations. Again , initially, we only propose a redirection of the current investment in infrastructure that the government is making.

Comprehensive Approach

Question: *There are a lot of problems what need to be solved in rural India. Why not concentrate on just one for now and then work on the rest later?*

Problems do not exist in isolation. There are important linkages between them and if you wish to solve only one of them, it may not only be impossible, but it could even be harmful, to just address only one of them.[22] Given a set of interrelated problems, the only way may be to solve them all at once. In other words, you cannot leap across a chasm with many small steps: a big leap is required. We propose market mechanisms through enablement of core infrastructure, and concentration of resources that entrepreneurs may need.

Opportunities Ahead

Question: *If it is such a great idea, why hasn't it been implemented already? Could it be because the opportunity does not exist in rural India?*

This is the classic '$50 bill on the sidewalk' question as the economists call it.[23]

If there are $50 bills lying around in rural India, why they have not been picked up yet? There could be a number of reasons. It could be myopia, for instance. If everyone reasoned like the professor, it can continue to sit on

[22] See the *"Theory of the Second Best"* for instance. Also, note what is called the *First Law of Ecology*: 'You can never do only one thing.'

[23] Two economics professors were walking along one fine day when they notice a $50 bill on the sidewalk. The younger one is about to pick it up when the older professor says, "Don't bother. The bill is obviously fake because if it were real, someone else would have picked it up." Convinced by this, they carry on with their walk discussing theoretical matters of great import, leaving behind a possibly real $50 bill on the sidewalk. If everyone were to reason like that, it is possible to find real $50 bills on the sidewalks.

the sidewalk. However, that may not be the complete explanation for this. Perhaps it requires the concerted effort of many people to pick it up. And absent that coordination, no single person can pick it up. Perhaps it is an instance of the prisoner's dilemma problem. Perhaps it is a lack of appreciation of the dynamics of endogenous economic growth. Perhaps it is a combination of all of the above and more. We argue that the time has not been right until now. It is only now that the enabling technology – information and communications technology – has become sufficiently mature that the barrier to rural economic development has become surmountable.

Business leaders and other academic gurus have been pointing out the opportunities that exist in the largely underserved rural population of the world.

Question: *So RISC is an infrastructural platform that provides utilities and above that is the layer of services. Who owns the building and who invests to build such a plant? Where does the capital come from?*

A consortium of companies that provide the components of the infrastructure will build the infrastructural layer. Power corporations, telecommunications giants, national and state governments, multinational organizations such as the World Bank and the IMF—all may be involved in the initial funding of the infrastructure.

As an analogy, consider how an airport operates. Some entity (private or public) finances the infrastructure and then airlines (these are the service providers) pay for the use of the infrastructure. There is a large sunk investment in the infrastructure but if done properly, the cost of the infrastructure can be recovered within a reasonable time.

Question: *Who will decide what sort of services will be offered?*

The market will decide to a large extent. As was already mentioned, a RISC will be a focal point for bi-directional flow of information and material. All imaginable services related to this will be available at a RISC. For instance, for agricultural activities, services which increase the efficiency of the delivery of inputs such as seeds, fertilizers, pesticides, etc will be provided. Essentially buying and selling of agricultural inputs and outputs will be core activities. Other important activities will be education and financial intermediation discussed in greater detail below.

Question: *Are there some 'killer applications' that can transform the rural economy?*

Indeed there are. They are **distance education** and **financial intermediation**.

Education of the population is not only a highly desirable social goal, it also plays an instrumental role in development. India has a very large illiterate and under-educated population. The human resources required for the job of educating such a large population is formidable. What makes the solution even remotely feasible is the technology of distance education. This application very clearly illustrates the advantages of ICT for delivering development.

