

Energy Conservation, Environmental Protection, and Sustainability of Economic Growth

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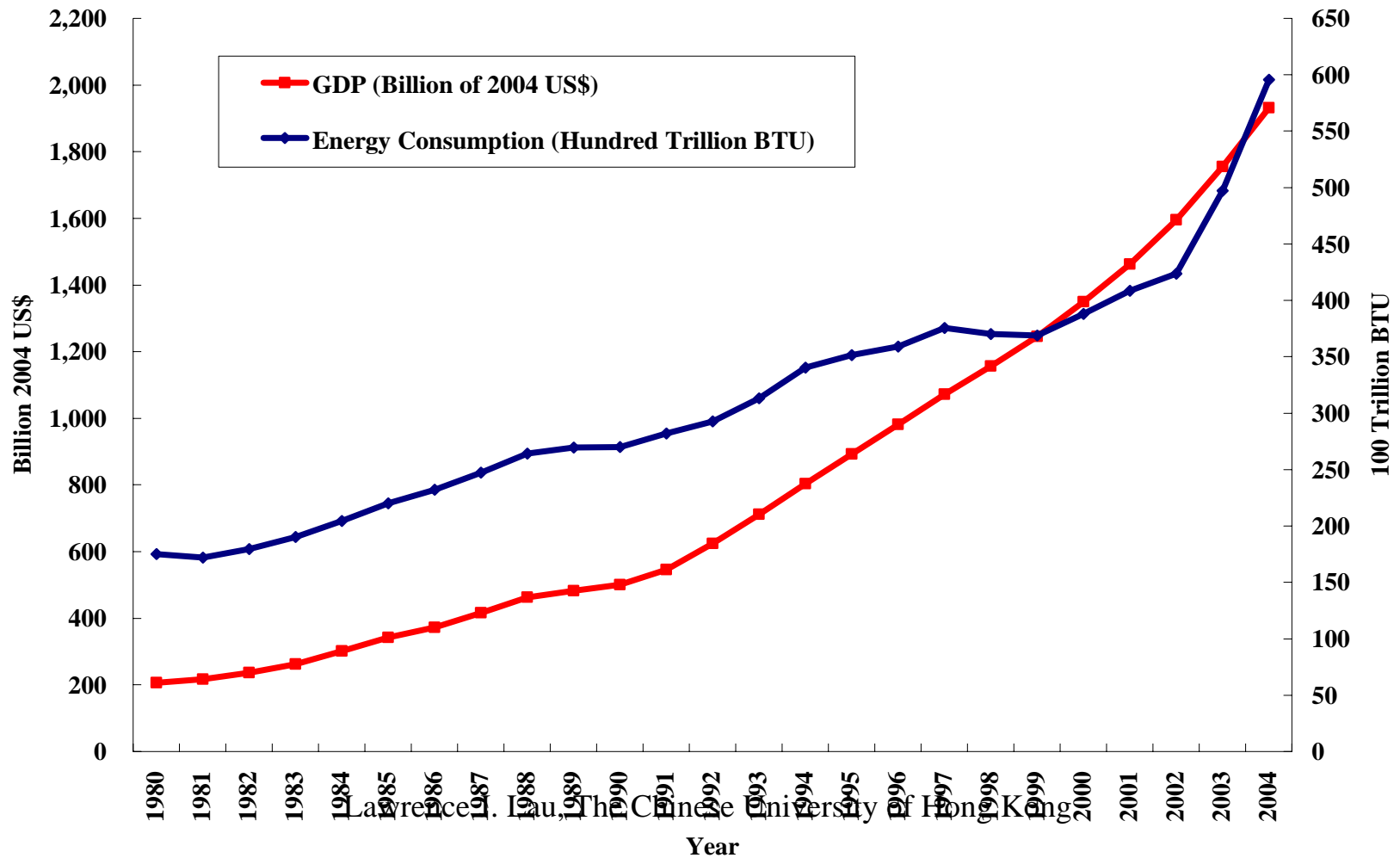
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A Preview

- ◆ The Energy/GDP Ratio
- ◆ Instruments for Energy Conservation and Environmental Protection
- ◆ Concluding Remarks: Sustainability of Economic Growth

