**Iceberg Technology**

Every student of international trade theory must have heard of the "iceberg technology." If you haul a ton of ice from country A to country B, only 900 kg remains by the time it arrives in the destination. The iceberg technology is a vivid metaphor for transportation cost. It is an especially convenient modeling device if we want to assume that transport costs are proportional to the value of the good being shipped.

Some economists thought the iceberg technology was introduced by Paul Samuelson. Wrong. The imagination of economic theorists pales in comparison to practical businessmen. The idea of hauling ice from one country to another was conceived by a Boston merchant Frederick Tudor in the early nineteenth century. It was a wild idea at that time as it is today, but Tudor proved everybody wrong and made a thriving business out of it. He even obtained the highest form of flattery: competition from imitators.

The Boston area is full of ice in winter. Tudor would order his workers to cut ice blocks from Fresh Pond in nearby Cambridge, haul them to the port, ship the ice to Havana, and sell it to the locals. His first cargo to St. Pierre in the West Indies took twenty days to arrive. Not that much melted on the way, so Tudor still had a good chunk left for his trades. Tudor's empire would subsequent expand to reach Charleston, New Orleans, Calcutta and even Singapore. A journey to Calcutta would cross the equator twice and could take about 120 days. Of course ice would melt on its way to reach the market, but most of the wastage occurred after it was sold. Perhaps a smart economic theorist could write a paper on how the iceberg technology parameter depends on the surface area rather than the bulk of the good.

I read the story of Tudor (*The Ice King: Federick Tudor and His Circle*, by Carl Seaburg and Stanley Paterson) with some fascination. I picked up the book to learn something about the iceberg technology, and I ended up learning more about the art of doing business. It turns out that insulation was only on the margin of Tudor's mind. In a theorist's language, we can say that the matter is "of second order importance" for the ice trade. The keys to his business lie in unexpected quarters:

- *Monopolize if you can:* The very first thing Tudor did for his business before even touching a block of ice was to talk to a senator. He failed to get the sanction (see my earlier blog) he sought. The second thing he did for his business was to send his associates to the West Indies to secure a monopoly at the other end of the market. On that front he partially succeeded. I imagine that Tudor must have invoked the infant industry argument and the theory of intellectual property in the lobbying process, along with plenty of booze.
- *Create your market:* Paul Romer argues that much of the gains from trade stems from the introduction of new goods rather than from comparative advantage. Tudor's business is a case in point. Given the technology in those days, no amount of capital or labor could give you ice in Cuba. When

Tudor brought ice to the West Indies, the locals did not know what to deal with it. To turn ice from a curiosity to a commodity, Tudor had to create demand. He had to educate the people about all the luxuries that ice could bring to their lives. He had to teach them that cold beer was infinitely better than warm beer. He even invented the "refrigerator" (a metal box with good insulation) along the way. In the end, it was the large market demand, not the monopoly right, which brought riches to Tudor and his competitors.

- *The importance of financing:* In the first dozen years of his enterprise, Tudor was plagued by persistent problems with financing. He had been chased out of town and had even spent some time in jail for not meeting his debt obligations. Financial intermediation was poorly developed in those days. Gathering the needed amount of working capital was the job that took up most of Tudor's time and energy. Rudimentary methods of risk sharing (having partners who take up partial interest in a shipment) were available, but they did not work very smoothly.
- *The perils of finance:* After Tudor became successful, he dabbed his hand in coffee futures. Was he more informed than others about this trade? I doubt it. Was he participating in an elaborate institution that efficiently allocates risks to those who can bear them most? There is no evidence for it. What mattered most to the ice business was financial intermediation, but Tudor was turning his attention to finance. It sounds pretty much like Wall Street today. The endings were the same, too. At one point, Tudor's position in the market amounted to one-sixth of coffee consumption in America. He spent the following couple years paying up his losses.

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