The content for educational courses could be developed at elite educational institutions such as the IITs. Content development is expensive. However, because it can then be delivered to millions of people through RISC centers, the average costs will be manageable. Given excellent course content, the requirement at the RISC will be for facilitators. Again, since one can imagine that thousands of facilitators will be required, the training of the facilitators themselves will benefit from scale economies. Potential partnerships can be imagined. For instance, the IITs could develop the content and firms such as NIIT do the training of the facilitators. That is where **scale economies** are obtained in just one of the many applications of RISC. Education, and sometimes just information, will be deliverable in small relevant chunks, possibly by facilitators (drawn from the national economy), on an economic basis, to supplement any government programs.

Taking the example a little further: the facilities that are used for providing distance education can be shared by other applications. For instance, another firm that provides market-making internet services can use the same computing facilities that deliver distance education. This is how **economies of scope** are obtained.

The other star application is **financial intermediation**. Granted that rural incomes are low. Yet the population has some savings. Most often these savings are held either as cash or converted into gold. Thus these are never aggregated and so they are not available for investment. In fact, the rural population suffers from credit constraints and often has to borrow at exorbitant rates from moneylenders.

Imagine that banking is made universally available to the rural population and the benefits of putting their savings made clear to them. Imagine that appropriate technology such as Smart Cards is used to bring the benefits of banking to them. The aggregate of small savings itself would be sufficient to fund much of the required investment for infrastructure.

Much has been written on microcredit. The RISC approach will make microcredit more effective and more in demand. RISC might even increase capital formation for microcredit.

Question: *How will a villager, whose daily income is barely $1 per day, afford these services?*

It is true that a villager whose income is $1 will not be able to consume $2 worth of goods. But we are not talking of consumption goods here. The services we are talking about are inputs for production and these actually raise the incomes of the users and therefore the user is willing and able to afford the user fees.

Let's take an example: a villager will not be able to afford the use of a cell phone to have a nice friendly chat. It is a pure consumption expense that he does not have the discretionary income for. But he will be willing and able to use the cell phone to find out which market he should take his production to so as to get the best price that day. By spending Rs 30 to make a cell phone call, he may increase his income that day by Rs 100. So he comes out ahead by Rs 70 by using a service. Fishermen along the Kerala coast have been using their cell phones to figure out where to land their catches so as to get the best price for their fish.[24]

Question: *Even if these high technology services are available, using them requires some degree of literacy and sophistication that is not there in the average rural person. How do we solve that problem?*

The solution is to have what we can call **mediated interaction**. While it is true that the average villager is not sufficiently literate, the rural population is heterogeneous. In any sufficiently large rural population, there will always be people who are educated and who are able to learn quickly. Some of these people are normally forced to migrate to urban areas in search of appropriate work because of lack of opportunities to use their skills in rural areas. So here is a solution that kills two birds with one stone. First, they need not migrate to urban areas just because they have advanced skills which they cannot use closer to home. This solves the problem of rural 'brain drain'. Second, we have local people who can mediate the use of the technology for the local population. On the one side they can speak the local language and appreciate the local problems; and on the other side they can interact with the tools of advanced technology such as computers and internet. Given the presence of a RISC will act like a magnet and may start a flow of people from the urban to the rural area. After all, rural areas have benefits of cheaper housing, low pollution, family ties, and so on.
It should be emphasized that there are many non-technical products and services that are also facilitated.

[24] Such stories abound. Another story is that of a woman in Rajasthan. She asked someone to put some of her handicrafts on the web. Some buyer from a major department store in England saw it and ordered a few thousand neckties with traditional Rajasthani mirror-work. The increased income from that sale more than paid for the cost to her for getting someone to put her craft on the web.

Question: *Some of the services such as education and training will not increase the output right away. So the assumption of ten percent increase in output right away appears too generous. How can you justify that?*

We have to distinguish between long term and short term effects of RISC on the economy. In the short term, there are incredible opportunities that can boost incomes by simply reducing the existing inefficiencies in the system. This is possible because the system is far from optimized. So in the short term we do 'cherry picking' or going for low-hanging fruit. Because it will take some years before the low-hanging fruits are picked, it will give us sufficient time for the long-term effects to start bearing fruit.