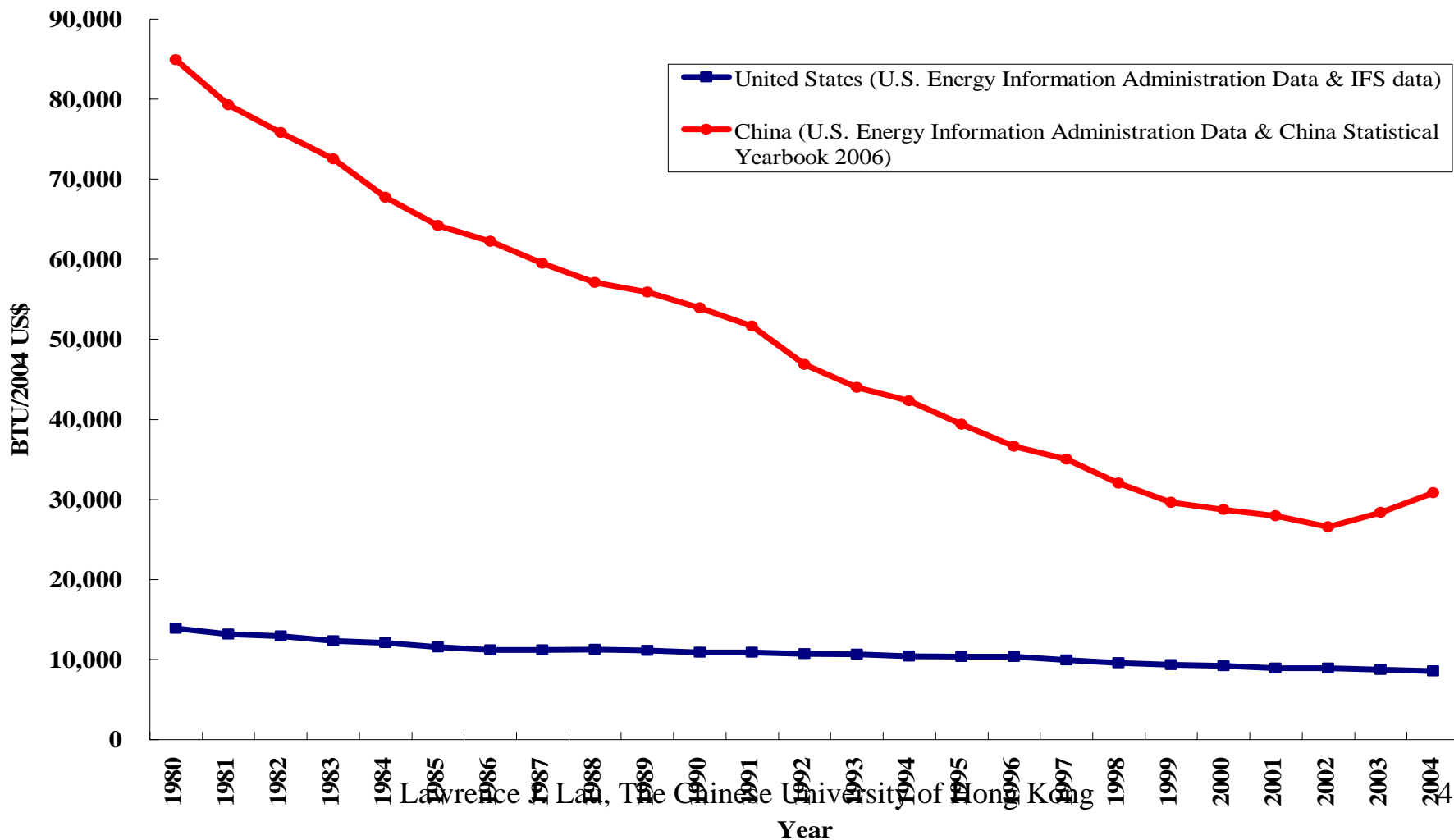
Real GDP and Energy Consumption of China, 1980-2004

