DOES FAST GROWTH IN INDIA AND CHINA HARM U.S. WORKERS? INSIGHTS FROM SIMULATION EVIDENCE

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Abstract
A major political and policy issue today is whether globalisation and rapid economic growth in India and China would have an adverse affect on labour markets in the U.S. and other advanced countries. Some leading economists have argued that even though the recent integration of India and China with the liberalised global economy has not so far had a serious negative impact on wages and employment in advanced countries, it is most likely to do so in the future in view of the growing technological and scientific capabilities in the two developing countries. This is also because it is suggested that this integration represents a sudden doubling of the world labour force without a concomitant increase in capital. The present paper argues against this plausible thesis, essentially on two grounds: (a) it does not take into account the demand side effects of fast growth in India and China; and (b) it abstracts from the dynamism of the U.S. real economy and its innovative large corporations. However, simulations of different scenarios on the CAM world econometric model indicate that at a disaggregated level there are severe supply side constraints on energy, raw materials and food which thwart the expansionary demand side effects of fast growth in India and China.

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Keywords: Globalisation; China and India; Simulation; U.S. Workers; Economic integration.

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Introduction

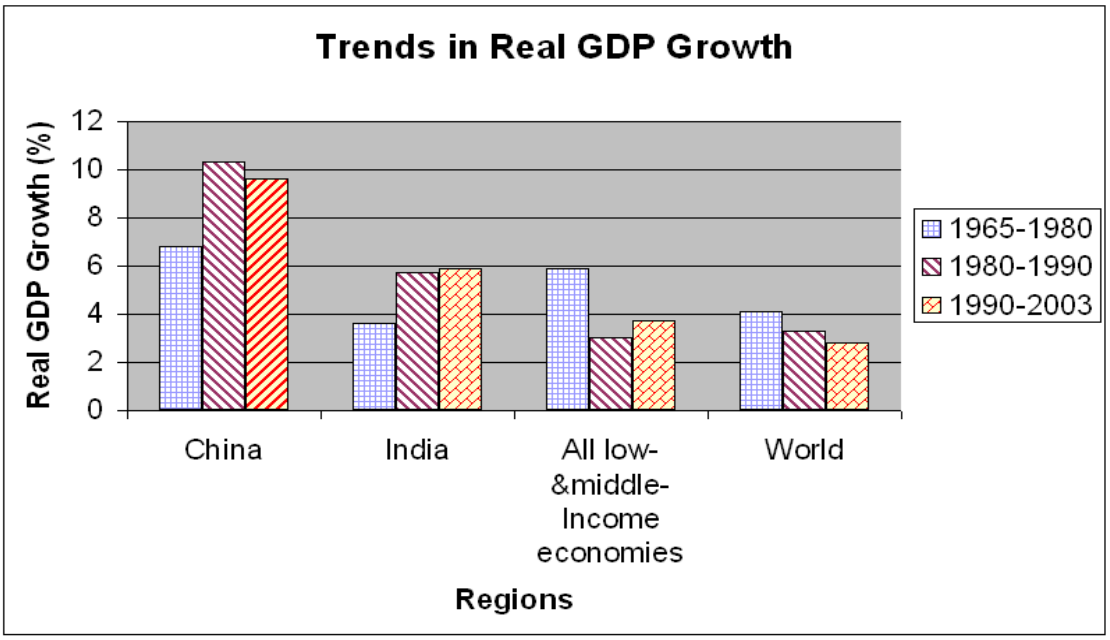
This paper examines the impact on labour markets in advanced countries (ACs) of the integration of the two giant fast-growing countries, China and India, with the liberalised global economy. This integration is taking place under 'current globalisation,' which consists of free-trade, free capital movements and domestic labour market flexibility (instead of free international movement of labour). These are, broadly speaking, the 'rules of the game' under which the world economy presently operates. In this context, the paper gives special attention to the pioneering contribution of Richard Freeman (2005), Professor of Economics at Harvard University. Freeman suggests that even if trade with the South may previously not have seriously disadvantaged workers from the rich countries of the North, the doubling of the global labour force with India and China's recent integration with the international economy may nevertheless have profoundly unfavourable repercussions for Advanced Countries' (AC) workers.

As this paper is being presented in the U.S. the following paragraph which was written for a non-U.S. audience is not needed. (It is nevertheless included in a footnote below.) This is because the question being addressed is acknowledged to be at the top of the political and policy agenda in this country. Professor Freeman, who is one of the most eminent labour economists in the country, has made seminal contributions to its discussion and analysis. So it is fitting that Professor Freeman's contributions should be the main focus of this paper.[1]

1. The International Context

One heartening feature of the evolution of the world economy during the last two to three decades has been the outstanding economic success of China and India – two of the world's most populous and hitherto extremely poor countries. Starting out with the world's largest absolute numbers of people living in poverty, in narrow economic terms the two countries have achieved impressive growth. Graph 1 provides a broad-brush statistical profile of GDP growth over the last four decades for China, India, and all medium and low-income countries, that is for developing countries (DCs), and for the world economy as a whole.

Graph 1: Trends in Real GDP Growth: China, India, developing economies, and the world 1965- 2003 (*Average annual percentage growth)*



Source**:** Adapted from Dasgupta and Singh (2005).

China has undoubtedly been the fastest growing country in the world over the last quarter of a century, achieving historically unprecedented, almost double-digit, growth rates since 1980. Similarly, although not as fast as China, India's economic growth has nevertheless also been one of the highest in the world since 1980, its per capita growth rate tripling between 1950-1980 and 1980-2005 (Kelkar, 2005). India was among the ten fastest growing countries in the world over each of the two decades 1980-1990 and 1990-2000. This record is not matched by any country other than China. Indeed, the acceleration of growth in India and China in the last quarter century is particularly remarkable, as it has taken place at a time of deceleration in world economic growth. Fast economic growth has led to large-scale income poverty reductions in both countries, although the extent in the Indian case since 1990 is still debated. There have also been huge improvements in human development indicators. For recent contributions to this debate see, for example, Sen and Himanshu (2004), Srinivasan (2003) and UNDP (2005, Box 1.3).

The rapid economic expansion of these two giants has given rise to serious concerns in advanced nations ('the North') regarding both the short and the long-term implications for their people. Since the end of the 'golden age' of fast economic growth in ACs in the mid-1970s, most advanced economies have been suffering from serious labour market difficulties. Specifically, workers and

trade unions blame competition from low-wage economies such as China and India for their problems, including:

- Deindustrialization: while India and China have been expanding their industry at a very fast rate and are undergoing industrial revolutions[2], the absolute numbers employed in manufacturing as well as the share of manufacturing in employment in ACs has been falling.
- There has been increasing income inequality in many ACs, particularly the UK and the US. This has often been ascribed to stagnant or falling real wages of the unskilled workers in the North as a result of competition from the low-wage countries of the South, which, moreover, are alleged not to obey international labour standards.
- There have been high rates of unemployment particularly in the European Union (EU), which are also popularly attributed to competition from the South.

