Embodied human capital unemployment

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Abstract

Adam Smith (1776) devoted the first three chapters to the *division of labor* in his *Inquiry into the Nature and Causes of the Wealth of Nations*. This process, carried far enough, eventually results in a divergence between the *distributions* of supplies and demands of such horizontally-differentiated distinct types of human capital embodied in different persons, leading to the emergence of *Embodied Human Capital Unemployment*. We illustrate the relevance of this new concept of unemployment to the U.S economy in the first decade of the 21st Century. This helps achieve a deeper understanding of the current global economic crisis, and *inter alia* to identification of potentially effective, and potentially ineffective, public policies. (111 words).

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1. Introduction

Unemployment of persons who want to earn income from sale of their labor services, but fail in their attempt to do so, occurs due to distinct reasons, often simultaneously. The root cause, however, is material to the effective remedy. In this communication, We identify distinct types of unemployment on the basis of their respective original causes, so as to distinguish the public policies that will be effective, from those that will prove ineffective, in alleviating the adverse consequences suffered by unemployed persons and their dependents.

In particular, we provide a simple model, which is an *N*-sector variant of the Specific-factors model developed by Ron Jones (1971), with endogenous international capital mobility as modeled by Peter Neary (1995), and a fixed co-efficient technology, to provide grounds for distinguishing among (1) *Marxian unemployment* that, according to Joan Robinson (1937), arises from a shortage of productive capital for workers to work with, (2) *Keynesian unemployment*, which arises due to a shortage of aggregated demand for final commodities, and (3) the emergence of a new face of unemployment, more predominant in modern economies, that arises because a divergence between the distribution of supplies and the distribution of demands of horizontally-differentiated distinct types of human capital embodied in different persons, a phenomenon which may be called, for want of a better name, *Embodied Human Capital Unemployment*. The emergence of EHC unemployment is a natural consequence of a continual increase in specialization and division of labor. In his *Inquiry into the Nature and Causes of the Wealth of Nations*, Adam Smith (1776) found the *division of labor*, and *inter alia* the specialization of workers, to be so crucial a phenomenon for economic growth in capitalism that he included 'the division of labor' in the title and content of all *three* of the first chapters of his book. In modern economies, especially of the United States, individual persons are now so highly

specialized in distinct fields that crossing lines of productive activities has become both very expensive and quite time consuming. It is precisely to such a widely-differentiated spectrum of the supply of workers in an economy that this paper is addresses.[1]

After developing the theoretical framework (in Sections 2 and 3), we illustrate the relevance of this concept of unemployment to the U.S economy in the first decade of the 21st Century (in Section 4), so as to obtain a deeper understanding of the global economic crisis, and *inter alia* to identify those public policies that could potentially, though only over time, mitigate wide-spread human torment suffered during this crisis. Section 5 contains some concluding remarks.

To motivate the idea, first consider Marxian unemployment. Human beings typically do not work with their bare hands to produce output of commodities that are valued by people. A farmer needs a plough, just as a hunter needs a spear or a stockbroker needs streaming quotes on a computer screen. A plough and a spear and a computer are capital goods because, by definition, they are human-made tools and implements of production that have functional *instrumental value* only insofar as they can be used by a worker to produce final commodities that do, in fact, have *constitutive value* to persons.

If there are ten hunters and ten spears than all of them can go about their productive work. However, if three spears are sent to another tribe, then seven hunters can get some meat, while the other three would be left standing unemployed.[2] This is Marxian unemployment. And if an expansionary fiscal policy is adopted by the government of this tribe, more supply of meat will not come forth, but it will only serve to create inflation. There simply isn't enough capital to employ all workers: more is needed.

On the other hand, if three of the ten hunters are unemployed because the aggregate demand for meat in the tribe is fully satisfied by the output of seven hunters, the arrival or more spears in addition

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[1] A plasma physicist, for example, cannot be converted costlessly or instantly into a material-science engineer, let alone into a neurologist or a social choice theorist, and conversely.

[2] Of course, this is based on the assumption that there are no berries around to be picked, or any other such activities that the tunneled-vision hunters can engage in.

to ten, will simply not lead to the employment of the remaining three. Effective public policy would not be production of more capital goods but an expansionary fiscal policy, because the root cause of this is the insufficiency of effective demand, and thus the unemployment is Keynesian in nature.

It should be noted that, compared to a state in which there is enough capital to employ all workers, in a different state that is characterized by Marxian unemployment, there will also arise Keynesian unemployment as a consequence, because those who remain unemployed will not have the income to demand final commodities. Similarly, Keynesian unemployment will lead to the emergence of Marxian unemployment, as lower demand for final goods leads to the shutting down of factories. The origin of unemployment in Less Developed Countries is typically Marxian even though the Keynesian type is also present as a consequence. On the other hand, in the Great Depression of 1929 – 36, the cause was Keynesian unemployment and the effect was Marxian.

In the first decade of the 21st Century, the U.S. economy is characterized by both Keynesian and Marxian unemployment, but these are both *effects*, as we shall explain presently, while the root *cause* is Embodied Human Capital unemployment. This, however, is not the case in most of Europe and Asia, for example, again, as explained in Section 5.

2. Model

The model we develop here draws on Batra and Naqvi (1989). Assume that in an economy, N commodities are produced in the quantity x_i, $i = 1, ..., N$. The production function is

(1) $x_i = F^i(K_i, L_i)$,

With the requirements that $F^i(0, L_i) = F^i(K_i, 0) = 0$, $F^i_j(K_i, L_i) > 0$, $F^i_{jj}(K_i, L_i) < 0$ for commodity i, where $F^i(K_i, L_i)$ is concave and linearly homogeneous in both arguments, which implies that the inputs are cooperative, *viz.*, $F^i_{KL}(K_i, L_i) = F^i_{LK}(K_i, L_i) > 0$.

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Assume further that the *Inada conditions* hold, and that a_i is constant insofar as it is invariant to x_i.[3] Here, K_i is the quantity of homogenous productive capital demanded and employed in industry i, with $\sum_1^N K_i = K$ as the aggregate demand and employment of capital in the economy, and L_i is the quantity of *sector-specific* labor of *horizontally-differentiated* skill type i demanded and employed in the production of commodity i.

