



How Economics is Changing the Face of Engineering

Don Morris, Ph.D.

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Adam Smith

**Economist and Philosopher
1723–1790**

**“Virtue is more to be feared than vice,
because its excesses are not subject to
the regulation of conscience.”**

—*Adam Smith*

How Economics is Changing the Face of Engineering

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May 8, 2007

**We Are Dealing With the
Movement of Knowledge,
Skills, and Production From
an Area of Development to
Somewhere Else.**

Some History

- **Ceramics & Porcelain**
- **Ships**
- **Iron & Steel Making**
- **Automobiles**
- **Televisions**
- **Aviation**

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Ceramics & Porcelain

- **Developed first in China** circa 200 C.E.
- **Crude imitations in Europe** 1500s & 1600s
- **The “Formula” was discovered in Europe**
by J.F. Bottger in 1709
- **China continued to restrict access to the
products & technology**





Ceramics & Porcelain

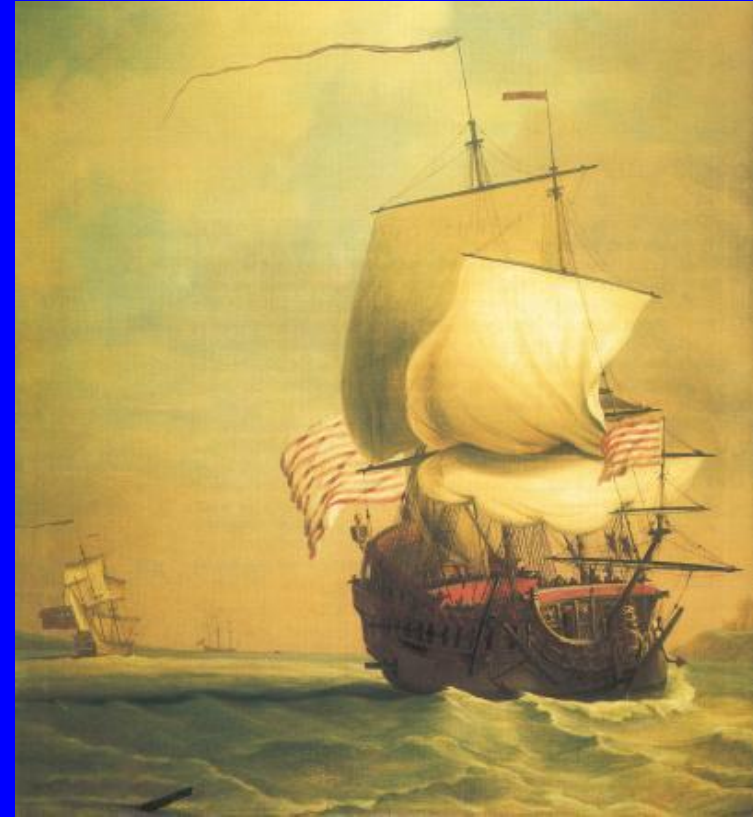
- **Josiah Wedgwood creates a new process in England in 1763**
- **England became the source of the finest “china”**
- **The technology did move to be closer to the customers**

Some History

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High Tech Ships of the Times

- *The East Indiaman*
- Average speed was 3 to 4 knots
- With enough wind, 5 to 6 knots
- Heavily armed against pirates
- Huge cargo capacity
- “World Class” shipping rates
- Only built in the British Empire



Shipbuilding in 1700

- **America (not yet the US) was becoming a shipbuilding outpost for the British Empire & the world**
- **Not great ships, but adequate (for the price)**
- **Priced at 50% of European prices**
- **Cheap labor**
- **Lots of great timber supplies!**

Shipping Laws

- **In 1786 British Navigation Laws for US**
(until repealed in 1859)
- **In 1793 US built ships barred from France**
- **In 1817 US version passed (until 1951)**

American Situation

- American ship builders are shut out by protectionist laws from most shippers
- Only American shippers for customers
- Could almost duplicate world class ships
- American shippers could not compete on cost or tonnage hauled & therefore were not effective on the world markets

What Happened?