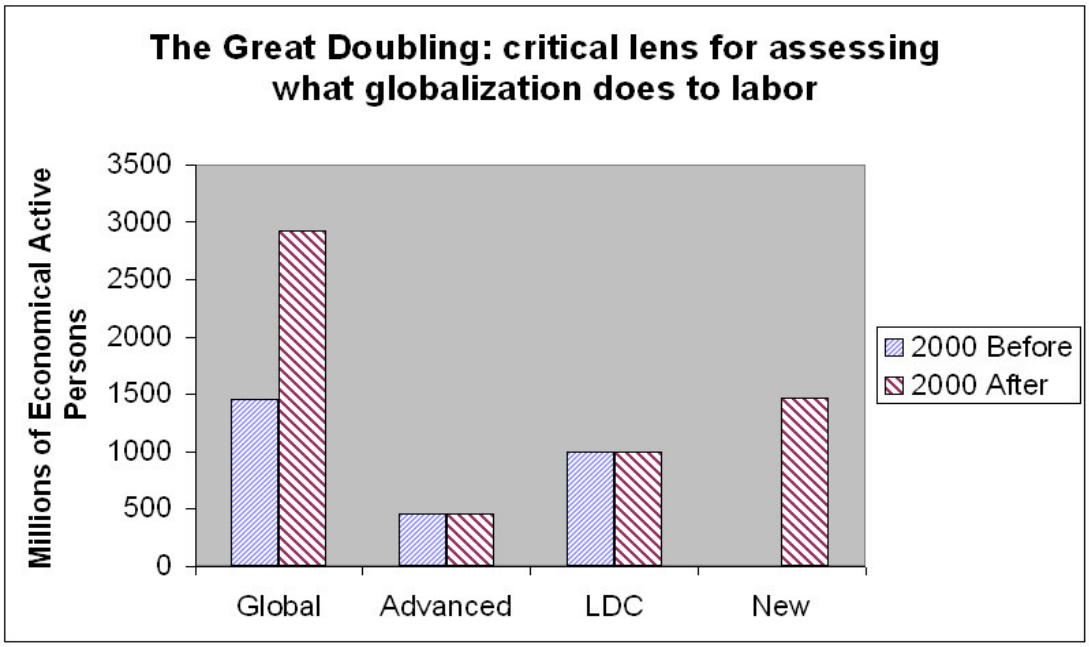
In the post-World War II period, the economics profession, as well as the traditional liberal establishment in the US have favoured free trade and taken a broadly benign view of the effects of competition from poor countries on economic welfare in the North. This position has been backed up by research. Despite following different methodologies, the research indicates that the effects of globalisation, in particular of trade between rich and poor countries, has had very little impact on employment and wages for workers in advanced countries such as the US. The labour market problems of advanced country workers are attributed in this analysis much more to the nature of the new technology rather than to globalisation. However, it is precisely this favourable perspective on globalisation which has seriously been challenged by Freeman.

2. Dangers from New Globalisers for ACs -The Freeman Thesis

Freeman's new post-1995 line of thought, which regards globalisation as a potentially major threat for the North's workers, chimes in very well with popular sentiment in advanced countries (ACs). Opinion polls indicate 6 out of 10 citizens in the US are not persuaded by the supposed benefits of globalisation. This is quite remarkable in view of the fact that the US economy has recorded the strongest growth rate of all major economies in the last 10 years. Further, it has also been much more stable than ever before (Martin and Rowthorn 2005) However, U.S. wages and salaries have been more volatile than before which suggests that the general scepticism about globalisation is perhaps not so remarkable after all. Freeman's 2005 contribution provides a formidable and sophisticated articulation of this sentiment; further, in addition to the short term, Freeman is very much concerned with the potential adverse long-term effects of global economic integration. The latter aspect adds to the weight of Freeman's analysis.

The essential basis for Freeman's argument is his observation that the global labour force has all of a sudden doubled with the entry of India, China and former Soviet Block countries into the liberalised global market in the recent period. He suggests that in 1985 there were about a billion workers who competed with each other under 'globalisation' i.e. these countries by then had achieved more or less free trade and more or less free capital movements amongst themselves. This globalised countries group at the time consisted of the OECD economies and Latin America. According to Freeman's estimate, approximately 960 million people worked in these countries in 1980. By the year 2000, the size of this labour force had increased to 1460 million workers, mainly through population growth in the developing countries part of this group. However, with the entry of India and China and the former Soviet bloc countries into the globalised economy, by the year 2000 the global labour force had doubled to 3 billion, of which nearly half, i.e. 1.47 billion were the Chinese, Indian and other new entrants to the labour force (see Graph 2). This doubling of the labour force of the world's integrating liberal capitalist economy Freeman suggests, has, on the whole, pleasant consequences for low income countries such as India and China, but potentially rather unpleasant outcomes for high wage workers in rich countries.

Graph 2: The Great Doubling: critical lens for assessing what globalization does to labor



Source: Freeman (2005)

Freeman notes that these additional 1.5 billion workers from the newly globalising countries had brought very little capital with them. As a result, the global capital labour ratio was cut to 55 percent of its pre-2000 level. This decline in the world capital labour ratio not only reduces average productivity but also makes capital scarce shifting the balance of power towards it.

The conventional analysis of North-South trade involves the notion that countries should produce according to their comparative advantage, with rich countries specializing in skill intensive or capital-intensive products and poor countries in labour-intensive and less skilled products. Freeman regards this theory as obsolete in view of the outsourcing of many skill intensive jobs to the South and the ability of countries like India and China to produce more absolute numbers of engineers and science graduates than the US In 2003, China graduated 325,000 engineers and the US only 65,000. Even taking into account the technical superiority of the American engineers over the Chinese, this difference is too large for US comfort. Freeman argues that the probability of achieving technological innovations depends on the *absolute* numbers of technically trained people rather than their relative numbers. The reality according to Freeman is that the US is likely to lose its technological lead unless it takes extraordinary steps to reverse the present course of events. In the hi-tech sector, US pre-eminence is visibly under threat. The US share of world exports of hi-tech manufacturers fell from 30 percent in 1980 to 17 percent in 2000 and similarly its share of imports rose from 13 to 18 percent over the same period. To sum up, Freeman is basically suggesting that industrial revolutions in China and India, represent gigantic supply-side shocks for many parts of the world economy, particularly the US These are likely to be extremely disruptive and harmful for these countries and regions not just in the short-run but also importantly in the long-term.

Nevertheless, it must be emphasized that Freeman does not advocate protection as a way out of these difficulties. Though non-protectionist, Freeman's policy perspective is highly interventionist, and none the worse for that. He calls for resolute and determined government intervention, at the national as well as at the international levels to manage the transition during which the new globalisers will catch up with the United States. He expects this transition to be long and protracted – it may take as much as thirty to forty years. His examples of good transition include West European catch-up after World War II; the bad transitions include southern American states' integration after the civil war with the more industrialised north. These also include the East German integration with West Germany after the break-up of the Berlin Wall. Freeman argues against the current 'Washington Consensus' globalisation that, in his view, is biased towards protecting the interests of capital. He writes eloquently: 'The

international financial institutions may have to worry about instability of capital markets and crony corrupt capitalists, but they don't have to worry about capital more broadly: George Soros and his billionaire friends can take care of themselves. It is the average worker in the world who needs the protection of the international community' (Rocco C. and Marion S. Siciliano Forum 2005, pages not numbered).

3. Supply-Side Shocks and the Growth of Demand

Professor Freeman's apprehensions about the impact of China's and India's integration on the North's workers are well argued and supported by careful analysis and evidence. Like his 1995 article, this research represents a seminal contribution to the debate on this important subject. His arguments therefore require careful consideration.

At a theoretical level Professor Freeman's essential argument is that the supply side shock of doubling of the world's labour force will have a profound impact on labour markets in other countries. The size of the shock will make it disruptive. There is much in Freeman's analysis we agree with, but there are also parts with which we have difficulties. For reasons of space and to add to the debate, it is the latter that we highlight below.

Thus, one important shortcoming of Freeman's analysis, in our view, is that it provides very little explicit consideration of demand side factors. In an early contribution, Singh (1977) suggested that foreign competition and the balance of payments position of an economy can affect its growth and industrial development through three distinct but related channels: (a) through the level and growth of demand; (b) through the structure of demand and (c) importantly, through investment. In considering these channels, R.S. Sayers's (1965) simple distinction between the complementary and competitive aspects of economic growth elsewhere is useful. The central point of Sayers's analysis is that 'the expansion of the world economy, although it may raise the demand for a country's products, also creates alternative sources of supply, which may compete with them in any market, including its home market. So, from the point of view of a particular country, the development of the world economy may be characterised by a changing balance between 'complementarity' and 'competitiveness'.'