Assume further that each industry is perfectly competitive in both commodity and factor markets. Let this be a small open economy, both in commodity and capital markets, so that it takes the price of each commodity p_i , and r^* the world rental rate of capital, as exogenously determined on world markets, whereas w_i is the endogenously determined wage rate of workers of skill i . Then, we have the following,

(2) $p_i F_K^i(K_i, L_i) = r^*, \forall i = 1, \dots, N$

and

(3) $p_i F_L^i(K_i, L_i) = w_i, \forall i = 1, \dots, N$,

as the relationships that constitute the conditions that the values of marginal product of each factor equal their respective factor prices, with the additional requirement that in the initial Walrasian general equilibrium, all workers are fully employed, so that $L_i = \bar{L}_i, \forall i = 1, \dots, N$, where $\bar{L}_i$ is the inelastic supply of workers of skill category i in the economy.

Given the world rental rate of capital r^*, the employment of capital in sector i, and thus the aggregate employment of capital K in the economy is endogenously determined by international capital mobility. However, labor of every skill type is, by assumption, internationally immobile.

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[3] Here a_i is the minimum amount of capital required to employ a worker of skill type i in Sector i.

With the assumptions specified, a Walrasian competitive general equilibrium exists, it is unique, and it is stable under a wide array of adjustment mechanisms if all commodities are strong gross substitutes.

Let B_i be the real-income cost of *educating-and-training a new entrant* in the labor force to acquire sector-specific skills and become employable with skill i in sector i, and let B_{ij}^v be the cost of *re-training* a worker of type v with skill i to acquire skill j so as to become *employable* in sector j, and assume that B_i, $B_{ij}^v > 0$, with v to be specified presently.

3. Emergence of Embodied Human Capital Unemployment

Suppose this economy receives an external sizable, not infinitesimal, structural, shock. In particular, a rental rate of capital of $r^{**} > r^*$ suddenly becomes available in a subset of productive activities for those capital owners who are willing to relocate their capital abroad, which they immediately do.

More formally, partition the N productive activities into $i = 1, \dots, m$, some *positive* production of which is financed abroad by capital exported by the home country, while some *non-negative* production of these commodities, in smaller quantities, may still takes place in the home country when r^{**} comes to prevail. The rest of the activities $i = m + 1, \dots, N$ are the internationally non-traded activities, such as the services of nurses and school teachers that require contact between the provider and the recipient.[4] This changed structure of the economy is reflected in (2) being replaced by

(2a) $\qquad p_i F_K^i(K_i, L_i) = r^{**} > r^*, \forall\, i = 1, \dots, m,$

and

(2b) $\qquad p_i F_K^i(K_i, L_i) = r^*, i = m + 1, \dots N.$

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[4] These are activities, $i = 1, \dots, m$, are the ones that can be performed off-site from their source of demand in the home country.

With the constancy of p_i, and with $F^i_{KK}(K_i, L_i) < 0$, corresponding to a higher rental rate of capital r^{**}, a new non-Walrasian temporary-equilibrium value of K_i will arise, and this value must be lower $\forall\, i = 1, \dots, m$, which, in turn, implies, give constancy of a_i, that some skilled workers in each of these m sectors will be laid off. If the lower quantity of labor of skill type i demanded in sector i is l_i, then $U_i = \overline{L}_i - l_i > 0$ will be the magnitude of unemployment of workers of skill category i, as long as the wage rate w_i, $\forall\, i = 1, \dots, m$, does not adjust downwards fast enough to clear the labor market for labor of skill type i. A proxy for this sluggish adjustment in temporary equilibrium analysis is taken to be fixed prices, which is the type of exercise I undertake here, and the assumption that I make. And, this is not inconsistent with different quantities of workers with distinct types of embodies human capital in the new temporary equilibrium, in the non-traded sectors of the economy, $i = m + 1 \dots N$, such as in healthcare and education.[5]

There are many reasons why capital that has left the country will not return, even if wage rates ultimately fall for labor of skill type $\forall\, i = 1, \dots, m$. One such explanation is based on a *hysteresis argument,* according to which, there is a *band on inaction*, $[r_l, r_h]$ for agents, so that if the return to capital at home does not rise above an upper-bound r_h, or if this return does not fall below a lower-bound r_l abroad, capital owners will not bring about a reverse flow of capital back to the home country.[6]

In addition, recall that $B^v_{ij} > 0$ is the real-income cost of *re-training* a worker of type *v* with skill i to acquire skill j so as to become employable in sector j. Therefore, an aggregative expansionary

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[5] *Structural* unemployment results as a temporary phenomenon due to a shock – internal or external – that an economy experiences, because some sectors contract, but subsequently other sectors expand to absorb those workers who lost employment in the sectors that contracted. This latter phenomenon of *re-employment* of workers who are laid off in the sectors that contract does *not* occur in the case of EHC unemployment, simply because they lack the skills required for employment in sectors that exhibit excess demand for labor.

[6] The band of inaction emerges if (i) the return on capital is uncertain in either country (home or abroad) and this return follows Geometric Brownian Motion, and (ii) there is a one-time, positive cost of moving capital abroad or of bringing it back home.

fiscal policy, aimed at the entire economy at once, not a program of human-resource planning that carries incentives for the acquisition of specific types of human capital, will fail to convert a worker with skill i into a worker with skill j, thereby rendering fiscal policy ineffective.[7]

But, this is not all. Suppose $\bar{B}^v$ is the real-income cost that society or the government or a mechanism designer has concluded is an *acceptable* cost to incur for retraining a worker of type v, as part of a social goal. Then, (i) $\exists v: B_{ij}^v < \bar{B}^v$, and (ii) $\exists v: B_{ij}^v > \bar{B}^v$, rendering the second category of workers of type v un-trainable, from the point of view of society, even if they are willing to retrain, in which case they would unambiguously remain *involuntarily* unemployed, which is a conceptual issue – and a practical one – that has been found to be difficult to grapple with in the literature.[8] The problem with the concept of involuntary unemployment faced in the past has nothing to do with unemployment *per se*, but rather with the content of the concept of *involuntariness*. Separating the motivation of the employment seeker from that of the employment provider or facilitator resolves the issue.