Real GDP and Energy Consumption of China, 1980-2004



Primary Energy Consumption-GDP Ratios (China and the United States), 1980-2004

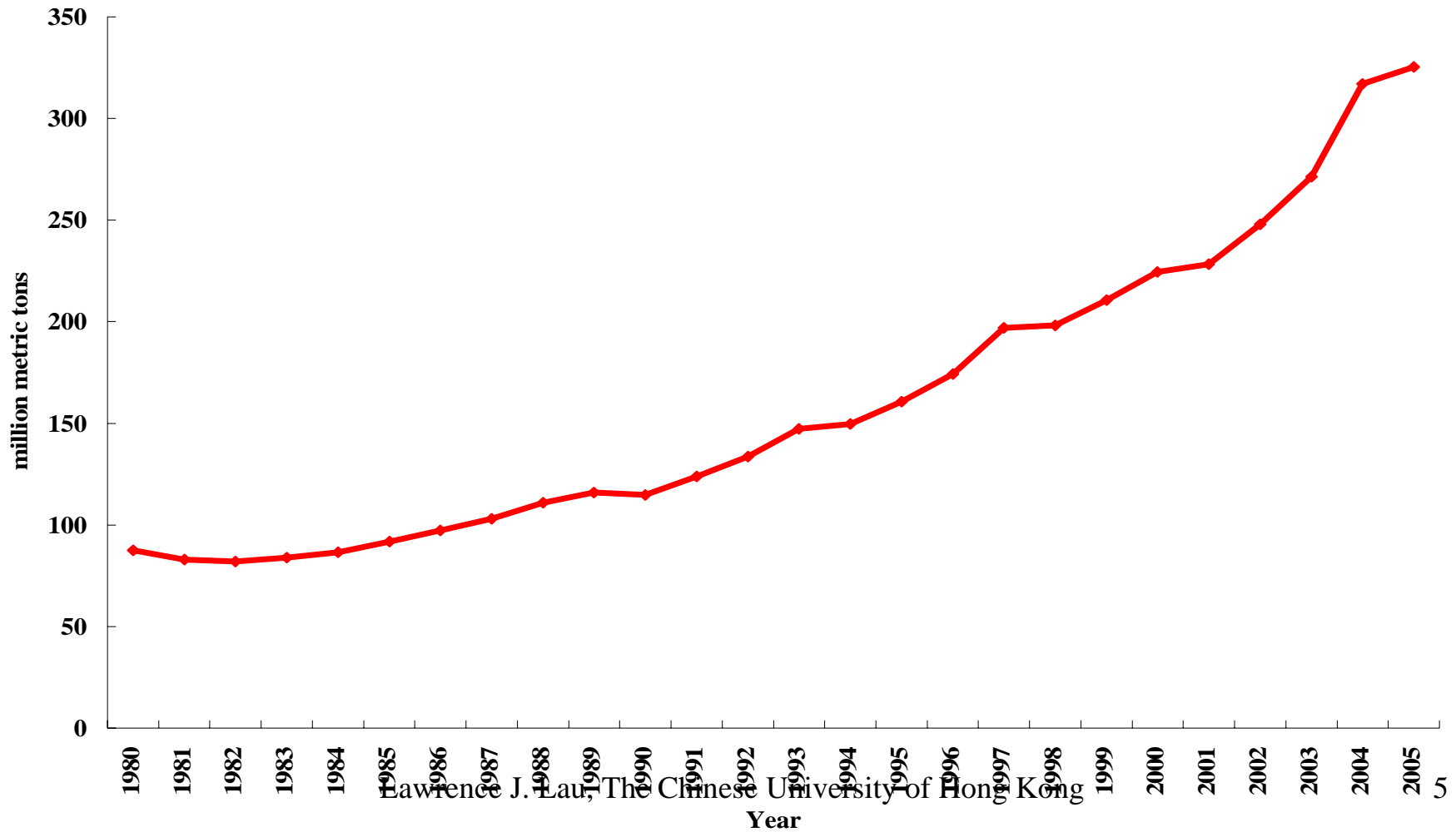
Primary Energy Consumption-GDP Ratio (China and United States)