In the specific case of the integration of China and India with the world economy, economic growth in these two countries is on the whole likely to be more complementary than competitive with the US economy and that of many other countries. The essential point is that India and China, by virtue of their size and high growth rates which they require for meeting their huge employment and other social needs, now constitute another growth pole for the

world economy. Together, these two countries account for about **20 percent** of world production and world demand. Their demand side effects have already led to expansion in several countries, both developed and developing. There is evidence that in the recent period China's trade with Japan was helpful in preventing the Japanese economy from going into recession. As Overholt (2005) notes,

> 'Chinese demand provided the stimulus that lifted Japan out of recession [during the slowdown in world economic growth following the collapse of the technology bubble on the stock market]. It is difficult to overstate the risk the world economy faced from the Japanese situation, where mountainous debt created the risk of a domino-like collapse inside Japan and subsequent rippling collapses around the world. That risk seems to have passed, helped by a critical margin of stimulus from China. Few books are written about global depressions that never happened, but it is quite possible that China's globalisation saved us from beginning the new century with a drastic global economic squeeze.'

Developing countries in general have benefited from the demand stimulus for raw materials and commodities provided by fast economic growth in China and India leading also to faster economic growth elsewhere. Sustained growth in these two countries thus provides a stable source for the growth of world demand in general with favourable effects on the developing as well as developed countries.

The aggregate and sectoral demand effects of Chinese and Indian economic expansion manifest themselves in other ways too. For example, the production of cheap goods in India and China, particularly in the latter, helps reduce inflationary pressures in advanced countries thereby allowing their economies to be run at higher levels of output and employment than they otherwise would. Unfortunately, there are few empirical studies which quantify the effects of this channel. IMF (2006) has recently explored the question of the effects of globalisation on inflation. These effects are estimated to be in general quite small – a reduction in inflation of the order of 0.25 percent, although estimates rise to 1 percent or more for specific years and specific countries. These studies, however, are unable to measure the full extent of the effects of globalisation on reducing the general level of prices, in large part because the real influence of globalisation is in this instance not directly quantifiable. As Raghuram Rajan (2006) notes: 'In my view, however, the true impact of globalisation has been in contributing to wage and price restraint at a time when central bankers were establishing their inflation-fighting credibility, thus

allowing them to achieve targets and gain credibility without the need to tighten to politically difficult levels' (IMF (2006), p. xi).

The favourable impact of Chinese and Indian economic growth on the US economy comes also through other related channels. For example, it is estimated that lower prices for basic goods as a result of trade with China, India and other developing countries has contributed significantly to the standard of living of low-paid American citizens. Preliminary estimates suggest that these lower prices help raise standards of living of poor Americans by about 5 to 10 per cent. Similarly, Chinese purchases of US Treasury bonds have helped to finance US budget deficits without which the US would have had higher interest rates and hence slower growth. Although these may be regarded as short-term measures, they have nevertheless helped to keep up for several years the rate of growth of the US economy and hence of the world economy.

There are undoubtedly also some negative effects of Chinese and Indian economic growth on the US economy. The most important of these is the competition from the two countries for the world's scarce raw materials and commodities. The enormous Chinese and Indian demand for these products, including oil, helps raise their prices and thereby, other things being equal, disadvantage the US economy. Even taking this negative factor into account, the overall balance of globalisation for the US economy is certainly likely to be favourable, particularly if the world's nation states adopt in the future a mutually advantageous cooperative attitude towards issues concerning environment and scarcity of raw materials.

4. Limitations of Previous Research

The above considerations do not show adequately, if at all, in the three generations (namely those covering the periods 1960-1980, 1980-2000 and 2000-2005 respectively) of conventional studies of the impact of globalisation on US labour markets[3]. This is mainly because these are partial rather than general equilibrium studies. There is very little research of the latter kind that is available. There is, however, a recent contribution by Bailey and Lawrence (2006) that addresses this methodological problem to some extent. The two authors examine changes in employment between 2000 and 2003 in the US economy, a period which has been marked by a relatively short recession. The strong upturn following the recession did not however lead to much net job creation, and hence the emergence of 'jobless growth.' In the normal public discourse, these unfavourable labour market outcomes, are blamed on globalisation, including outsourcing of service jobs to India. The authors carried out their empirical analysis on a detailed individual industry basis. They use the following empirical model, as well as an input-output model of the US economy to address these questions.

$$e_i = w_d (d - v) + w_x (x - v) - w_m (m - v)$$

Where e_i connotes percentage change in employment; w_d, w_x and w_m are the weights attached to domestic use, imports and exports respectively. This equation is an ex-post identity, in which 'percentage change in employment is equal to the weighted average of the percentage changes in the differences between the growth rate of labour productivity and value added due to domestic use, value added due to exports, and value added attributable to imports' (p.229).

Using this framework, the authors conclude that of the 950,000 net manufacturing jobs lost by the year 2003, only 105,000 were due to trade and the remaining 845,000 to reduced growth of domestic demand (see Sichel 2004, p.279).

Thus Baily and Lawrence's paper suggests that the jobless growth in the US economy in the first half of this decade was not due to globalisation as is commonly believed, but to other factors. It further indicates that imports from the Third World, including out-sourcing, had a negligible impact on US labour markets. Much the greater impact of globalisation came from reduced US exports to other countries that was mainly a result of the appreciation of the US dollar against other currencies. The other main reason for the jobless growth and unfavourable labour market outcomes such as job instability arose from insufficient expansion of aggregate demand in the US economy. Although Baily and Lawrence's contribution represents a methodological advance over previous studies, even this does not yet provide a fully satisfactory general equilibrium model. Baily and Lawrence assume that the rate of growth of productivity is an exogenous variable, which many analysts would regard as being eminently endogenous.

5. Dynamism of U.S. Real Economy

Although Professor Freeman has raised the right questions about the potential for disruption which doubling of the world labour force raises, he perhaps under-estimates the capacity of the US economy to provide employment and adjustment to those who would lose their jobs as a result of competition. As John Hicks suggests, although there is no guarantee that all those who have lost their jobs due to competition in the product markets will find jobs elsewhere, the probability is much higher that they will do so in a fast-growing, dynamic economy than in a stagnant, low-income economy. The US, during the last ten years in particular, is precisely the former kind of economy.

Professor Jorgensen and his colleagues (see for example Jorgensen et al., 2005) have provided information on growth, productivity, IT services and other relevant variables for G7 countries on a comparable basis. This body of research, which includes several other papers by the authors and their collaborators, is the most authoritative work on the subject. It represents immense scholarship and exceptional application as it provides comparable data for all these countries, particularly in relation to the input and output of IT services, adjusted for quality changes.[4] The notable features of this research, which are relevant for this essay are given below.

- During the period 1995-2000, the US economy has been by far the fastest growing economy among G7 countries with a growth rate considerably higher than that of European countries as well as Japan. The Japanese economy performed better than the US in terms of the growth of labour productivity over this period. However, whereas hours worked arose by 1.99 percentage points in the U.S., in Japan these fell by 0.79 percentage points. Taking output and employment together, the U.S. performance was clearly the best of all G7 countries.
- In addition, there is general agreement that the U.S. economy has continued to perform strongly in the new millennium. The figures for the period 2000-2005 indicate that the productivity growth rate accelerated further and the country recorded during this period the highest productivity growth in its history. Overall, the data suggest that since 1995 the U.S. economy has achieved a trend increase in its long-term historic growth rate of almost one percentage point per annum. This surge in productivity growth in part contributed to the U.S. phenomena of jobless growth in the early parts of this decade. Jorgensen, Ho and Stiroh's suggest that the 1.57 percentage points difference between productivity growth in the periods 1973-95 and 1995-2003 respectively was about half due to an increase in capital per person including IT technology (i.e., capital deepening) and half due to an increase in total factor productivity. In view of the aging of the labour force the contribution of the labour input to productivity growth was slightly negative.
- In short, the above data suggest that the U.S. has one of the most dynamic economies in the world. The US dynamism is remarkable for the fact that it is not a catch-up economy but a frontier economy which has to do the hard work of discovering new knowledge in order to achieve sustained growth. In these circumstances the significant recent trend increase in output and productivity growth rates over that of the last hundred years is quite extraordinary.