Even for the first category of workers, who are socially deemed re-trainable, a well-funded implementation of a specifically-targeted human resource planning program, with incentives for re-training, would constitute a remedy, rather than a program of indiscriminate increases in aggregate government net spending. Moreover, a *schedule* of socially acceptable re-training costs in a game-form could well be such as to monotonically increase with the number of years left to retirement or with the wage rate of the type of human capital to be acquired, or, of course, both.[9]

This much, however, is quite clear. The remedy for Marxian unemployment, which arises as a consequence of EHC unemployment, will, by itself, fail to solve the problem of unemployment of

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[7] For example, a 20-year veteran automobile assembly-line worker will not be transformed into a nurse or a school teacher by an expansionary fiscal policy.

[8] In the first category could be a 25-year old person who has been on an automobile assembly line for a couple of years, and has 40 additional years before she is eligible to collect social security payments from a national retirement plan, while the second category could include a 60-year old financial analyst who has a mere five years to go before retirement age. It may not be unreasonable at all for society or a mechanism designer to decline re-training to the financial analyst and approve it for the automobile worker if, for instance, the retraining cost is $\bar{B} = \$200,000$ for both.

[9] The particular characterization of such an implementation mechanism is the subject matter of another paper, on which see Naqvi and Pech (2009).

distinct types of workers with embodied sector-specific human capital, the demand for whom is insufficient in relation to their respective supplies in the economy. Similarly, an expansionary fiscal policy alone, as already noted, will also fail in spite of the presence of Keynesian unemployment in the economy that again arises as a consequence of EHC unemployment.
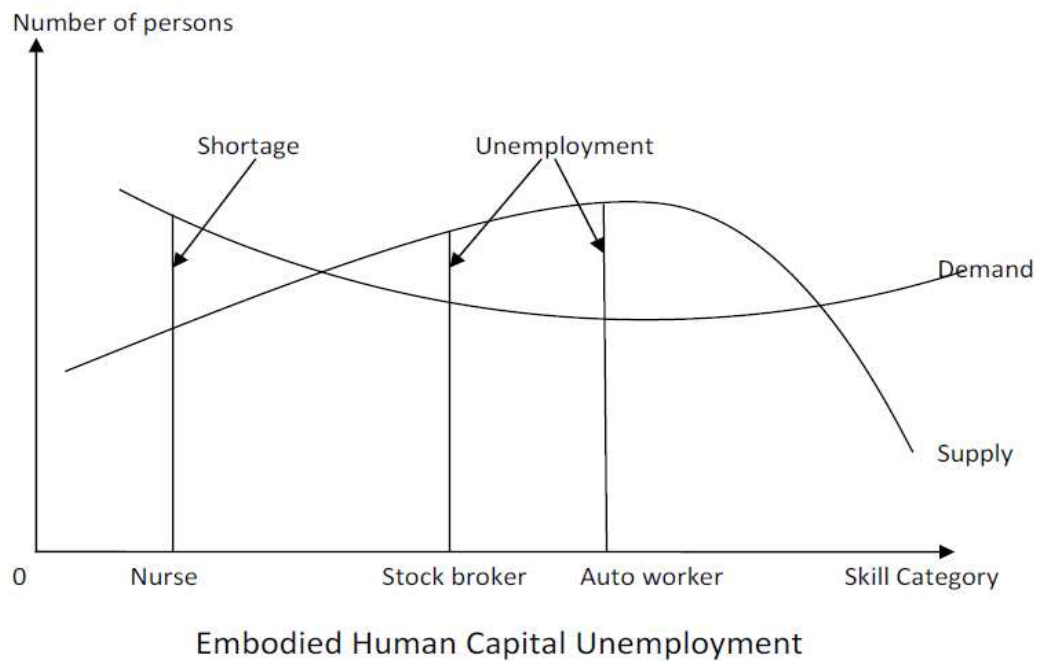

Figure 1

Early retirement for some unemployed workers, and a specifically-targeted *human resource planning program, with grants, loans and other incentives for education, training and skill acquisition*, would have to form an inescapable part of a necessary policy package to remedy EHC unemployment. But this will take time. In the intermediate term, however, if the economy is not producing a sufficiently large number of educated workers of the skill categories that have an excess demand, immigration of foreign workers – temporary or permanent – who have such skills, is the only solution.

4. Application to the U.S Economy and the Global Economic Crisis

Suppose the economy described in Section 2 is the U.S. economy, as it stood in late 20th Century, around 1995. In 2000-2001, due primarily to political decisions, the U.S. abruptly dropped virtually all *commodity-trade barriers* and *capital-flow controls* against China and India.[10] This naturally created a *super highway to low-wage heaven* in these countries (with international wage differentials in the range of 10:1 to 20:1), on which American-owned capital travelled at break-neck speed, year after year, in increasingly large cumulative quantities, as shown in Figure 1 below. This had to have given a rather stunning shock to the American labor markets, which is a phenomenon ignored in academic discourse thus far in an examination of the American economy in the first decade of the 21st Century, and which constitutes a serious omission that this note attempts to remedy.

While in the initial years starting 2001, the increase in demand for labor in the expanding sectors of the U.S. economy offset the decline in the contracting sectors due to capital outflow to China and India, in the later years of this decade, the cumulative outflow became sufficiently high to reverse this trend, as indicated in Figure 2.

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[10] This was done by the U.S. granting China a *permanent* Most Favored Nation status in 2000, and by helping China to be inducted into the WTO in 2001 in Seattle. Similarly, starting late September 2001, erstwhile stringent commodity-trade and capital-control barriers against India were removed, in return for India agreeing to monitor sea lanes for terrorist activity from Singapore to the Suez. Manufacturing activity increased in China, financed by American-owned capital that relocated to China, and since India was a British colony, just like the U.S., a great many Indians are familiar with the English language, so that substantial Information Technology related activities were increasingly outsourced to India. While I describe the economic consequences of such decisions, I make no claim whatsoever as to the desirability, or otherwise, of such political decisions.