- Four young Americans – Nat Palmer (37), Edward Collins (34), John Griffiths (27) & Donald McKay (26) had some ideas about shipbuilding & shipping
- *Speed* was the only open niche left for new entrants to the market

The Clipper Ship

- 15 to 20 knots
- 460 miles per day
- 80 days to Hong Kong
- End of the East Indiamen
- Later duplicated by the British & Australians, but too late!



Results

- **America turned the world upside down!**
- **Protectionist moves by the great shipping powers sent their industries into decline**
- **Technology did move to the location of lowest production cost anyway**
- **In 1859 Britain had to relent on importing ships**

Some History

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- **Ships**

Historical Subroutine

- **Iron & Steel Making**
- **Automobiles**
- **Televisions**
- **Aviation**

Adam Smith

1723–1790



In The Wealth of Nations, he showed that all endeavors are subject to the “laws” of economics, and provided a strong foundation that is still the preeminent book on the subject.

*...every individual necessarily labours to render the annual revenue of the society as great as he can. ..., he intends only his own gain, and he is in this, as in many other cases, led by an **invisible hand** to promote an end (to benefit society) which was no part of his intention.*

– Adam Smith

David Ricardo

1772–1823



- Read The Wealth of Nations in 1799
- Wrote papers on “comparative costs” in 1815
- He showed that trade between countries increased the wealth of both countries, even if *Poorland* is at a disadvantage on all products, and *Richland* is the low cost producer of all products.

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Outsourcing

- **Jobs will move to the area of lowest cost.**
- **Technology moves jobs to a “factory”**
- **Most, maybe 80%, of lost jobs simply disappeared, rather than having moved**