Professor Freeman raises two other issues that require comment in the light of the discussion above. He is worried about the U.S. economy being able to retain its technological lead in view of the much larger number of science and engineering graduates in developing countries. This apprehension also seems to be somewhat overdrawn. It is indeed true that India and China have large educated labour forces, but their capacity to innovate is hugely below that of the U.S. This is because innovation does not just depend upon the ideas of science and engineering graduates, but also importantly on the scientific and technical infrastructure, on the country's technical culture, and on organizational capabilities of firms. In these respects, the U.S. is way ahead of India and China and will remain so for a long time. Baumol (2002) has convincingly argued that the U.S. industrial structure of oligopolistic competition between giant firms is capitalism's built-in innovating machine. There is no reason to believe that this machine will become any less potent in the future. However, it may also be the case that substantial government intervention may also be required in this area to achieve the desired social goals. The U.S. economic historian, William Lazonick (2008) suggests that the U.S. government is already providing assistance to corporations working in high-tech industries.

Finally, Professor Freeman's point about investment is critical. However, the inherent dynamism of the U.S. economy suggests that it will continue to be an attractive place both for domestic and foreign companies.

6. Summing up: A Preliminary Assessment

To sum up, previous sections have paid particular attention to the important work of Professor Freeman which suggests that even if trade with the Third World has not in the past seriously disadvantaged workers in the North, the doubling of the global labour force with the entry of India and China into the liberalised global economy in the new millennium may have profoundly unfavourable repercussions for workers in ACs. The above analysis has welcomed Professor Freeman's pioneering and original contribution to this debate. It is broadly in sympathy with much of his analysis but it also contains a friendly and constructive criticism of parts of the Freeman argument. Two major points of difference with Freeman have been emphasized. The first concerns his inadequate attention to the demand side variables, which may in part address the supply side problems arising from the entry of India and China. Secondly on the supply side, he does not give adequate recognition to the dynamism of the U.S. real economy, its entrepreneurship and highly competitive and innovative large corporations. The best corporations from all over the world including the U.S. itself will continue to wish to invest in the United States. Achieving a solid presence in the U.S. market remains a coveted prize for businesses everywhere.

Further as Jorgenson and Vu (2007) rightly observe:

'Differences in per capita output levels (between countries) are mainly due to input per capita rather than productivity. This reflects the fact that technology is relatively easy to transfer from industrialized economies to developing economies, while mobilization of capital and labor inputs requires much more time and considerably greater effort. Outmoded techniques of production must give way to newer methods that incorporate the latest technologies, especially those that utilize information technology equipment and software.'

Hence the preliminary assessment of the present paper is that there are significant forces at work both on the demand and the supply sides which indicate that notwithstanding the size of the two countries, the effects of China's and India's present industrial revolutions on advanced countries in the future can be accommodated just as well as those of Japan and Italy were in the past during their periods of rapid industrialization in the 1950's and 1960's (See further Singh, 2005; UNCTAD, 1995). As elaborated in UNCTAD (1995) and Singh (2005), this accommodation occurred in the golden age, mainly because of faster OECD and world GDP growth. It will be recalled that between 1950 and 1973 real wages of the U.S. workers rose at a rate of approximately 2% per annum.

Thus although the analysis so far indicates that Professor Freeman has perhaps been unduly pessimistic about the prospects of the U.S. economy in response to Chinese and Indian industrial revolutions, he has nevertheless raised extremely important policy questions that deserve the attention of economists now and in the future.

7. Towards a Revised Conclusion

The main reason why the above assessment should be regarded as preliminary is because it has not been checked so far against an empirical model of the world economy. It is necessary to do so because issues involved are inherently complex and one needs to be sure that all the important inter relationships between variables are been properly taken into account.

The model we used for checking whether our hypotheses and conjectures in previous sections are broadly accurate is described in Appendix 1. This is the CAM world model which draws its inspiration from an earlier Cambridge model associated with Francis Cripps and Wynne Godley. This model was very influential in the UK during the 1970s and early 1980s[5]. It is essentially a demand-driven model but is subject to some resource constraints. The results from two simulations of the model are reported below. The first one is based on the scenario that the current trends continue. The second scenario puts China

and India as the main drivers of world economic growth. China is supposed to grow at a rate of 11% per annum (about the trends rate) and Indian economy is postulated to grow at 9% per annum (rate achieved during the last three years). The conclusions of the two simulations are reported in Appendix 2.

The central point which emerges from the simulations is that the first scenario is totally non-sustainable as it leads to huge current account deficits for the U.S. economy and other unsustainable features. The second simulation suggests that the high growth rates in India and China will also run into resource constraints and are incompatible with growth rates of 3% per annum in G7 countries. This simulation does not lead to non-sustainability as it is assumed that India and China as well as other countries pursue a strong program of achieving energy efficiency and making the necessary investments for more efficient production of food and raw materials. Despite all these adjustments, the postulated high growth rates for India and China are only compatible with reduced G7 growth rates. Thus Freeman is right after all in that there is a conflict between the interest of the workers in the North and the South. This requires coordination and cooperation between the two sides and as Freeman suggests a careful handling by the world community if global economic integration is to continue harmoniously.

It will however be appreciated that fast economic growth in India and China is a social necessity because of the need to shift hundred of millions of people from farms to industry. In the Indian case there is an additional compulsion of that of providing jobs for a labour force which is growing at 2% per annum. The rise of the Indian growth rate to nearly 9% per annum during the last three years is internally sustainable as it is based on a trend increase in the country's saving and investment rates from about 25% to well about 35%. However if such growth rates are not compatible with the desired growth rates of OECD countries this creates particular difficulties for India and China because of the social repercussions of insufficient job creation in these countries.

It is also interesting to observe that in our pre-model analysis in sections 5 and 6, at an aggregate level there did not appear to be a supply-side constraint for the world economy. The world economy has been growing at about 4% per annum in the recent period. The supply-side potential seemed to be huge because of the enormous catch up possibilities for China, India and other emerging countries. In addition, the world has available to it the revolutionary new technology of ICT which most countries have barely begun to use. However the simulations on the world economic model show that at a disaggregate level there are severe constraints on the supply-side which thwart the expansionary demand side effects of fast growth in China and India.

Notes

[1] For presentation to a non-U.S. audience, Singh (2007a) wrote as follows. 'There are three reasons why Professor Freeman's contributions have been given special attention in this paper. First, he is a leading US labour economist who has done highly regarded research on this subject. He also evidently has sympathies with the trade unions and may be regarded as a bell weather for important sections of American intellectual opinion. Secondly, about ten years ago Professor Freeman (1995) had written a seminal article with the mischievous title "Are Your Wages Set in Beijing?". He at that time argued that this was not the case and that there was insufficient integration between the US and Chinese labour markets to warrant the conclusion that it is the Chinese rather than the US labour market, which determines employment and wages for US workers. Professor Freeman today is more likely to reach an opposite conclusion. Thirdly, his argument is looking more to the future that to the past, as explained in the text above.'

[2] Many scholars would argue that two countries should have had their industrial revolutions more than a hundred years ago but they were thwarted in this endeavour by colonialism including unequal treaties.