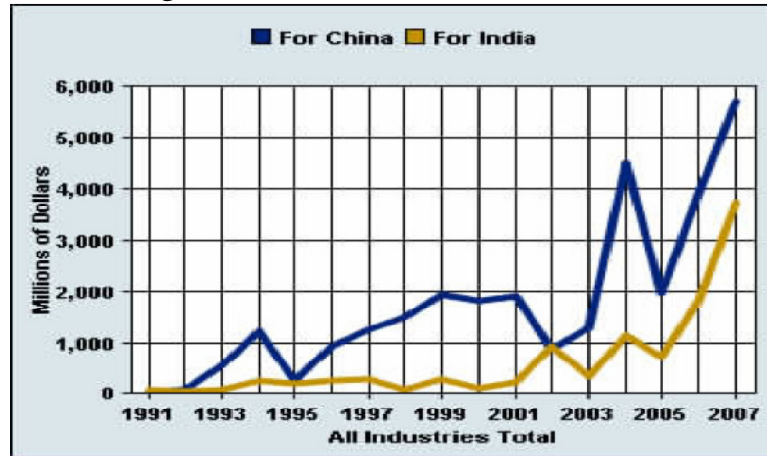## U.S Foreign Direct Investment in China and India

Figure 2
Source: U.S. Department of Commerce, Bureau of Economic Analysis, February 2009

In addition, since job losses lead to a decline in aggregate income and thus spending (Commerce Department data show that in the fourth quarter of 2008, the U.S. GDP contracted at an annualized rate of 6.3%.), there consequently also arose Keynesian unemployment, so the U.S. unemployment rate started to climb from 4.2% in 2001 to 4.7% in June of 2008, to 8.1% by the end of 2008, to 10.2% by September end 2009, and should be expected to continue to rise for a few years to come.

Why will this happen? Why will the American economy take a long time to recover? First, there is a set of collective beliefs that have led to the unfortunate social outcome that in the U.S., out of every four, only one high school graduate finishes college, not to mention the fact that the U.S. also has the highest high school dropout rate among industrialized nations. However, in a modern economy, *literacy* – defined as knowing how to read and write (or ninth-grade education, on the World Bank definition) – is no longer sufficient to make a person *employable*. A college degree and minimal digital literacy are now basic requirements for a person to become employable in a modern economy, whereas the vast majority of Americans are simply not employable. It is not a matter of shortage of jobs. If it were, why would work be outsourced from the U.S. to India, among other countries? But rather, there is *a shortage of American educated and skilled workers who are employable in a modern economy*. An

important question to ask is: what are these other three high school graduates without college degrees going to do? Collective beliefs in any society are extremely tenacious, and very slow to change. It will take years before two out of four, or three out of four, high school graduates in the U.S. will finish college. Moreover, not only does it take four years to finish college on average, it also takes several years to train, or retrain, somebody to become a nurse or a school teacher, in addition to the substantial education and training costs that must also be incurred. In fact, in a speech before the joint session of Congress on February 24, 2009 President Obama admonished,

> In a global economy where the most valuable skill you can sell is your knowledge, a good education is no longer just a pathway to opportunity – it is a pre-requisite.
>
> Right now, three-quarters of the fastest-growing occupations require more than a high school diploma. And yet, just over half of our citizens have that level of education. We have one of the highest high school dropout rates of any industrialized nation. And half of the students who begin college never finish.
>
> This is a prescription for economic decline, because we know the countries that out-teach us today will out-compete us tomorrow.
>
> And so tonight, I ask every American to commit to at least one year or more of higher education or career training. … By **2020**, America will once again have the highest proportion of college graduates in the world.

But this still is not all. We have already noted that it typically takes four years to finish college. In addition, given the uncertain return on private-sector financed education (simply because not all who start will finish college), and a positive cost of finishing college to become employable (in the model of Section 2, at a cost of $B_i > 0$ for skill i), the same hysteresis phenomenon (outlined in Section 3) that is keeping American-owned capital that left for China and India from returning, will keep the private sector from financing education, unless the government provides student-loan guarantees for higher education. That is why the current deprivation episode in the U.S. is likely to be protracted.

Remedies that could have helped have been legislated out recently by the U.S. congress. This is especially so in the light of the clause in the $787 Billion *Stimulus Package* bill passed by the U.S. Congress in March 2009, popularly known as TARP, that requires that any institution receiving public

funds under this act is prohibited from hiring foreign workers, including skilled and educated foreign workers graduating from universities in the U.S. (job offers to whom are being rescinded by corporations that have accepted TARP funds). This is precisely the type of protectionist measure that will further exacerbate the problems facing the U.S. economy.

Public works programs will certainly provide temporary relief to unemployed workers, but these are low-wage jobs that will simply not return the bulk of the middle-class residents of 2001 in America to their erstwhile status.[11] And increase in interpersonal inequality of income is an inevitable consequence of the structural shock received by the U.S. economy, as in Figure 3 below.
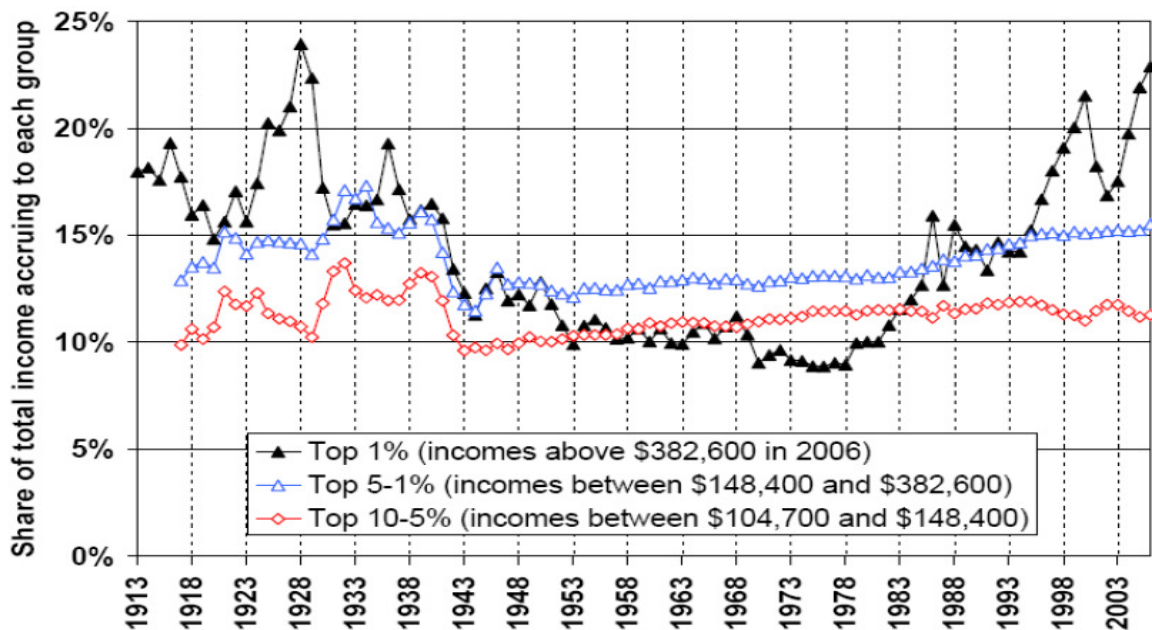
Computations based on family market income including realized capital gains (before individual taxes).
Incomes are deflated using the official Consumer Price Index.
Source: Piketty and Saez (2003), series updated to 2006