Consider the following:

1. Agricultural inputs: These are a major cost to the rural people. If the markets for these were made more efficient, the benefits would be phenomenal.

2. Agricultural output: If these were to have a more efficient market, again significant increases in incomes can be obtained. Reports indicate that unto 40% of produce is wasted in India. Imagine reducing that wastage by even 10%. The savings would add up to billions of dollars, more than paying for the infrastructure costs.

3. Non-agricultural outputs: Globalization has made the world a market for the non-agricultural output of India. The handicraft of India is immensely varied and valuable. All it needs is some way of bringing the output to the world. Fortunately, the internet has reduced the barriers to market entry and therefore potentially increased incomes.

So in the short term, there are immediate opportunities that can be profitably addressed and these will have **spillover effects** that can lead to long term opportunities.

Question: *What are some examples of spillover effects?*

There are numerous spillover effects. One of the most significant is that of increasing human capital. By enrolling the rural population in the provision of the services that rural population need, it increases the returns to education. The increase in human capital itself will more than pay for the investment in the physical infrastructure.

Appendix B

ICT and Development

ICT presents the opportunity for developing countries to make the most efficient use of the resources available. However, ICT is neither necessary nor sufficient for economic development. Clearly the advanced industrialized countries were underdeveloped (by today's standards) once upon a time and their transition from subsistence to a modern exchange economy did not involve ICT.

In contrast to the experience of the advanced industrialized countries, the developing countries find ICT available to them at a much earlier stage of their development. These economies don't have very well optimized economies and the use of ICT has the potential to help them transit from a subsistence to an exchange economy relatively rapidly. For this to happen, ICT must be targeted for domestic use, and not just seen as an avenue for foreign exchange earnings.

ICT is arguably strategically important for economic growth of all less developed countries (LDCs). However, government policies tend to emphasize the export-led growth potential of ICT. The India's success in the IT-export sector is often used as an example to be emulated by countries similarly placed along the development spectrum. It is important to recognize that while IT export-led growth is an attractive goal, it is not as relevant for sustainable economic growth for rural India. A policy that stresses the use of ICT within the country will lead to the development of an IT industry that can serve as an engine of growth by its direct contribution to job creation and GDP growth in rural India, in addition to its contributions to the urban economy. Though not covered here, other appropriate technology can also have a multiplier effect on resources available.

Production versus Use

The production of IT related products and services targeted for export markets is generally done in high-technology enclaves. The benefits of the production and the use of IT is therefore limited to the small number of producers in the LDC while the majority of the benefits accrue to the users of the products in the importing developed countries. The products address the needs of the importing countries and they gain significantly from the use of IT produced at low cost in the LDCs.

Increasing the Digital-divide

While the IT-export sector may be earning foreign exchange through IT production, there is no benefit from the use of IT products and services to the country as a whole. The vast majority of the people are completely unaffected and do not obtain any gains from the use of IT; only the producers of the IT

products increase their human capital. Consequently, the digital-divide within the country itself grows.

ICT for Sustainable Economic Growth

For economic development to be sustainable, it has to be broad-based. IT-export led growth alone cannot result in broad-based growth because the knowledge-goods produced by the country are targeted not to a domestic market but to an export market.

Economic growth models emphasize the importance of capital – both human and state of the technology – and on the dependence of growth on the size of the market. We view IT in this context as an enabler of "IN CONTEXT" facilitator of training, information, and other services for the economic delivery of services. Domestic demand for IT products and services will spur the domestic production of IT and knowledge-goods. There are important forward and backward linkages in the domestic consumption of IT products and services that go beyond the benefits attained by IT exports alone. For instance, the use of IT in the education and health sectors will provide a large user base which will not only have access to new technology but also participate in the information economy.