[3] This issue is discussed at some length in Singh (2007)

[4] The methodology underlying the analysis is succinctly summarised in Jorgensen (2001) as follows: 'Under the assumption that product and factor markets are competitive, producer equilibrium implies that the share-weighted growth of outputs is the sum of the share-weighted growth of inputs and growth in total factor productivity:

$$
\begin{aligned}
& w_{I,n}\,\Delta \ln I_n + w_{I,c}\,\Delta \ln I_c + w_{I,s}\Delta \ln I_s \\
& + w_{I,t}\Delta \ln I_t + w_{C,n}\Delta \ln C_n \\
& + w_{C,c}\Delta \ln C_c \\
= \quad & v_{K,n}\Delta \ln K_n + v_{K,c}\Delta \ln K_c \\
& + v_{K,s}\Delta \ln K_s + v_{K,t}\Delta \ln K_t \\
& + v_L\Delta \ln L + \Delta \ln A
\end{aligned}
$$

where w and v denote average value shares. The shares of outputs and inputs add to one under the additional assumption of constant returns,

$$w_{I,n} + w_{I,c} + w_{I,s} + w_{I,t} + w_{C,n} + w_{C,c} = v_{K,n} + v_{K,c} + v_{K,s} + v_{K,t} + v_L = 1.'$$

[5] This is the so called Cambridge Economic Policy Group (CEPG) model.

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Appendix 1: The CAM: Cambridge-Alphametrics Model of the world economy

World economy databank

The databank is constructed from observations reported by more than 200 countries and it is made possible thanks to the collaboration of UN/DESA and the UNDS who provide the raw data. Complementary data is obtained from databases of other multilateral organizations, like the WB and the IMF, and national statistical offices.

SoWE researchers at Alphametrics (Saraburi, Thailand) update a world databank at least twice a year. Original observations are recombined and supplemented by estimates to deal with boundary changes and fill gaps in the historical record. They are then further adjusted to reconcile totals obtained from different sources and enforce adding-up constraints for the world as a whole. Adjustments are made using an algorithm that minimizes changes to the original data. The algorithm is a creation of Alphametrics Co., Ltd. and is based on standard statistical methods for large systems.[6] Each observation in the databank records the original and final (adjusted) value with a source reference and quality indicator.

The data set in its final form is provided in an excel worksheet with an embedded VBA programme that extracts from the SQL databank. The databank provides over 840,000 observations on trade, balance of payments, income, expenditure, population and energy production and use. These data may be extracted as annual time series covering the period since 1970 for the world divided into 127 countries and country groups ('flexible geometry').

There are a number of pre-determined **country groups**, such as:

A **'standard'** disaggregation (12 blocs): U.S., Japan, Western Europe, Other Developed, Eastern Europe, Former USRR, Middle East, China, India, Other developing Asia, Developing America and Africa.

'Income' disaggregation (12 blocs): dividing the world into three broad geographical regions with high-income, low-to-middle income and low-income country groups. The USA, China and India are distinguished individually.

'Energy' variants: propose groups in five geographical regions, distinguishing exporters and importers. The USA, China and India are distinguished individually. The disaggregation proposed under the name '**UNLIC**', presented

at the EEA conference 2008, takes the UN classification of world regions, further subdivided into high, middle and low income groups thus allowing to focus on the situation of 'Low income countries' (LICs):

bloc		**% pop**	**cum%**	**%2006 income**	**cum %**
United States	US	5%		27%	
Japan	JA	2%		9%	
EU-15	EUH	6%		28%	
Other Europe: High Inc	EOH	1%		3%	
Other Developed	ODH	1%	15%	5%	72%
Other Europe: Mid-Inc	EOM	1%		1%	
CIS (former USSR)	CIM	4%		3%	
China & HK	CN	20%		6%	
D'ng Asia: Mid-Income	ASM	8%		5%	
West Asia	WAM	3%		3%	
Latam Mid- Inc	AMM	7%		6%	
Africa Mid-Inc	AFM	3%	46%	1%	24%
South Asia	SAL	24%		3%	
D'ng Asia: Mid-Income	ASL	3%		0%	
Latam Low- Inc	AML	1%		0%	
Africa Low-Inc	AFL	11%	39%	1%	4%

World economy model, baseline and scenarios

The model runs on EViews programming that can be altered to revise baseline projections and simulate alternative scenarios and even create model variants using different geographical disaggregations. The programs load historical data and generate series for model variables, run econometric estimations, define model equations and generate a baseline projection and policy simulations.

The initial step is to create the historic stock-flow **dataset** that is consistent with national accounts and world aggregation rules.

Further, **inequality measures** are calculated to monitor changes in the dispersion of average per capita values between blocs. A Gini index GY is calculated for income per capita; Theil indexes are calculated for a wider set of variables including income Y, expenditure H, energy use and energy supply ED and EP, and exports of manufactures and services XM and XS. These inequality measures are embedded into the model solution so that each projection provides the variations in inequality over the future.[7]

The typical way to construct the baseline is to project implications of a continuation of current trends and policies into the future.

Alternative scenarios explore the potential requirements and consequences of policy changes. Scenarios may be defined by setting targets for a number of endogenous variables (outcomes), implying modification of the future path of a corresponding number of exogenous variables or structural relationships (instruments). Combinations of targets and instruments must be chosen carefully with consideration of mutual compatibility and timescales. Scenarios may also be used to examine sensitivity of the model (impact of changes in assumptions).

Methodological principles

The model is anchored in a **consistent stock-flow framework** by the application of a strict accounting principles and the use of algorithms to make that identities hold in each run.

The **structural relations** that drive adjustments are estimated and fitted according the following principles:

• The same structural forms are used for all blocs to facilitate use of the model with different lists of blocs.
• Structural relations are estimated econometrically under a variety of specification models and geographical aggregations in panel data (including a time series – cross section panel for the 127 countries!). After revising results and studying properties and confronting with historic evidence beyond the raw economic data (e.g. institutions, history, etc) final values are decided to construct 'pseudo-inexact' relations depending on the stochastic properties of the residuals and trends.

• Consistency of historical data with structural relationships is examined using normalized series. Typically a first difference form is estimated for the historical period and continuation of the same residual behaviour is assumed in the baseline projection.
• The historical pattern of residuals is examined to check plausibility of data and structural relationships. In cases where trends change significantly for reasons that are reasonably well understood but not captured by the model (eg demography or energy supply) baseline forecasts may be modified by inclusion of add factors.
• Values of structural coefficients are imposed and should not be revised unless there is good reason or evidence for the change. Prima facie the same structural coefficients (elasticities and lags) are applied for all blocs.
• Fine tuning of structural forms and coefficients may be misleading and thus is not recommended. Simulation properties should not depend too much on the point in time at which simulations are calculated or the geographical disaggregations used.
• Add factors may also be used to model the present - ie adjust predictions for the last or current year in the light of known developments that are not reflected in the databank.
• These same add factors are used to simulate policy scenarios by imputing known (established by econometric or circumstantial evidence) or assumed policy effects.

Overview of main structural equations in the CAM

Population

Population N is extrapolated using a difference equation

$dlog(N) = c + u$

Real exchange rate

The real exchange rate for each bloc is an index of the ratio of the price of domestic expenditure to the price of world exports of manufactures. It is assumed that the real exchange rate is influenced by the current account position; if a country has a strong current account the real exchange rate appreciates more rapidly. The equation for each bloc written in difference form is

$$dlog(RX) = c + RX\_add - 0.10\ log(RX(-1)) + 0.25\ log(1+CA(-1)/(RX(-1)*Y(-1))) + u$$

where RX_add is an instrument that may be used to push the real exchange rate for the bloc in one direction or another (eg in reponse to policy).

Predicted real exchange rates for all blocs, RX, are scaled up or down to maintain a constant ratio of the price of exports of manufactures to the price of domestic expenditure for the world as a whole.

Primary commodities

World markets for primary commodities are driven by price, more particularly the terms of trade between primary commodities and manufactures. When the terms of trade move in favour of primary commodities we can expect faster growth of supply and greater efficiency in use, reducing growth of demand relative to income. When the terms of trade move against primary commodities market pressures work in the opposite direction. The influence of changes in the terms of trade takes time to come through since responses require organizational changes and investment in R&D, infrastructure and production facilities.

For the purposes of the CAM model the average lag in response of production and demand to changes in world prices is assumed to be around 3 years. The model defines lagged price variables PALS and PELS in log form as

PALS = 0.3 log(PA) + 0.7 PALS(-1)
PELS = 0.3 log(PE) + 0.7 PELS(-1)

where PA and PE are terms of trade indexes for food and raw materials and energy products respectively.