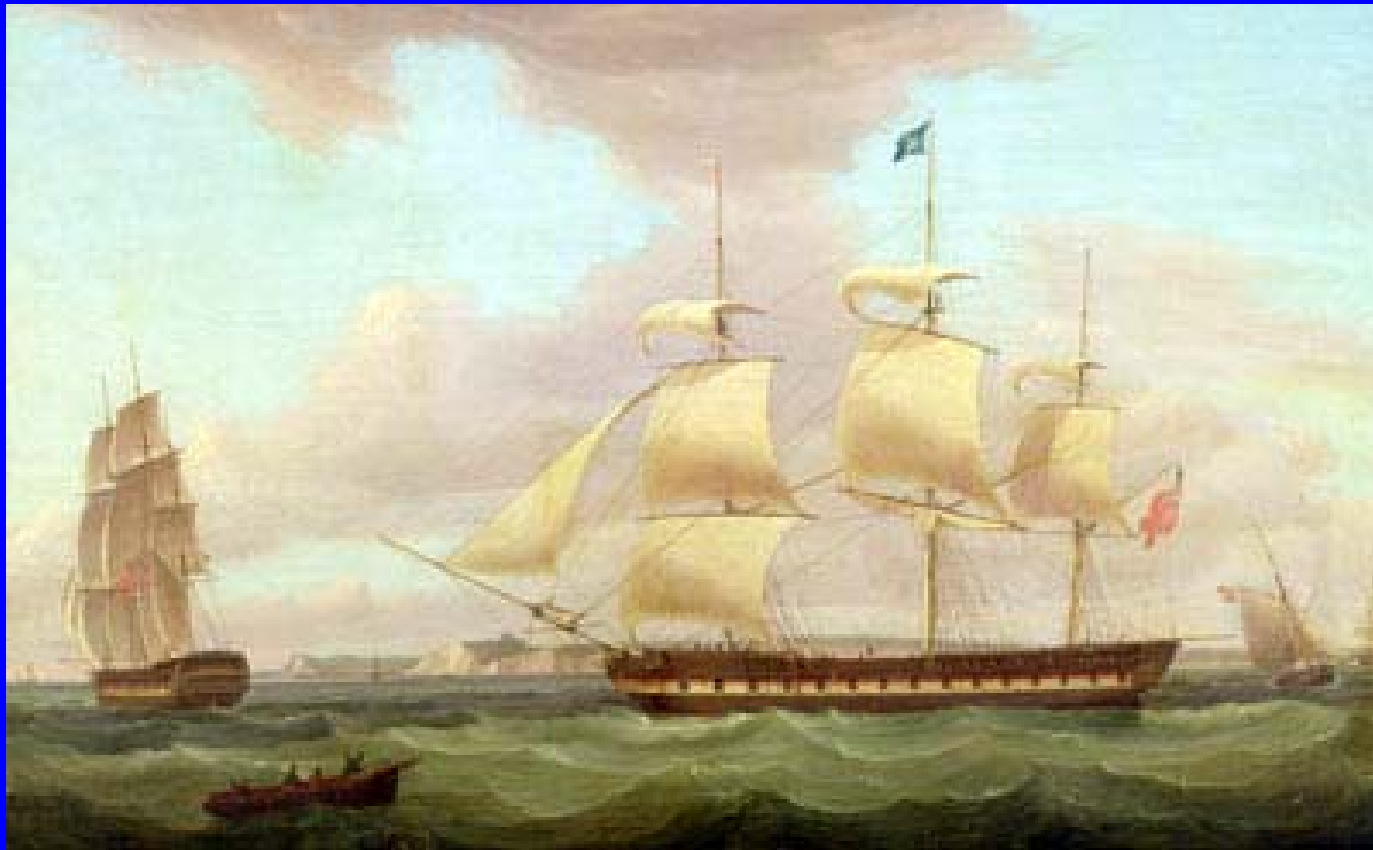
Mature & Global Industries

- No longer protected successfully
- Located by the *invisible hand* of Adam Smith
- Innovative products & economics rule
- Global parts sourcing strategies
- Note that these haven't all gone to the low cost regions of the world

The Controlling Factors

- ***Economics*** will rule under normal conditions & will not be ignored, no matter how hard anyone tries.
- ***Innovation*** will start a new sequence of economic development, as with new porcelain finishes or new & better designs such as the Clipper ships.

Britain, the Birthplace of Modern Globalization



The British Empire

- By 1740 Britain had global aspirations.
- The first country to industrialize.

The British Empire

- From 1880 to 1900 Britain achieved:
40% of world manufacturing, and
50% of world shipping.
- Provided *Pax Britannica* by
suppressing slavery, piracy, and
funding universal mail services.

Great Britain

- By 1970 the Empire was just history, and the UK provided economics with the term: the *British Disease*.

Great Britain

- **Today, Britain is a Thriving, Global Economy.**

Great Britain

- Today, Britain is a Thriving, Global Economy.

WHY?

HOW?

Great Britain

- In the 1980s they de-industrialized with a vengeance!
- Exported mass manufacturing,
- Retained high-Tech and R&D.
- Early adopters of outsourcing and off-shoring.