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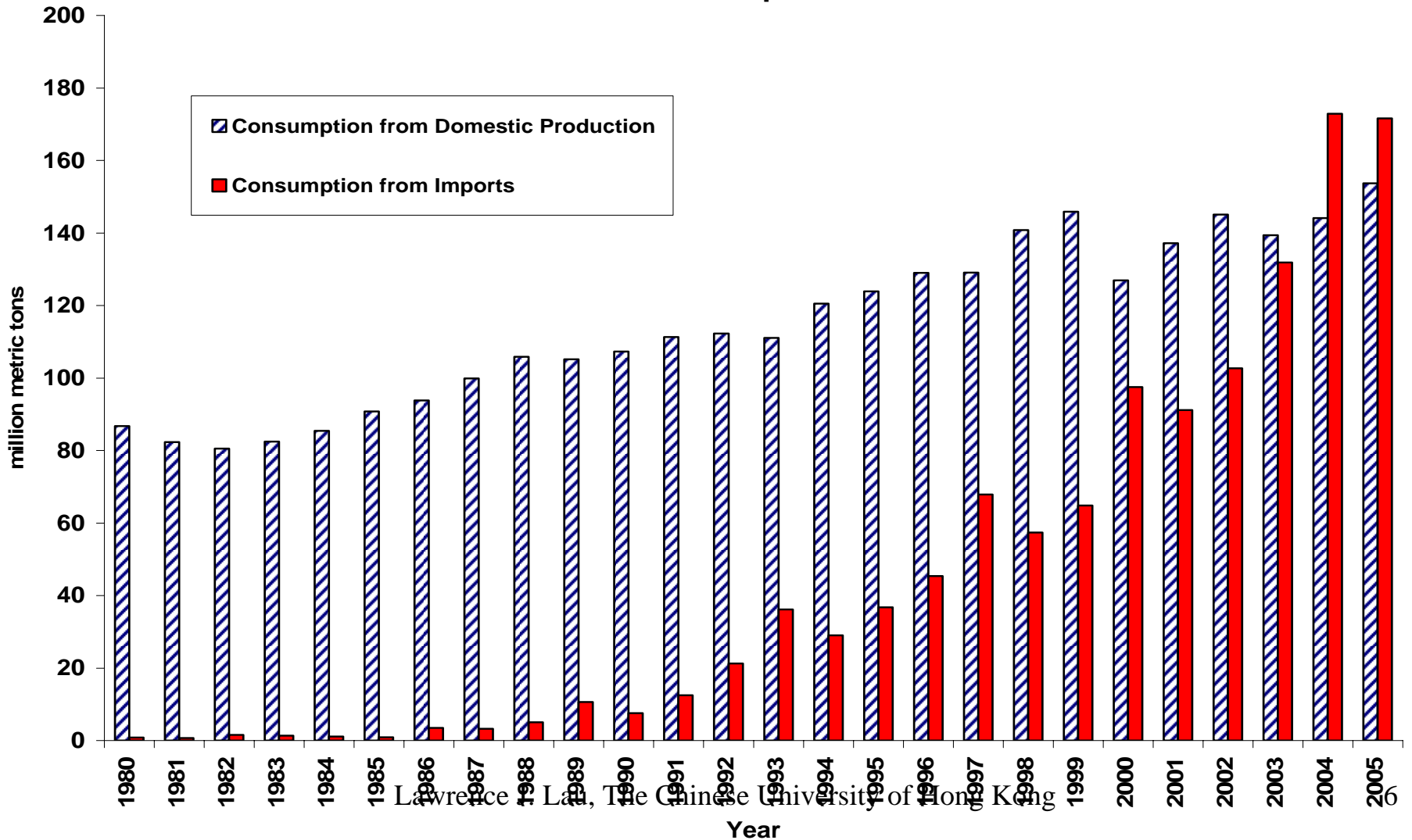
The Chinese Demand for Oil

Total Petroleum Consumption



Oil Consumption in China

Petroleum Consumption in China



Energy Efficiency

- ◆ Energy consumption in China has been growing more slowly than real GDP until 2002.
- ◆ Energy efficiency, in terms of energy consumption per unit GDP, has actually improved significantly during the past two decades, until the last couple of years.
- ◆ It is, however, still considerably higher than that of the United States, Japan, and other developed economies. In part, this reflects the sectoral composition of GDP; but in part, this also is the result of much lower energy prices in China.
- ◆ The high energy/GDP ratio in China suggests that there is considerable room for significant further improvements.

The Principal Reasons for the Difference in the Energy/GDP Ratios

- ◆ Differences in the sectoral composition of GDP by originating sectors—primary, secondary and tertiary—which in turn also depend on the domestic consumption patterns (e.g., the distribution between goods and services). In general, the secondary sector consumes the most energy per unit of GDP and the service sector the least.
- ◆ Differences in life-style: locational patterns, housing, transportation, temperature preferences.
- ◆ Differences in the energy efficiency of the existing capital stocks of both the enterprises and the households—structure and equipment, housing, automobiles—which are legacies of the historical actual and expected pricing of energy.
- ◆ Differences in the historical, current and expected future prices of energy (to the ultimate users of energy).