Figure 3

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[11] In 1980, the top 1% income earners in the U.S. garnered 8% of the national income. By 2008, this figure had risen to 24%. Further, the U.S. does not have any apprenticeship program of the kind that Germany has, which could have afforded a middle-class living standard to Americans. In the light of these facts, the middle class in the U.S. has dwindled, and for it to re-emerge, there is no escape from larger proportion of Americans attaining higher education and skills of the type that are in demand in a modern economy, as that of the U.S., where specialization and division of labor has been carried to the farthest extent in human history.

5. Concluding Remarks

There are four additional points worth noting. First, persons who become unemployed cannot typically make mortgage payments, they file for bankruptcy, and they lose their houses to foreclosures. This makes their loans in a Mortgage Backed Security (MBS) non-performing, thereby reducing the market value of the MBS of which these loans are a constituent part, in turn making the MBS what is now-a-days called a "toxic asset," and institutions that have portfolios containing a substantial portion of their wealth in the form of MBSs become insolvent when their clients seek to withdraw their deposits. Thus, the financial crisis is the *effect*, not the cause, of the economic downturn, which started with the U.S. suffering a sudden and stunning jolt due to rapid capital out-flight, as a consequence of political decisions. Thus cleaning up the balance sheets of financial institutions is necessary, but it will, by itself, not suffice in pulling the American economy out of the current crisis.

Second, while irresponsible and possibly irrational behavior may have played a role in originating the so-called "sub-prime" mortgages, it is *not* necessary at all to invoke such agency failures to explain the global economic downturn of the early 21st Century; structural change, by itself, suffices in accounting for it. In this sense, it is *structure*, not necessarily *agency*, which needs to be the object of examination. Placing blame on unscrupulous agents is unhelpful, and can actually lead to seeking remedies that would simply prove ineffective.

Third, in the U.S., there first emerged Embodied Human Capital unemployment as a consequence of cumulative capital out-flight, which consequently induced both Keynesian and Marxian forms of unemployment. However, this is a new face of unemployment, so the remedies for the two latter forms of unemployment will not solve the problem. The process that led up to the economic crisis of 2008 in the United States was *causally* quite different from the other cases. And just because the symptoms appear to be the same, it does not follow that the causes, and thus cures, are too. If the original cause is not understood, remedy will be hard, if not impossible, to find.

The last point we would like to make is that the problems in the U.S. economy arose out of a structural shock due to abrupt capital out-flight, which induced Marxian unemployment and Keynesian unemployment as consequences. However, in the rest of the world, especially in Europe and Asia, that is not the root cause of the economic decline, even though the symptoms of rising unemployment across a wide array of skill categories appear to be the same. This is so because labor markets in Europe, Asia, South America, Africa and Australia did *not* experience adverse structural shocks due to capital out-flight, unlike the United States. Moreover, the sheer size of the U.S. GDP is very large in comparison with the GDPs of other countries.[12] As a consequence, a fractional contraction in U.S. spending, such as the 1.58% GDP decline in the fourth quarter of 2008 (or 6.3% annualized decline), amounted to a reduction of spending by $217 Billion. Similar contractions again in the next two quarters of 2009 sent not just waves, but a tsunami of import-demand reductions across the world, which in turn lead to thousands of factory closings (in China, among others), freezing of all construction activities (in Bulgaria, Romania and Ukraine, for example), plummeting automobile sales world-wide (especially from the U.S., Japan and Germany) and soaring unemployment rates (from China and Russia to Spain and Mexico, among others). And, by the end of June 2009, the British economy had already exhibited the greatest annual shrinkage in half a century![13]

Hence the remedies for the countries other than the U.S. are not the same as the ones necessary for the United States. In fact, (1) these other countries are suffering from loss of asset values because they were holding once highly-valued but now with zero-market-priced American MBSs, about 50% of which were held in several Western European countries, *and* because (2) they have experienced a straightforward Keynesian contraction due to a reduction of American import demand. Thus for these countries, merely cleansing of the financial sectors, and expansionary fiscal policies to counteract

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[12] In 2008, U.S. GDP stood at $14 Trillion, Japan $4 Trillion, China and Germany $3 Trillion each, then France, followed by the U.K., all the way to India in the 12th place with $1 Trillion, in that order.
[13] All this has happened despite massive Central Banks' nominal interest rates reductions: it is 0% – 0.25% in the U.S., 0.25% for the Bank of Japan, 1% for the European Central bank, and the lowest rate in a more than 300-year history of the Bank of England, among others.

American import-demand contraction, should be expected to be effective in restoring economic activity to healthy levels, unlike the U.S., that *also* requires a well-funded and carefully-designed human resource planning program to be implemented, as noted by President Obama in his February 2009 speech before the joint session of Congress.

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Appendix

1. A Miniature Model of the American Economy

Let all economic activity in the American economy be divided into three broad sectors, the export sector, with a domestic output of X, the import-competing-good sector with domestic output M, and an internationally non-traded good sector with an output of N. We can, if it helps, think of X as the output of skilled services (IT, R&D, etc.), M as industrial output (of TVs, computers, refrigerators, cars, etc.), and N as the output of home goods (such as roofing services, health-care services, and so on), which require contact between a provider and the customer.