James Dyson

Born: May 2, 1947

**Cromer, Norfolk,
England**

**Living on his wife's
salary (art teacher)**



Sir James Dyson

Born: May 2, 1947

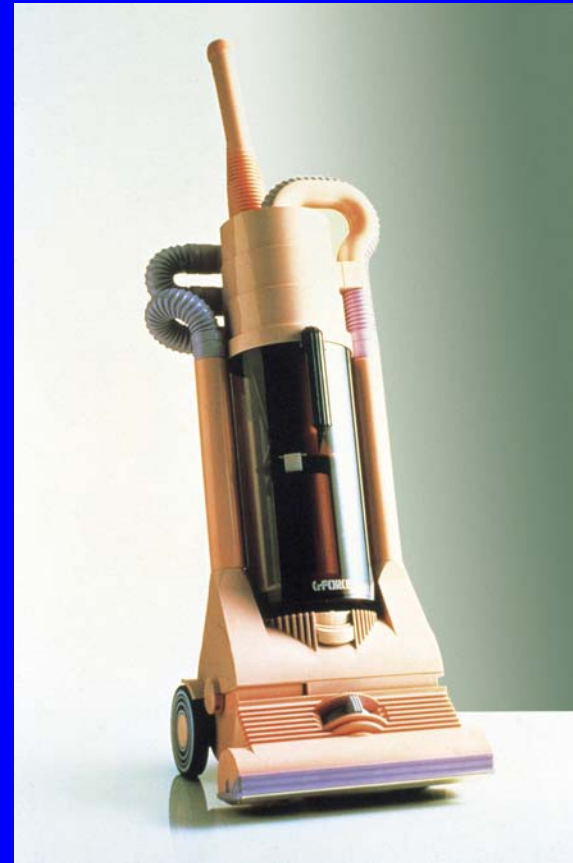
**Cromer, Norfolk,
England**

**Living on his wife's
salary (art teacher)
to billionaire!**



The Bagless Vacuum Cleaner

- In 1978 conceived the idea of a Bagless Vacuum Cleaner.
- 5,127 prototypes later ...
- Licensed in Japan
- \$2000 machine
- Japanese consumers loved it!



The Factory

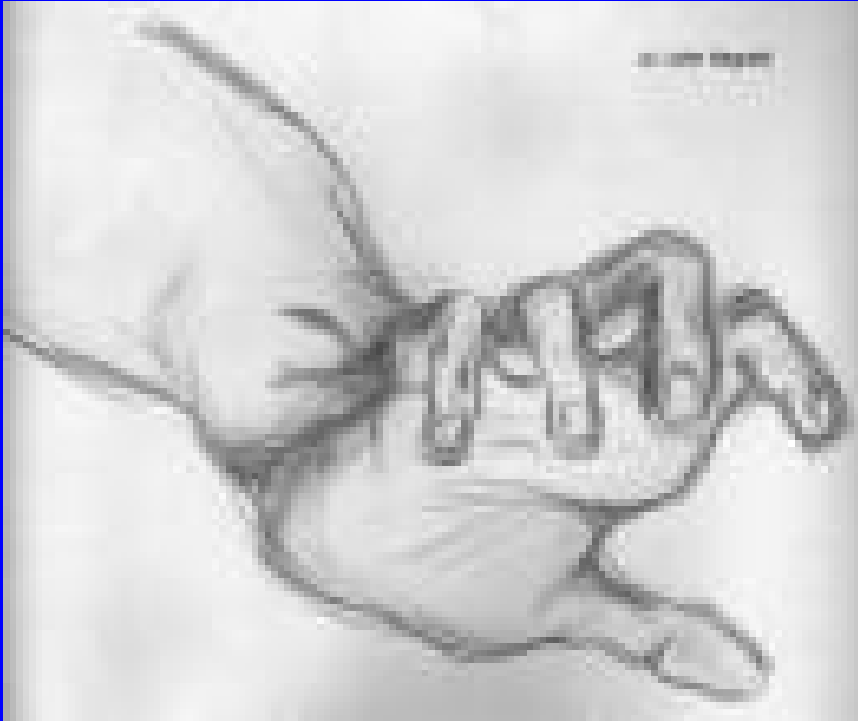
- In 1993 Dyson built his own factory in rural Britain (Wiltshire).
- Used local suppliers for many parts.
- Became the best selling machines in Britain.
- Increasing sales world-wide.
- Annual production: 800,000 units

Adam Smith Visits Wiltshire



- The local suppliers disappeared.
- The labor costs doubled.
- Local authorities shunned expansion!

Adam Smith Visits Wiltshire



- Closure of Manufacturing was imminent,
- Now, the locals were VERY concerned!
- **Bye Bye Jobs!**

Jobs for Malaysians

- **Three factories in Malaysia**
- **All suppliers are within ten miles.**
- **Production costs dropped by 3X**
- **Annual production: 4,000,000**
- **Revenue is £600M or \$1.2 B**
- **The base business is growing**
- **And new products are being introduced.**

The Winners and the Losers

- Malaysia has an obvious win.
- The consumers have a better product at one third the cost.
- But we better look at the Losers in this situation.