Energy Conservation, Environmental Protection and Pricing in Externalities

- ◆ The depletion and exhaustion of once abundant natural resources, such as oil, water, and timber, can potentially cause an economy to slow down and decline. Over-dependence on imported energy can also cause an economy to be vulnerable to supply interruptions.
- ◆ Externalities are not entirely reflected by prices in the market, for example, the price of an automobile may not include the (social) cost of its eventual disposal; the price of gasoline may not include the (social) costs of congestion, pollution and global warming.

Instruments for Energy Conservation and Environmental Protection

- ◆ One solution is to promote conservation through appropriate pricing of the natural resource, and through the facilitation of the substitution between higher capital cost and lower operating cost. (For example, triple-paned windows are more expensive but houses equipped with them consume much less energy. Without incentives the developers are likely to opt to use single-paned windows to lower the up-front capital cost.)
- ◆ Externalities can also be priced in through the imposition of taxes on specific industries and/or products. For example, taxes can be imposed on oil and/or gasoline because of the negative externalities that the use of gasoline generates: air pollution, congestion, global warming, etc.
- ◆ The government can also mandate energy efficiency standards.

Instruments for Energy Conservation and Environmental Protection

- ◆ Even the announcement of planned future price/tax increases, holding current price/tax constant, can have a substantial impact because they affect directly the choice of new capital equipment in terms of its energy efficiency.
- ◆ However, it takes time for the energy-consumption characteristics of the capital stock to turn over—it can be five years or more. But early signaling is essential.
- ◆ Another crucial factor is the potential trade-off between capital costs and operating costs. Some preferential financing of energy-saving investment may be necessary.

Instruments for Energy Conservation and Environmental Protection

- ◆ The price of energy can be set much higher, to the levels prevailing in international markets, eliminating any general subsidization; in particular, the retail price of gasoline should be raised to levels comparable to those of Japan and Western Europe through a combination of allowing the price of energy rise to international levels and in addition the imposition of a gasoline tax.
- ◆ It is a myth that the high price of domestic gasoline deters the development of the automobile industry. Both Japan and Western Europe have long had high retail prices of gasoline and both have prosperous automobile manufacturing firms. The U.S. has the lowest price of gasoline but its automobile industry has been struggling.

Instruments for Energy Conservation and Environmental Protection

- ◆ The use of lifeline rates on different forms of energy, e.g., electricity, to protect the low-income households and as instruments of income redistribution. Lifeline rates basically imply that the initial say 5 kilowatt-hours of electricity will be charged a very low or even zero rate, but the 6th kilowatt will be charged the full social marginal cost, including the cost of externalities. Low-income households do not have high energy-consuming air conditioners and refrigerators.
- ◆ Subsidies for urban mass transit can also be used to protect low-income households and as instruments of redistribution.
- ◆ For enterprises currently enjoying a low rate of energy, e.g., electricity, they can continue to enjoy the low rate for a number of years but only up to the historical quantity consumed. Anything over and above will be charged at full social marginal cost. Thus, they will not be allowed to expand their usage at the same low rate, and yet they can have a number of years for adjustment so that they do not have to lay off all of their workers immediately.

Instruments for Energy Conservation and Environmental Protection

- ◆ The prices of water and other resources should also reflect their scarcities and any externalities.
- ◆ Pollution of all forms should be taxed, wherever possible.

Environmental Protection

- ◆ Chinese per capita GDP, estimated at US\$2,025 (2006 prices) for 2006, is still very low compared to developed economies (e.g., the U.S. per capita GDP is around US\$44,000, more than 22 times Chinese per capita GDP).
- ◆ Japan did not begin to clean up its environment seriously until the 1970s, when its per capita GDP reached more than US\$10,000 in 2006 prices.
- ◆ It is of course much more efficient and economical to control pollution and contamination at the outset rather than to clean them up afterwards.
- ◆ China can lead the world by beginning to promote conservation, efficiency and thrift and protect its environment at a much earlier stage of economic development than the developed economies today and hopefully to attain long-term sustainability thereby.

Environmental Protection

- ◆ Environmental degradation can be prevented through education and through the imposition of fines and other sanctions.
- ◆ Air and water quality standards should be set and continuously monitored.
- ◆ The anti-pollution laws should be vigorously enforced against individual enterprises and households.
- ◆ Wherever possible, the externalities should be internalized so that the total social costs are fully reflected.