Let the production function in the export sector be,

$$\hat{X} = F(\hat{S}_X, \hat{K}_X), \tag{1}$$

where S_X and K_X are the employment of skilled labor and capital, respectively, and $F(\ )$ is a concave and linearly homogeneous production function with indispensable inputs and positive and diminishing marginal products.[14] Similarly we can specify,

$$\hat{M} = G(\hat{L}_M, \hat{K}_M), \tag{2}$$

where L_M and K_M are the employment of unskilled labor and capital in the domestic production of manufactured goods, and $G(\ )$ is a similar production function.[15] In the non-traded sector, the production function is

$$\hat{N} = H(\hat{L}_N, \hat{S}_N), \tag{3}$$

Where L_N and S_N, are the employment of unskilled labor (as roofers, for example) and skilled labor (as medical doctors, for example), respectively, and $H(\ )$ is again the usual production.

In (1), (2) and (3), capital is internationally mobile, as well as intersectorally mobile across export and import-competing production sectors. Unskilled labor is only mobile between the import-competing and the non-traded sectors of the economy, and its supply is exogenously fixed. While skilled labor is intersectorally mobile between the export and non-traded sectors, it is internationally immobile, and its supply is perfectly inelastic.[16]

We assume that all markets are perfectly competitive. That is, all three sectors are populated by many, though finite, firms that act as price takers in both commodity and factor markets. Further, all firms in each sector are cost-minimizing profit maximizers, and there is free entry and exit of firms in long-run

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[14] For a two-input production function, concavity, constant returns to scale and diminishing marginal products together imply that inputs are cooperative, insofar as a larger employment of one factor induces an increase the marginal productivity of the other. That is, $F_{SK} = F_{KS} > 0$.
A 'hat' over a variable denotes its endogenously determined general equilibrium value in the initial, pre-structural-shock state of the economy.

[15] Throughout, we treat manufacturing workers as unskilled workers, not because they are completely unskilled, but because they are less so.

[16] Agriculture contributes barely 2% to GDP and employs less than 1% of the labor force. This stylized fact is utilized in making some bold assumptions in the formulation of the model of the American economy, with the linkages to India and China to be specified presently.

Walrasian general equilibrium. Then, international mobility of capital implies that, in general equilibrium,

$$p_X F_K(\hat{S}_X, \hat{K}_X) = r^*, \tag{4}$$

where p_X is the exogenously specified world price of the country's export commodity, which one might recall is IT services, F_K is the marginal product of capital, and r^* is the exogenously determined world rental rate of capital.[17]

Similarly for the import-competing sector, international capital mobility implies that the value of marginal product there must also equal the same rental rate of capital that prevails in the world economy. Thus,

$$p_M G_K(\hat{L}_M, \hat{K}_M) = r^*, \tag{5}$$

where again, p_M is the world price of the manufactured good that this economy's import-competing sector takes as parametrically fixed, and G_K is the marginal product of capital in manufacturing.

In the pre-shock state of the economy, the values of marginal product of unskilled labor in manufacturing and non-traded sectors must to be equal in general equilibrium, as is the case with the values of marginal products of skilled labor in the export and non-traded sectors. Thus, we have

$$p_M G_L(\hat{L}_M, \hat{K}_M) = \hat{p}_N H_L(\hat{L}_N, \hat{S}_N) = \hat{w}_L, \tag{6}$$

and

$$p_X F_S(\hat{S}_X, \hat{K}_X) = \hat{p}_N H_S(\hat{L}_N, \hat{S}_N) = \hat{w}_S \tag{7}$$

where w_L and w_S are the economy-wide unskilled and skilled wage rates determined endogenously in general equilibrium.

In (6) and (7), it is important to make a distinction between the pre-shock real-sector conditions that obtained, and the state of affairs post-shock. Thus we also have,

$$\hat{L}_M + \hat{L}_N = L, \tag{8}$$

where L was the fixed supply of unskilled labor, and (8) is its sectoral allocation before 2001, and

$$\hat{S}_X + \hat{S}_N = S, \tag{9}$$

where S was the fixed supply of skilled labor, with (9) as its sectoral allocation before 2002.

Domestic demand and supply of the non-traded good sector determines the domestic price of the non-traded good in equilibrium, so that,

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[17] Notice that this r^* is the effective world rental rate of capital that American entrepreneurs can avail of in general equilibrium, *before* they have access to much lower manufacturing and IT wage rates in China and India, respectively, and *inter alia* before they can avail of the consequent higher returns to capital investment in these countries (due to lower labor costs).

$$\hat{C}_N(p_X, p_M, \hat{p}_N, \hat{Y}) = \hat{N}(\hat{p}_N, r^*, \hat{w}_L, \hat{w}_S), \tag{10}$$

where Y is national income (or the GNP of the country), that is an argument of the domestic aggregate demand function for the non-traded good in (10),

$$\hat{Y} = p_X\hat{X} + p_M\hat{M} + \hat{p}_N\hat{N} = \hat{w}_L(\hat{L}_M + \hat{L}_N) + \hat{w}_S(\hat{S}_X + \hat{S}_N) + r^*(\hat{K}_X + \hat{K}_M) \tag{11}$$

on the presumption that all human and physical capital employed in the country in the initial general equilibrium are domestically owned.[18]

This completes the specification of the model, except for an explicit treatment of the currencies and foreign exchange rates, on which I comment in the Appendix I, and issues of interpersonal income distribution that I take up in Appendix II.

2. Initial General Equilibrium

To see how the equilibrium values of the endogenous variables are determined by the relationships of the model of the American economy, before the tsunami of 2.3 billion people hit the U.S., some pictures might help. These are presented in Figures 1 through 4 below.