The Winners ...

- The Mfg facility became an R&D + HQ
- Total employment is higher.
- Average salary is much higher.
- Britain receives taxes on the profit from \$1.2B in revenue!



... and the Losers.

**The Low Level Workers w/o the
Skills or Capability to Retrain**

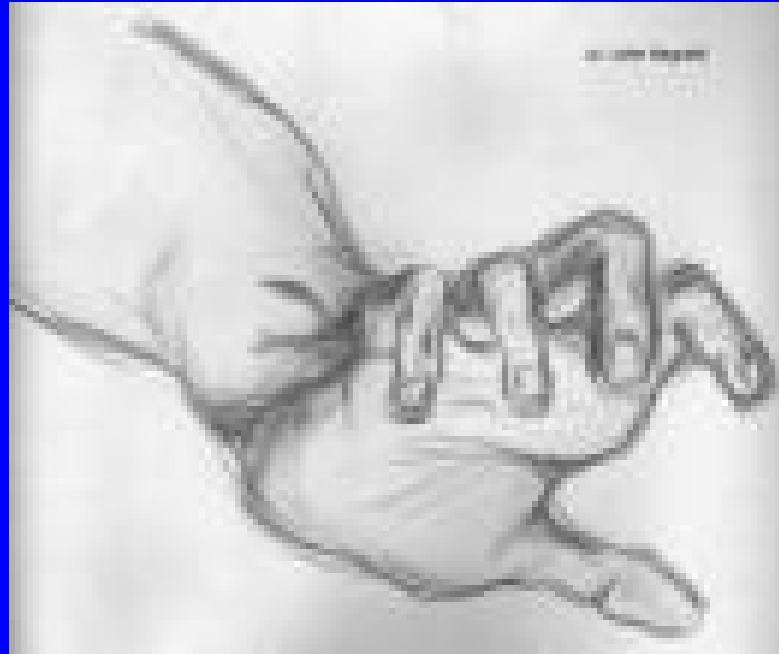
Innovation Is The Key

- **Unneeded workers will be laid off.**
- **Workers will be hired for new needs.**
- **When a job is lost, a new job of greater value must be created.**

Summary

- **Jobs, technology & commercial activities will always be disappearing.**
- **Economic health will be measured by the creation of new industries & jobs.**