A lagged real exchange rate variable RXLS_{%b} calculated with the same lag is used to convert world terms of trade indexes to a domestic price basis for each bloc.

Although prices in the world market are important, production of primary commodities in each country or region (bloc) also depends on growth of domestic demand, whether because of product differentiation, transport costs, subsidies or other forms of protection. To capture the influence of domestic demand on production, the CAM model defines assumed components of production for the domestic market, AH and EH, that are insensitive to world prices. These components are imputed as follows:

AH = AP AD / (AP3 + AD3)1/3
EH = EP ED / (EP3 + ED3)1/3

where AP, EP and AD, ED measure production and domestic use of food and raw materials and energy products respectively.

The value of these functions approaches 80% of domestic demand or production when production equals domestic demand.

Demand for food and raw materials AD in each bloc is assumed to follow an Engel curve of the form

AD = 150 N + 0.5 Y exp(-0.3(PALS-RXLS))

while demand for energy is given by an equation for changes in energy efficiency:

dlog(ED/Y) = c - 0.05 d(PELS-RXLS + log(1+ED_tax)) + u

where N is population and Y is income. The symbol c denotes a bloc-specific intercept (rate of energy saving) and u is a stochastic residual. The variable ED_tax is used in scenarios to simulate 'green tax' measures or carbon credits that restrict energy use and emissions.

Changes in production depend on domestic demand and world prices as well as other bloc-specific factors represented by intercepts c and stochastic terms u:

*dlog(AP-AP_add-0.7*AH(-1)*AD/AD(-1))-0.1*d(PALS-RXLS) = c + u*
*dlog(EP-EP_add-0.7*EH(-1)*ED/ED(-1))-0.1*d(PELS-RXLS) = c + u*

The add factors AP_add and EP_add could be modified in baseline projections and scenarios to incorporate variant assumptions about future supply trends in each bloc.

The terms of trade PA and PE are adjusted to balance supply and demand for the world as a whole

AP = AD and EP = ED

The adjustment is implemented at each iteration of a model solution using the following formulae:

PA = PA (AD / AP).8
PE = PE (ED / EP).8

The terms of trade for each commodity group are instantly adjusted up or down by 8% for each 1% shortfall or excess in global supply relative to demand.

Trade balances for primary commodities

In the case of food and raw materials, series representing demand and production have been defined to satisfy a simple trade balance identity for each bloc:

BA = PA (AP - AD)

where BA is the trade balance measured in terms of purchasing power (for exports of manufactures), PA is the terms of trade and AP-AD represents net exports or imports measured in constant dollar terms.

In the case of energy products the trade balance measured in value terms (purchasing power for exports of manufactures) is compared with the physical balance

EB = EP-ED

which is measured in million tons of oil equivalent and the real price of oil.

The relationship is written as a difference equation:

*BE - BE(-1) = 140 * (PE EB - PE(-1) EB(-1))*

The coefficient (140) represents the average base-year price of traded energy products in dollars per ton of oil equivalent. To ensure that the value balance for the world as a whole will sum to zero when the physical balance sums to zero, no intercept or residual autocorrelation has been estimated.

Trade in manufactures

Imports of manufactures MM are assumed to change progressively as a ratio to domestic spending H and exports of manufactures XM, the latter having an import content two-and-a-half times as high as the former:

dlog(MM/(H + 2.5 XM)) = c + 0.8 dlog(RX) - 0.2 d(dlog(H + 2.5 XM)) + u

The equation includes a real exchange rate term with an elasticity of 0.8; thus a higher real exchange rate implies an increase in the value of imports in foreign currency terms and a small reduction in terms of domestic purchasing parity.

Exports of manufactures depend on the exporting bloc's market share SMp in imports MMp by each partner bloc:

XM = sum (SMp.MMp)

Market shares depend on exchange rate movements and ongoing structural shifts:

dlog(SMp) = c + SM_add + 0.2 dlog(RX) - 0.5 d(RXLS(-1)) + u

There is an adverse first-year effect of devaluation which is reversed in the following years provided the real exchange rate advantage is maintained. Shares calculated by the above formula are scaled to sum to unity.[8]

The trade balance is the difference between exports and imports:

BM = XM - MM

Services
Imports of services are assumed to depend on the real exchange rate, domestic demand and imports of manufactures (the latter being heavily weighted):

*dlog(MS) = c + 0.6 dlog(RX) + 0.9 dlog(H+5.0*MM) + u*

Exports of services are predicted on the basis of world imports MSw and own imports of services.

dlog(XSU) = c + 0.7 dlog(MSw) + 0.5 dlog(MS) + u

Results for each bloc are scaled to sum to world imports.

External income and transfers
The balance on income and transfers is assumed to change in response to the prior-year current account (net lending or borrowing) and exchange rate movements (devaluation being favourable for a country with a deficit on income and transfers):

d(BI) = c + 0.025 CA(-1) + 0.5 BI(-1) d(RX_?)/RX(-1) + u

Adjustments are made to ensure that credits equal debits for the world as a whole.

Domestic expenditure

The model is completed by specifying the adjustment of domestic expenditure H in each bloc as a function of income Y. The balance of payments on current account CA has been introduced as an additional influence on domestic credit expansion whose weight depends on a country's relative per capita income level YR. Thus the balance of payments is assumed to exert a significant influence on demand policy in low-income countries but little influence in high-income countries. An intercept term allows different blocs to have a stronger or weaker tendency to credit expansion and residuals are assumed proportionate to spending.

d(H)=0.5d(Y)+0.25d(Y(-1))+1/(1+YR(-1)2)2(CA(-1)-0.2d(Y(-1)))+(c+u).H(-1)

The global closure of the model

The balance of payments on current account is the sum of balances on merchandise trade, services and income and transfers and its closure encompasses the adjustment of structural relations at the 'domestic' level of each bloc:

$$CA = BA + BE + BM + BS + BI$$

Income Y is the sum of domestic expenditure and the current account measured in PPP units:

$$Y = H + CA/RX$$

The model is demand-determined and does not have economy-wide constraints on expansion of GDP. Supply constraints in individual sectors (food and raw materials, energy and manufacturing) influence aggregate demand and income through their impact on the trade balance.

Overview of Policy Scenarios

Scenarios are projections that make different assumptions about specific variables as a basis for a new solution of the model as a whole. In some cases, policy measures and their effects are imputed in the existing relations. It is not expected that a global model will have explicit variables and behavioural specifications for each imaginable policy initiative.

‘Target-instrument’ scenarios posit a policy objective (target), like an accelerated reduction in the US current account deficit from certain point in time onwards and proposes changes in a policy stance or condition (instrument), like imputed changes in US domestic demand emulating fiscal tightening or credit restraints, that could help achieving the objective.

Another type of scenario is one in which ‘add factors’ are changed one at a time to explore how such changes affect the results. This kind of scenario shows the 'sensitivity' of the model to changes and can be used to make ‘trial-error’ experiments in policy-making.

Some of the scenarios that are usually proposed in the CAM are:

How to reduce the US current account deficit
Either by ‘target-instrument’ or ‘trial-error’, CAD reduction can in principle be achieved by means of (i) deflation in the US, (ii) adjustments to the real exchange rate, or (iii) domestic expansion in surplus blocs. Generally, realistic scenarios result from a combination of some of these alternatives, but the specific configuration remains arbitrary.

The implied trade-offs are obvious: deflation in the US is recessionary both for the US and the rest of the world; drastic or lasting changes in the exchange rate may disrupt financial markets, asset prices, real balances and portfolio allocations in generally unknown ways; rest of the world reflation requires coordination and if it is achieved by a global demand push is leads to excessively high prices of commodities and energy (i.e. it reaches environment constraints).