Evidence of the effect of ICT on Economic Growth

Is there any hard evidence that ICT has an effect on growth? Most of us believe that the ICT does have a positive effect on growth. In a recent book[25], Matti Pohjola reports that The Working Group of the United Nations Commission on Science and Technology for Development[26] recommends that each country establish a national ICT strategy aiming at maximizing the benefits of ICTs and minimizing their risks. He concludes that

> "… in recent years IT has had a strong influence on economic growth in industrial countries and at least in those newly industrialized countries (that is, Korea and Singapore) studied in this volume. Admittedly, however, developing countries seem to have neither invested in IT nor benefited from such investments to the same extent as industrial countries. There is concern that information is becoming a factor, like income and wealth, by which countries are classified as rich and poor. To prevent this from happening, developing countries need to formulate national IT strategies to promote the use of these new technologies."

It can be argued that more than the production of IT goods and services, the use of IT goods and services is more critical for economic growth. The question whether ICT contributes to growth or not is akin to the question whether transportation contributes to growth. Both are instrumental and provided that they

---

[25] "Information Technology, Productivity, and Economic Growth: International Evidence and Implications for Economic Development" ed by Matti Pohjola, Oxford Univ Press, 2001.

[26] UNCSTD 1997

are used appropriately, growth will be enhanced. Investment in ICT for developing countries is not anymore an option than investing in a transportation network is an option. It is absolutely necessary, although it is far from sufficient to ensure growth.

The two most important functions for ICT are these. First, improving the functioning of markets. What to produce, how to produce, what to sell, how to sell, where to sell – all these are critical questions that directly affect growth. Clearly ICT is indispensable for this function. The second function is in the area of production and delivery of educational content. When the majority of the population is illiterate, the resources needed for educating them (and not just making them literate) would be formidable. ICT provides the only hope of leveraging limited resources to address this problem.

The proximate causes of poverty can be seen as two gaps: the ideas gap and the objects gap. The objects gap is the lack of physical resources – too little land, too little capital stock, etc – that contributes to persistent poverty. The ideas gap is the lack of know-how about how to make the best use of the resources one has. It is the ideas gap that ICT can most effectively bridge.

The Case for India

India has had a reasonable amount of success in the export of ICT products and services. From the UNDP's Human Development Report 2001, page 37:

> **India's export opportunities in the new economy**
>
> What real promises does the new economy hold for developing countries? The explosive expansion of global ICT has triggered new opportunities for niche activities. In India the industry generated $5.7 billion in 1999, 15 times the level in 1990, and exports rose from $150 million in 1990 to nearly $4 billion in 1999. One study estimates that this could rise to $50 billion by 2008, leading IT to account for 30% of India's exports and 7.5% of its GDP. Employment in the software industry is projected to rise from 180,000 in 1998 to 2.2 million in 2008, to account for 8% of India's formal employment.
>
> ICT has created new outsourcing opportunities by enabling services to be provided in one country and delivered in another. Delivered by telecommunications data networks, the services include credit card administration, insurance claims, business payrolls and customer, financial and human resource management. The global outsourcing market is worth more than $100 billion, with 185 Fortune 500 companies outsourcing their software requirements in India alone. India now has 1,250 companies exporting software.
>
> India shows why public policy is important. By providing

education for IT—India's English-language technical colleges turn out more than 73,000 graduates a year--and investing in infrastructure (especially high-speed links and international gateways with sufficient bandwidth), the government has ensured India's place in the new economy. These efforts will deliver long-term benefits for human development and equitable economic growth.

Source: Landler 2001, Reuters 2001, Chandrasekhar 2001

It is important to note that only export related IT activities show up above. Until IT is used, it is hard to predict what exactly the impact will be. However, it is a reasonable expectation that IT cannot but have a beneficial effect by its use.

Domestic ICT use must be given the attention it deserves because only through broad-based ICT use can the benefits of modern technology be made available to all and bridge the digital divide. Domestic use will have important linkages to the supply of human capital required for the export of ICT products and services.

For a large country such as India, domestic demand for ICT products and services can provide the necessary base for sustaining the industry and to shield it from external shocks. Therefore, India must create the institutions that encourage the use of ICT domestically. Initial use of ICT might be in Egovernment which has many auxiliary benefits too.

.