Don't try to defy the



***The Cold, Dead Hand
of Adam Smith!***

References

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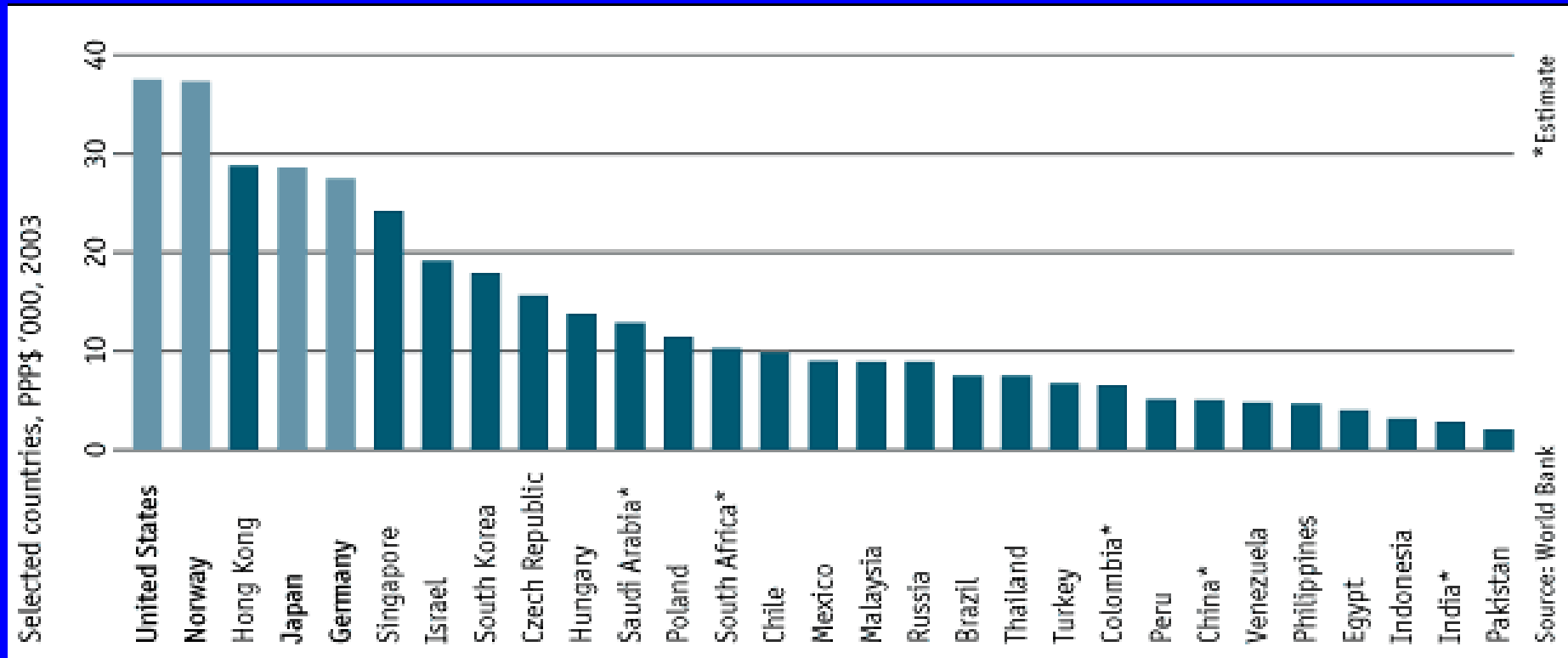
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*...every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an **invisible hand** to promote an end which was no part of his intention.*

Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good.