Notice that in the model, the exogenous variables, are p_X, p_M, r^* and L and S, the world prices of the export good, the import-competing good (equal to the world price of imports), the world rental rate, and the inelastic supply of unskilled and skilled labor, respectively. To obtain the reduced form of the model, substitute for L_N from the unskilled labor supply constraint (8) in (6), for S_N from the skilled labor supply constraint (9) in (7), and substitute for Y from (11) in (10). With these substitutions, taken together with (4) and (5), (6), (7) and (10) are five equations in five endogenous variables: K_X, K_M, L_M, S_X and p_N. These five relations uniquely determine the general equilibrium values of these five endogenous variables, and then the rest are obtained by appropriate substitutions.[19]

Of course, in addition to the assumptions made about the structure of production, it is important to note that some additional assumptions have to be employed to guarantee the existence and stability of equilibrium. These are (I) the skilled and unskilled wage rates and the price of the non-traded good are perfectly flexible; (II) personal preferences are defined on the set of ordered triples of the quantities of the three commodities consumed by a person, and these preferences are represented by a binary of relation of weak preference that completely orders a finite set of alternatives. This relation satisfies the properties of strong monotonicity and convexity and continuity.

These assumptions not only guarantee the existence of general equilibrium, but they also produce downward-sloping excess demand curves for all commodities and factors of production, so that under the a wide array of adjustment mechanisms, this general equilibrium is, in fact, stable. Of course,

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[18] There are some issues related to the interpersonal distribution of endowments, and *inter alia* the distribution of income in the economy, with serious implications for both the interpersonal aggregation of commodity demands and for the assumption of interpersonal comparability of these personal demands, in the empirically significant case when the incomes are unequally distributed. This pertains to both descriptive and prescriptive matters. I take these up in Appendix II.

[19] From (8) and (9) the values of $\hat{L}_N$ and $\hat{S}_N$ can be obtained. Substituting the value of all of these endogenously determined values in (1), (2) and (3) gives the general equilibrium values of the outputs of the three sectors, and from (6) and (7) we obtain the two wage rates.

because Walras law for markets holds, only relative prices are determined in general equilibrium. This solves the model completely, and a graphical solution is presented in Figures 1 – 4.

3. Adjustment to Structural Shocks

The stage is now set to subject this economy to a sudden exposure to 2.3 billion people, starting 2000-2001, with vast numbers of low-cost unskilled, manufacturing workers in China (willing to work for $w_{China} < \hat{w}_L$) and low-cost skilled workers in India (willing to work for $w_{India} < \hat{w}_S$), thereby offering to the American capital owners greater profit-income opportunities, if only they would move their capital to these countries to avail of significantly lower labor costs.

Given lower labor costs, the rate of return on American-owned capital becomes higher, so that (4) and (5) change to (4a) and (5a), respectively, insofar as the values of marginal products in the Chinese manufacturing and Indian IT-related activities now equal $r^{**} > r^*$ in China and India. Moreover, in the post-structural shock state, (6) changes to (6a) and (6b), and (7) changes to (7a) and (7b) below. All four of these changes constitute structural shocks, not infinitesimal changes. More on that presently, in Section 6.

The new, post-2001 structural model consists of (1) – (3), (10) – (11), and

$$p_X F_K(\tilde{S}_X, \tilde{K}_X) = r^{**} > r^*, \tag{4a}$$

$$p_M G_K(\tilde{L}_M, \tilde{K}_M) = r^{**} > r^*, \tag{5a}$$

$$p_M G_L(\tilde{L}_M, \tilde{K}_M) = w_{China} < \hat{w}_L, \tag{6a}$$

$$\tilde{p}_N H_L(\bar{\bar{L}}_N, \bar{\bar{L}}_N) = \hat{w}_L, \tag{6b}$$

$$p_X F_S(\tilde{S}_X, \tilde{K}_X) = w_{India} < \hat{w}_S, \tag{7a}$$

and

$$\tilde{p}_N H_S(\bar{\bar{L}}_N, \bar{\bar{S}}_N) = \hat{w}_S. \tag{7b}$$

Equations (8) and (9) no longer hold in the new, non-Walrasian temporary general equilibrium with *fixed domestic unskilled and skilled wage* rates that are pegged at the pre-shock values, due to which quantity constraints emerge, as in Neary (1980) and DeLorme, Naqvi and Wemhöner (1995), among others.

The solution of this second structural model is presented in Figures 5 – 8 below. Here $U^{Unskilled}$ and $U^{Skilled}$ are the unemployment of American manufacturing and skilled workers, respectively. These are the persons who lost jobs as a consequence of the sudden and abrupt exposure of the American economy to the economies of China and India between 2000 and 2002.

To see how the endogenous variable values are determined in the post-structural shock of the economy in general equilibrium of a very different nature, notice that from (4a), (5a), (6a) and (7a) the values of the four variables $\tilde{K}_X, \tilde{K}_M, \tilde{L}_M$ and $\tilde{S}_X$ are uniquely determined.

A heuristic explanation is that, once the politically imposed barriers to American capital investment in China and India were dropped in 2000 and 2001 respectively, a higher rate of return on capital r^{**} could be earned, because of a lower unskilled wage rate in China w_{China} , and a lower skilled wage rate in India w_{India} , some American capital started to flow to these two countries. This led to both some manufacturing and some IT businesses closing in the U.S., which, in turn, was associated with employment of smaller quantities of capital in the two sectors at home, in the amounts $\bar{\bar{K}}_X$ and $\bar{\bar{K}}_M$, as indicated in Figure 5 and Figure 6.

With less productive capital employed in these two sectors, there occurs a fall in the marginal products, and therefore the values of marginal products, of unskilled labor in the manufacturing (import-competing) sector, as well as of skilled labor in the IT services (export) sector of the American economy, simply because the two sets of inputs in these sectors are cooperative (positive cross partials of the production functions). From Figure 7 and Figure 8, we see leftward shifts of these values of marginal products curves for unskilled labor in the import-competing sector and of skilled labor in the export sector.

Reduced employment of labor in these two sectors to $\tilde{L}_M$ and $\tilde{S}_X$ leads, in the next round, as it were, to inward shifts of the values of marginal product curves for capital in Figure 5 and Figure 6, again because inputs are cooperative. Thus the final general equilibrium employment of productive capital in the two sectors falls to $\widetilde{K}_X$ and $\widetilde{K}_M$, as indicated in these two figures and in Equations (4a) and (5a). The amount of productive capital that flows to China is simply $\widetilde{K}^{China} = \widehat{K}_M - \widetilde{K}_M$, and the capital flow to India can be seen to be $\widetilde{K}^{India} = \widehat{K}_X - \widetilde{K}_X$, so that $\tilde{k}_f = \widetilde{K}^{China} + \widetilde{K}^{India}$ is the aggregate productive capital flow from the U.S. to these two countries. It is also useful to define $k_d + k_f = k$ as the total amount of American-owned productive capital, of which k_d is the amount employed at home, which is less than k. There is capital flight from the U.S. to China and India as long as $r^{**} > r^*$.