A Collective Life-Style Choice

- ◆ What types of cities are the best for China (and for the world)?
- ◆ “A car in every garage” is a nightmare scenario for China and the World. (Imagine 400 million automobiles on the road and a replacement demand of at least 40 million automobiles a year eventually!)
- ◆ Urban sprawl and the traffic congestion that it generates are the natural outcomes of the growth of cities in the absence of adequate urban planning.
- ◆ Convenient, user-friendly urban mass transit is the only feasible alternative to the automobile, but it works effectively only in cities with high-density residential and non-residential neighborhoods.
- ◆ High-density neighbours can be achieved and urban sprawl can be avoided only through early urban planning.

A Collective Life-Style Choice

- ◆ Thus, one of the most important policy choices with long-term implications facing China is what can be described as a choice of urban life-style: Does China want its existing and future cities to be like Los Angeles and San Jose, where automobile ownership is a necessity, or London, New York, Paris and Singapore, where convenient and efficient mass transit systems exist and automobile ownership and/or use are genuine choices?
- ◆ It is critical for China to maintain a viable alternative to the automobile as a means of daily urban travel for the vast majority of the middle class, in addition to bicycles and walking.

A Collective Life-Style Choice

- ◆ However, such urban life-style choices must be made early on. Once made, often by default, they cannot be easily reversed. For example, it is far too late for Los Angeles and San Jose to try to become a city like New York—the low density and the sprawl have basically made such a change impossible.
- ◆ The modes of mass transportation also require a collective governmental choice as well as integrated urban planning and regulation on density, land use, spatial distribution and transportation routes. They must take into account the externalities and cannot be left alone to the invisible hand of the market.

A Collective Life-Style Choice

- ◆ Urban mass transit should be provided, and subsidized if necessary, by the municipal governments wherever possible as an alternative to the use (but not necessarily ownership) of automobiles.
- ◆ Mass transit systems must be user-friendly to encourage greater utilization—fast, clean, efficient, and easy accessibility. The Paris Metro was designed so that any one standing anywhere in Paris is no more than 400 meters away from a station.
- ◆ The greatest success of mass transit systems is achieved where there is a relatively high density pattern of distribution of the urban population. However, in order to achieve high densities, urban planning is essential.
- ◆ Thus, there will be high density living rather than free-standing single family homes.

Industrialization and Urbanization

- ◆ New cities can be planned from scratch, and the design and construction of mass transit systems (including the manufacture of the equipment and rolling stock) in medium-sized (say, between 1 and 2 million population) cities can become a growth industry in itself. Over the next decade or two, the number of such new cities is easily on the order of 50 to 100.