– Adam Smith

Relative Costs Per Person



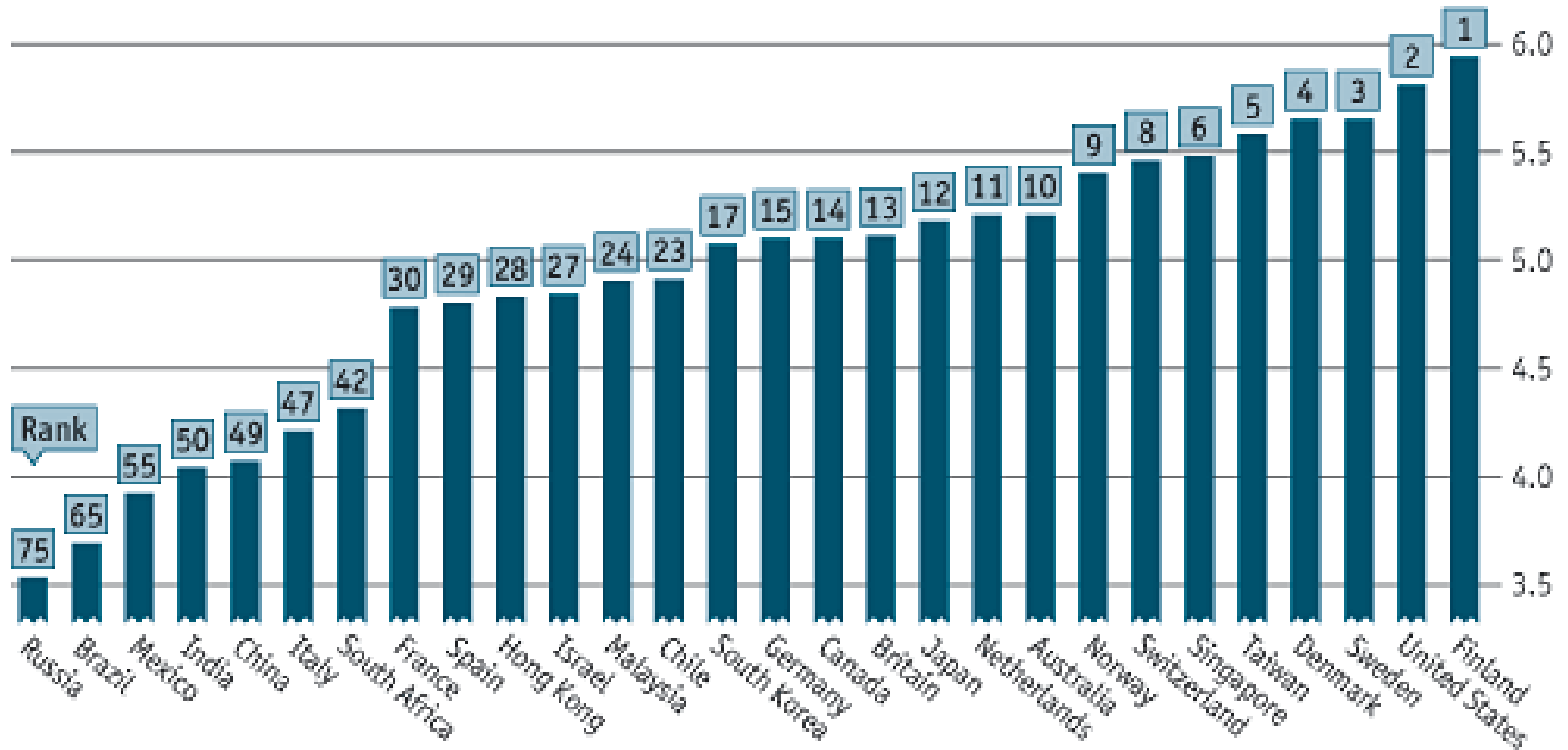
The Economist, October 2, 2004

GDP per person

Measured on a purchasing power parity (PPP) basis, which takes account of exchange-rate fluctuations, Singapore's GDP per head in 2003 was only around 14% less than Germany's, according to recent estimates from the World Bank. Hong Kong remains the richest emerging economy regularly tracked by *The Economist*. It had an income per head in 2003 of \$28,810, compared with America's \$37,500. China has leapfrogged Venezuela since last year's estimates were published. Its income per head now stands at almost \$5,000. India, despite rapid growth, still trails Indonesia.

Competitiveness

Index score, 2005



Source: World Economic Forum

Growth competitiveness

Finland again tops the World Economic Forum's league table of global competitiveness, followed by the United States. Of the ten highest-ranked countries, five are Nordic. Despite high taxes, these countries receive high marks for the quality of their public services and macroeconomic policy, including budget surpluses, areas in which America mostly scores lower. Thanks partly to its economic recovery, Japan moved up to ninth place from 21st in 2001.

Iron & Steel Industry

- **Ultimately, the cold, dead hand of Adam Smith has determined where the industries will survive!**
- **Politicians, Capitalists, Union Leaders, and Workers have tried unsuccessfully to thwart Adam Smith.**

Automobiles

- US industry was well entrenched with economics of location & history as pluses.
- This market was mainly lost by losing focus on Quality, Reliability & Features, not cost...
why are foreign companies here?

Television

- **A mature, commodity market where cost is the primary differentiator.**
- **The US lost out completely whereas Japan has retained the high-end due to continual product & technical innovation.**

Aviation

- A truly international set of vendors with world-wide subcontracting & customer base.
- Commercial success has depended upon continual attention to all elements of

PQRDC

Manufacturing in the US

- The US is the world's #1 manufacturer!
- Manufacturing value has grown at 4% per annum since 1991.
- Manufacturing jobs have declined each year since 1991.
- Even Chinese manufacturing jobs are declining.

How to Fail

- **Protectionist regulations**
- **Tariffs**
- **Refuse to change**
- **Ignore legitimate economic issues**
- **Stop innovating**

How to Thrive

- **Companies must accept economic reality & innovate new products & services.**
- **Societies must be flexible & able to modernize.**
- **People must be able and willing to innovate to invent their own future.**