How to stabilize global energy use and reduce emissions
The obvious mechanisms are (i) global growth slowdown, and (ii) green taxes. To achieve energy reduction, say to allow energy use to growth at ‘no-more’ than the average of last two decades, requires a severe recession with declining per capita income in most blocs. The price of oil declines in real terms, removing any price incentive for increased efficiency of energy use or substitution of clean sources in place of carbon-based fuels. Meanwhile, a tax on energy use (by raising an ‘add factor’ that has been named ED_tax), can be used to push up the user price of energy as necessary to prevent increases in global energy use. The producer price of energy declines in real terms at the same rate as in a reduction by global slowdown, but the user price increases substantially on account of the tax. In this way there would not be impact on global income (as compared with the base scenario), but there is an implied

redistribution of (trade) income from energy exporters to energy importers due to the reduction in the producer price.

The model does not yet provide for redistribution of revenue generated by the 'carbon tax', but it can be thought to add to, say a 'liquidity provision mechanism' to sustain either economic development in general or investment in energy efficiency.

How to obtain sustained income growth in low and middle income blocs
There are various alternatives. This could be achieved by domestic demand expansion (say a positive fiscal or credit stimulus) in low and mid-income countries. The combined impact is a boost to world markets. This scenario implies accelerated growth in high income countries and a smaller reduction in inequality indexes. Energy use increases faster and the price of oil rises more rapidly than in the baseline.

Another way is by calibrated ' ex-ante' real exchange rate depreciation in relevant blocs. Whether and how such a movement can be engineered by government and monetary authorities is debatable and by wage repression should be discarded. It is more likely that this can result from productivity increases due to improve production techniques, infrastructure and large economies of scale (see below). Supposing that such a trend can be achieved without social costs, the result of this scenario is faster growth in the blocs concerned and slightly slower growth in other blocs with some increase in global income and a small reduction in oil prices relative to the baseline. Inequality indexes for income, expenditure and energy supply and use improve faster than in the base scenario. Low income blocs would be moving up towards the world average. There are problems about the sustainability of this scenario, particularly if is it is not supported by sustained productivity increases. Firstly the trend is normally for the real exchange rate to appreciate in blocs where per capita income grows faster. If real exchange rates were to start moving in a more normal direction again it is logical to ask whether convergence will be halted or reversed. Another issue is the likelihood that real depreciation will aggravate income inequality within low-income countries.

An alternative would be a combination of the above with a strong emphasis on industrial policy, intra-regional trade (or better: South-South) trade aimed at increasing export manufacturing shares, and regulation aimed at checking excessive asset and debt dislocations.

Further on combined scenarios and international policy co-ordination

Experiments with the model are instructive and can as well serve to inform about concrete policy recipes. But to secure success to resolve problems of global scope two things need to be considered: well calibrated but parsimonious mixes of policy instruments to take care of trade-offs and policy reactions, and to coordinate policy worldwide. The CAM could serve as a tool for policy coordination exercises in so far as it advances in incorporating constraints and features that are critical for adjustment in the various world regions.

A1. ***Model variables***

AD million $, 2000 IPP Demand for food and raw materials
AP million $, 2000 IPP Production of food and raw materials
AH million $, 2000 IPP Domestic deliveries of food and raw materials
BA million $, 2000 IPP Trade balance in food and raw materials
BE million $, 2000 IPP Trade balance in energy products
BI million $, 2000 IPP Balance on external income and transfers
BM million $, 2000 IPP Trade balance in manufactures
BS million $, 2000 IPP Balance on services
CA million $, 2000 IPP Balance on current account
EB million tons of oil equivalent Net exports of primary energy
ED million tons of oil equivalent Primary energy use
EH million tons of oil equivalent Domestic deliveries of energy products
EP million tons of oil equivalent Primary energy production
H million $, 2000 PPP Domestic expenditure on goods and services
MM million $, 2000 IPP Imports of manufacturesX
MS million $, 2000 IPP Imports of servicesX
N millions Population
PA 2000 = 1 Terms of trade for exports of food and raw materials
PALS Log weighted lag value of terms of trade for exports of food and raw materials
PE 2000 = 1 Terms of trade for exports of energy products
PELS log weighted lag value of terms of trade for exports of energy products
PAL 2000 PA = 1 Lagged terms of trade for food and raw materials
PEL 2000 PE = 1 Lagged terms of trade for energy exports
RX Real exchange rate ratio (of domestic prices to W. price of manufactures)
RXLS log weighted lag value of real exchange rate
SM ratio Share of exports of manufactures of each bloc in the import market of
each partner bloc
XM million $, 2000 IPP Exports of manufactures
XS million $, 2000 IPP Exports of services

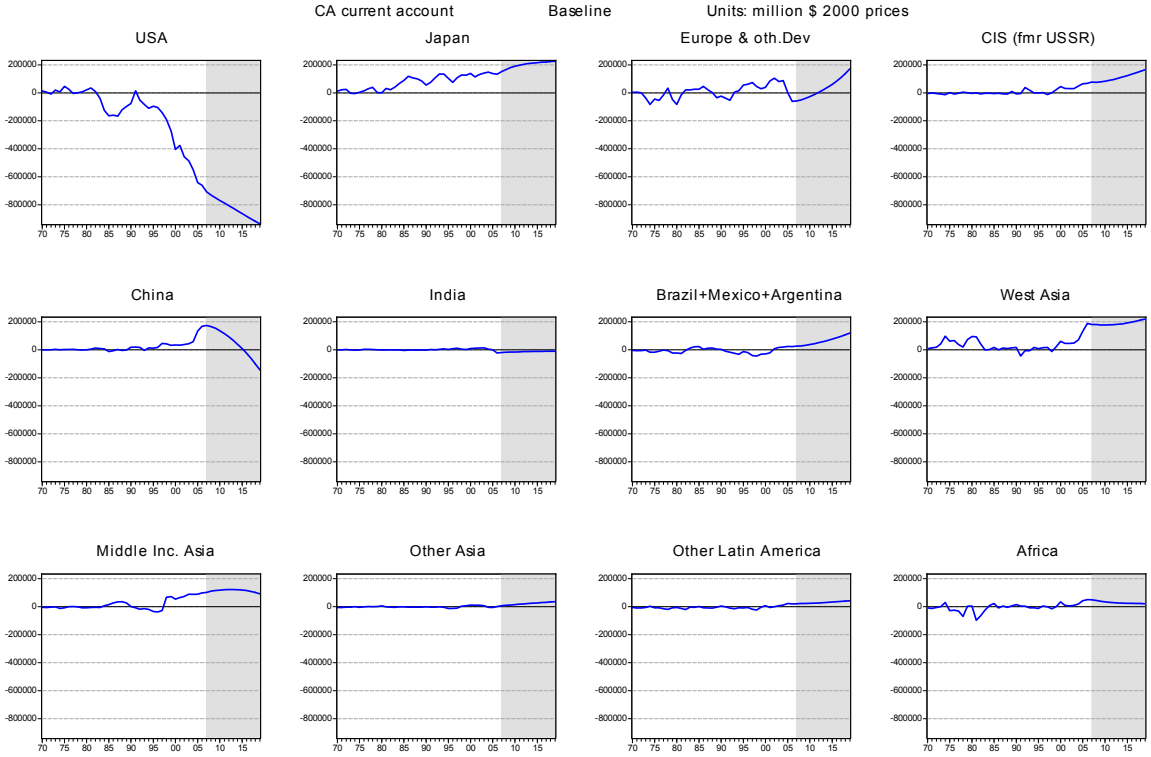
Y million $, 2000 PPP Disposable income
YR index, world avg = 1 in each year Relative per capita income (PPP)