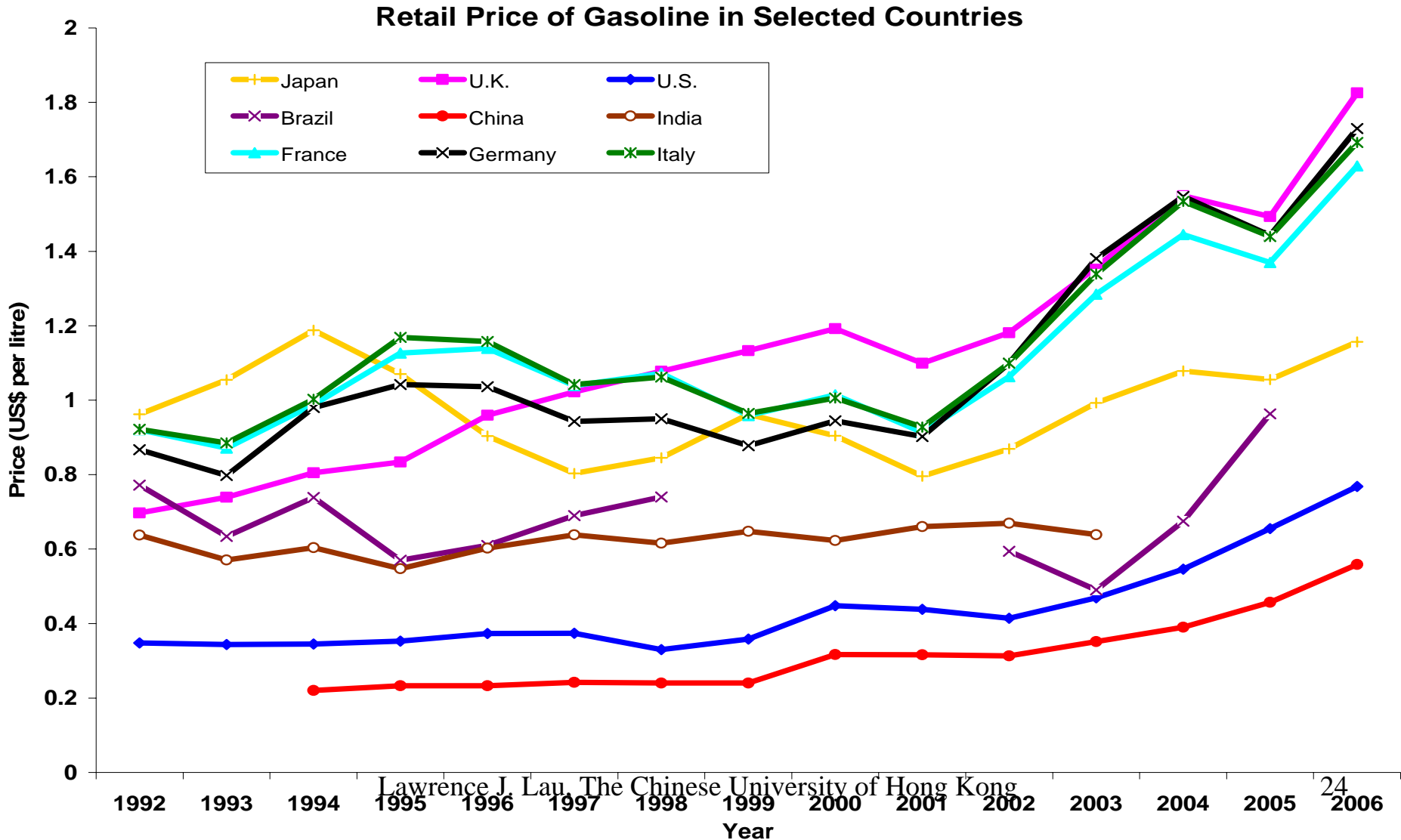
Achieving Efficiency in Land Use

- ◆ There are significant economies of scale in heating and cooling, e.g., houses share walls, incorporation of new technologies.
- ◆ Complementarity between the efficiency in land use and the efficiency in the consumption of resources, e.g., high density housing enhances the efficiency of mass transit and public transportation systems, and the availability of convenient mass transit reduces the demand for automobiles and for gasoline, and hence congestion and pollution.
- ◆ Life-style choices—design of furniture and appliances to fit in small spaces so as to make small spaces seem larger.

The Role of the Urban Middle Class

- ◆ The emergence of an urban middle class has both positive and negative implications on energy conservation and environmental protection. On the one hand, the urban middle class demands many products and services (e.g., automobiles and gasoline) that are both resource-intensive and environmentally unfriendly. On the other hand, the urban middle class, being better educated, tends to be more socially and environmentally conscious and values the quality of life.
- ◆ Protection of the environment by the government actually improves the after-tax distribution of real income because everyone, regardless of income levels, can enjoy the benefits of a clean environment—clean air, clean water, etc. It also enhances social harmony as well as the quality of life in general.

Retail Prices of Gasoline in Selected Countries



The Gasoline Tax and the “Gas Guzzler” Tax

- ◆ The retail price of gasoline in China is among the lowest in the world, even lower than in the United States.
- ◆ China can impose a tax on gasoline consumption that is similar in order of magnitude to that in the Western European countries
- ◆ China can also impose a gas guzzler tax (license fee) linked to the fuel efficiency of the automobile that penalizes inefficiency.
- ◆ The gasoline tax and the “gas guzzler” tax can reduce the externalities generated by the use of the automobile (e.g., congestion and public health (including loss of productive time), local and global environmental pollution), enhance long-term sustainability and reduce over-dependence on oil imports.

The Gasoline Tax and the “Gas Guzzler” Tax

- ◆ The best time to impose and/or raise gasoline taxes and other user taxes is before there are too many automobile owners, not afterwards. It becomes politically difficult or even impossible to do so once the majority of the households own and depend on automobiles for their daily transportation needs.
- ◆ Such taxes as the gasoline tax and the “gas guzzler” tax are likely to be progressive in China because only high-income people are likely to have private automobiles. It may therefore be viewed as another means of “redistribution”.

The Implementation of the Gasoline Tax and Other Measures

- ◆ The gasoline tax can be flexibly structured so as to maintain the retail price of gasoline (in real terms) at a stable level, independently of the short-term fluctuations in the world price of oil. Thus, when the price of oil rises in the international market, the gasoline tax rate per gallon can be lowered so that the retail price of gasoline, including the tax, remains stable. Similarly, when the price of oil falls, the gasoline tax rate per gallon can be raised to its previous level.
- ◆ The proceeds of the gasoline tax can be used to finance public investment in mass transportation.
- ◆ Access fees to the central business districts during peak periods, as used in Singapore, are also an option.
- ◆ The promotion of a car rental industry and the encouragement of ride-sharing.

Implications for Industrial Development

- ◆ Providing urban residents with a viable and workable system of mass transportation does not necessarily mean that they will not have the opportunity for automobile ownership. Nor does it imply that the domestic automobile industry cannot be effectively developed. (Look at Japan and Western Europe.)
- ◆ There are between 50 and 100 Chinese cities with populations in excess of two million. The market for mass transportation systems is so large in China that China can become the world leader in the supply of such systems. China can start by developing and supplying its own domestic mass transportation systems.

Development and Commercialization of New Technologies

- ◆ China has the potential of leap-frogging because it has a vast domestic market but no strong vested interest yet to protect, no large existing investment that must be amortized. It is relatively low cost for China to switch to a hydrogen car but not so for the United States because of all the sunken investment in the stock of automobiles, in the invested structures and equipment of the automobile industry, and in the extensive gasoline-based fuel distribution system. the possibility of creation without destruction.
- ◆ Hydrogen and fuel cell technologies can be tried on an experimental basis.
- ◆ The hybrid car can be more widely promoted.
- ◆ New clean technologies for the efficient utilization of coal can be developed and promoted, perhaps in cooperation with the other country with large coal reserves—the United States.
- ◆ Encouragement of the use of biodegradable materials.
- ◆ Promotion of recycling and mandatory disposal of products at the end of their useful lives by the original manufacturers.

Reducing Vulnerability to Supply Interruption

- ◆ Exploration and prospecting
- ◆ Encouragement of conservation, renewal, restoration and recycling
 - ◆ E.g., Land, nuclear fuel recycling
- ◆ Research and development on new technologies
 - ◆ Coal gasification, coal liquefaction (conversion to oil), fuel cells, breeder-reactor, super-conducting transmission lines, new composite materials, including bio-degradable materials
- ◆ Diversification of types and sources of primary energy, including hydroelectric, nuclear, solar, wind, natural gas.
- ◆ Participation in world markets
- ◆ Reduction of reliance on imports.
- ◆ Establishment of strategic reserves

Reducing Steady-State Demand

- ◆ Encouragement of conservation.
- ◆ Encouragement of capital cost-operating cost substitution—e.g., encouragement of substitution of capital cost for operating costs—the private rate of discount may be higher than the appropriate social rate of discount; substitution of better insulation and construction of buildings for fuel; energy-efficient light bulbs; durable products.
- ◆ Development and adoption of substitute new materials, e.g., fiber glass instead of metals, ceramics, eco-plastics.
- ◆ Encouragement of recycling.

Concluding Remarks:

Sustainability of Economic Growth

- ◆ It is in the long-term interests of China to pursue a balanced and integrated strategy in planning for its industrialization and urbanization and supplying its transportation needs, taking into account all the externalities. It is the only way in which its economic growth can be sustainable in the long run.
- ◆ Incentives, both positive and negative, are necessary.
- ◆ The diversification of the types and sources of primary energy and the establishment of strategic reserves of oil and other forms of energy help to minimize the adverse impact on economic growth resulting from supply interruptions.

Concluding Remarks:

Sustainability of Economic Growth

- ◆ Energy conservation and environmental protection will help enhance the quality of life—cleaner air, cleaner water, reduced congestion.
- ◆ Efforts at environmental protection also promote social harmony. A clean environment can be enjoyed by all citizens rich and poor. Clean and efficient mass transit is also a great “equalizer.”
- ◆ However, it will take time to see concrete results because of the lags in the turnover of the existing capital stocks. One must therefore be patient. Just because one does not see immediate results does not mean that the policy is not working.
- ◆ By pursuing a strategy of energy conservation and environmental protection, China will be able to comply with the spirit of the Kyoto accord. China can lead the world and set an example for other developing countries by pioneering a new mode of development.