Ratios and inequality measures:
CAY per cent Current account as per cent of income
Dxx per cent per year Growth rates of income Y, population N, per capita income YN, exports of manufactures M, exports of services XS, production of good and raw materials AP, energy production EP
GY, range 0 to 100 Gini coefficient for per capita income
LYR log Relative per capita income (log scale)
MMY Imports of manufactures as per cent of income
Txx, range 0 to 100 Theil inequality measures (comparing blocs) for income Y,
domestic expenditure H, energy use ED, energy production EP, exports of manufactures XM and exports of services XS
RX ratio Real exchange rate (ratio of domestic prices to world price of manufactures for the world as a whole)
RXL ratio Lagged real exchange rate
XMM Exports of manufactures as per cent of imports of manufactures
XMS per cent Exports of manufactures as per cent of world total
YN $ 2000 PPP Per capita income

Appendix 2

The relevant features of this empirical exercise are the following:

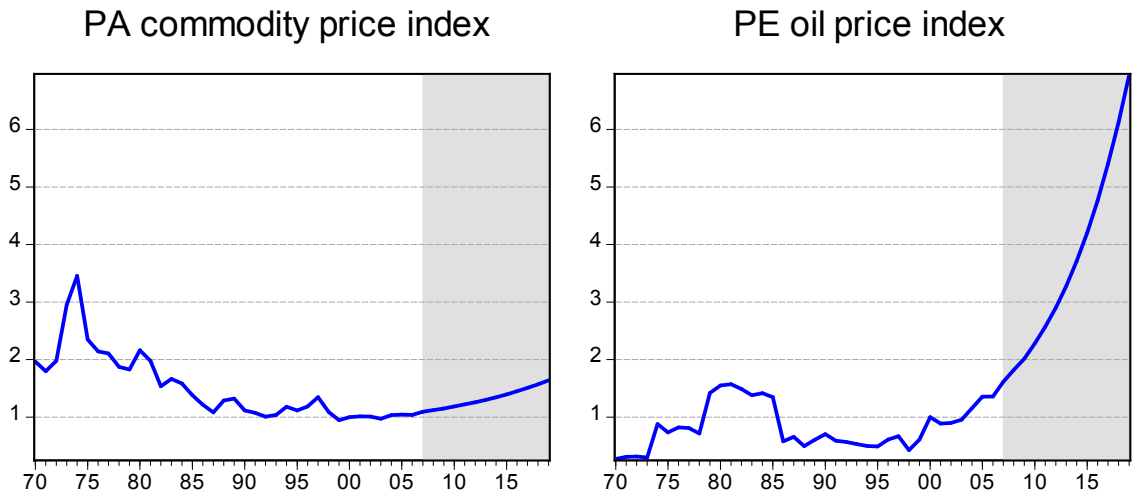
a) without policy intervention and international coordination, the current patterns point to a continuation of global imbalances in which astronomic current account deficits in the US will be matched by rapidly rising surpluses in other developed regions and main oil exporters. Exporters in primary commodities (like the Latin American region) will show surpluses as well (while China's surplus will start to decline as pressure on resources increase):



b) These patterns are untenable, firstly for reasons that have started to emerge in the current global financial turmoil: credit driven excesses of spending over income leads to the accumulation of unsustainable debts and thus are prone to crises. Secondly, the pressure on resources, particularly on energy but on primary products as well, is so great that, under current production and utilization patterns prices will surely escalate. If patterns of this kind are confirmed with time, this will have severe terms of trade and inflation implications for all. Most importantly perhaps, the rapid rising of such prices relative to the price of

manufactures will actually work as a disincentive for countries in the developing world to industrialize.

Prices of commodities and energy in Baseline
(relative to manuactures: base 2000 = 1)



c) the thesis proposed in this paper is that industrialization in the developing world is essential to the progress of these nations and that moreover efforts to industrialize can be coordinated in order to help resolving the problems posed above regarding global macroeconomic balances and pressure on global resources. A coordinated solution will seek complementary, rather than substitution, among industrializing nations, by which more advanced economies could concentrate on energy and input-saving production techniques that require greater capital accumulation and research costs. Meanwhile, all countries will strengthen efforts towards increasing production in primary resources and food, which in developing countries is more challenging because it requires significant and sustained investments in infrastructure. This is most important because the industrialization in developing nations and the expected growth convergence are likely going to imply unprecedented rises in the demand for food and raw materials. Likewise, there should be an effective mechanism to develop new techniques to save energy as well as investing in alternative sources.

d) For such a coordinated solution to kick start and avoid further reverberations of a drastic unwinding of global imbalances and a free fall of the dollar, the US economy will have to experience a noticeable adjustment of a 'soft-landing' kind, which is likely going to result from a combined slow down of domestic demand and a controlled devaluation. Eventually the latter will play the role of shifting market shares particularly among developed nations but because of the combined efforts in other industries than manufactures and the success in avoiding sky-rising prices of inputs and energy, all developed nations will eventually manage to grow around trend.

e) While at the same time assure that in the without policy intervention and international coordination, the current patterns point to a continuation of global imbalances in which astronomic current account deficits in the US will be matched by rapidly rising surpluses in other developed regions and main oil exporters. Exporters in primary commodities (like the Latin American region) will show surpluses as well (while China's surplus will start to decline as pressure on resources increase):

Simulation of Scenario 2

The purpose of this exercise is to illustrate the scope and limits of a scenario for the world economy with the following characteristics:

- ✓ The main drivers of global growth are India (IN) and China (CN)
- ✓ These blocs industrialize at a fast pace: CN follows the pattern consolidated over the last decade, while IN accelerates its industrialization drive. Together with a rapid increase of domestic demand, the impetus of exports of manufactures allow for growth rates of 9% in IN and 11% in CN.
- ✓ Because such patterns put a tremendous pressure on resources, these countries in particular are assumed to stress policies on energy and commodities. On commodities (raw materials and food) they have to accelerate production as well as efficiency of use. On energy, the main effort by both countries is on efficiency use, but CN will accelerate production as well.
- ✓ The rest of the world also contributes to alleviate pressure on resources, mainly by efficiency of use.
- ✓ The United States (US) experiences an adjustment in the direction of slowly reducing its current account deficit.
- ✓ Yet, the US and other developed regions (Japan, JA, and other developed included Europe, ED) will not be affected by a significantly slower growth (their growth rates will be around 2.5%). The initial adjustment in the US results from a combination of reduced domestic absorption and real exchange rate depreciation. Such a depreciation turns out to be against all regions, with the other developed blocs absorbing the most of the it. It is the exchange rate appreciation of developed regions which drives the relatively moderate growth performance in those regions and NOT the industrialization of IN and CN.
- ✓ The scenario improves all measures of distribution (income, manufacturing, etc.)

This scenario is posed as an alternative to the constructed ‘baseline’ which is a non-sustainable solution. The problems of such baseline are many, of which:

- o Global imbalances will continue to grow indefintively, with all the consequences that it carries.
- o The pressure on resources (energy and commodities) is exorbitant, which is manifested in ever rising prices of energy and commodities (food and raw materials).

- Under this baseline scenario there is hardly scope for countries in the developing world to develop by industrialization and the only source of success is the specialization in exports of raw materials and energy.

A series of plots comparing both scenarios are available from the authors. They are not included here for reasons of space.

The world is grouped into the following 12 blocs/countries: 1US, 2 JA, 3 ED: Europe & other developed, 4 IN, 5 CN, 6 UR: former USSR, 7 BMA: Brazil+Mexico+Argentina, 8 WA: West Asia, 9 AM:Other Middle income Asia, 10 AS: other Asia, 11 LA: Other Latin America, 12 AF: Africa.

Appendix notes

[6] See, for example, Nicolardi V. 'Balancing Large Accounting Systems: An Application to the 1992 Italian I-O Table'

[7] The Gini index is computed as

GY = 100 (1 - sum(n (s + s(-1)))

where the sum is taken over blocs ranked in ascending order of per capita income, n is the share of each

bloc in world population and s is the cumulative share of world income.

The Theil index is computed as

T = 100 (1 - exp(- sum(s ln (xn / XN)))

where s is the share of each bloc in world income or any other variable of interest, xn is the per capita

value in each bloc and XN is the per capita value in the world as a whole.

[8] The final result is equivalent to that of a CES or 'Armington' model.