Since $\widehat{L}_M - \tilde{L}_M$ unskilled workers and $\widehat{S}_X - \tilde{S}_X$ skilled workers lose jobs in the import-competing and the export sectors, respectively, in (11), the GNP of the country changes from $\widehat{Y}$ to

$$\tilde{Y} = p_X \tilde{X} + p_M \widetilde{M} + \tilde{p}_N \bar{\bar{N}} + r^{**}k = \left(w_{China}\tilde{L}_M + \widehat{w}_L \bar{\bar{L}}_N\right) + \left(w_{India}\tilde{S}_X + \widehat{w}_S \bar{\bar{S}}_N\right) + r^{**}k \quad . \text{ (11a)}$$

This is a subtle point that deserves explanation. In (11a), we have $\tilde{X} = F\left(\tilde{S}_X , \widetilde{K}_X\right) < \widehat{X}$ from (1) because of lower employment of both skilled labor and capital in the new temporary equilibrium. Similarly, from (2) we obtain $\widetilde{M} = F\left(\tilde{L}_M , \widetilde{K}_M\right) < \widehat{M}$ for similar reasons. Since American capital owners have a choice of employing Chinese unskilled workers in China or American unskilled workers in the U.S., in the import-competing sector the wage rate will have a tendency to converge to the Chinese unskilled wage rate. Similarly, Indian skilled workers in the IT services sector are substitutes for American skilled workers in the export sector as far as American capital owners are concerned, because of which this wage rate in the U.S. will also have a tendency to converge to the Indian skilled wage rate.

Such is not the case, however, with the unskilled workers or the skilled workers in the non-traded sector in America. Therefore, in a *temporary* equilibrium with fixed prices and quantity constraints, there need not be such a strong tendency for convergence of these wage rates to the corresponding rates abroad, so that unemployment will have a tendency to emerge as a temporary equilibrium phenomenon at the pre-shock wage rates, thereby leading to the employment of $\bar{\bar{L}}_N < \widehat{L}_N$ unskilled workers in the U.S., with $\widetilde{U}^{Unskilled} = \bar{\bar{L}}_N - \tilde{L}_M$ of these workers becoming unemployed, because the short side of the

market always prevails in a temporary equilibrium with fixed prices and quantity constraints. This is displayed in Figure 7. Since this process is still underway, and has not reached completion yet, one should expect the unskilled unemployment rate to rise in the months and years to come. Of course, in a long-run Walrasian general equilibrium, the flood of unemployed workers – both skilled and unskilled – both wage rates will have to fall in the U.S., since the exposure to china and India is now a reality for Americans.

By a similar argument, $\tilde{U}^{Skilled} = \bar{\bar{S}}_N - \tilde{S}_X$ skilled workers will become unemployed in the U.S., as indicated in Figure 8, again as a temporary equilibrium with fixed prices and quantity constraints. This process is also not complete yet. However, the numbers of skilled Indian substitute workers are far fewer in number, so that this process should be expected to be completed earlier.

There is, however, another problem that the U.S. faces in the case of skilled workers. First, there is no actual shortage of demand for unskilled workers; if there were, why would skilled jobs be outsourced to India. It is merely that the American skilled workers have to get accustomed, in the long term, to working for lower salaries than they were used to in the pre-shock state of the economy. Second, as already noted, since only one out of every four high school graduates in the U.S. finishes college, getting educated takes years, and since the kind of new jobs that are created in America are of a skilled nature, in turn due to the American comparative advantage in innovation and R&D, the phenomenon of there being far too many unemployable American workers should also be expected to persist for a few years. This phenomenon will exhibit itself alongside the unemployment of that category of skilled workers for whom there are substitutes available in India.

In any event, $\tilde{Y} \neq \hat{Y}, \bar{\bar{L}}_N \neq \hat{L}_N$, $\bar{\bar{S}}_N \neq \hat{S}_N$. Therefore, this, and the fact that with quantity constraints the price of the non-traded good, $\tilde{p}_N$, in the new non-Walrasian general temporary equilibrium is simply not, in general, the same as this price, $\hat{p}_N$, in the initial, pre-structural-shock general equilibrium. To see this, note that (10) changes to

$$\tilde{C}_N(p_X, p_M, \tilde{p}_N, \tilde{Y}) = \bar{\bar{N}}(\tilde{p}_N, r^*, \hat{w}_L, \hat{w}_S, \bar{\bar{L}}_N, \bar{\bar{S}}_N). \tag{10a}$$

There is still the issue of an increase in interpersonal income inequality concomitantly with a positive rate of growth of real national income until 2008, and a contraction of this aggregate that is expected 2009 onwards. The model presented so far is not capable of handling this issue. However, an extension is proposed in Appendix II that does indeed address this matter and the issues of aggregation and interpersonal comparability, both in the context of description (positive analysis) and in the context of developing policy prescription (inevitably a normative analysis).

To compare the collective human wellbeing actually realized by the American people in the two general equilibria, all we have to now do is to specify a collective human well-being evaluation measure. Then we would be ready to solve for the value of this index in the pre- and post-structural-shock situations.[20]

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[20]That is, for the phases both before and after the American economy was suddenly exposed to 2.3 billion people we can then ascertain the impact on the extent of realization of well-being of the American people, or lack thereof. The collective human well-being evaluation index I would adopt is $W = y^\alpha (1 - G)^\beta$, where y is per capita income, G is the Gini coefficient of the interpersonal income distribution in the US, and α and β are non-negative parameters that embody the value judgment regarding how much weight in social evaluation should be given to distributive considerations and how much to the scale of average achievements. For an axiomatic derivation and for a persuasive justification of the use of this measure of collective human well-being, see Sen (1976) and Naqvi (2008). Suffice it to say that this Collective Human Well-being Evaluation Measure is ordinally measurable. This measure incorporates the distributive value judgment of inverse interpersonal-income rank-order weights. Also, for $\beta = 0$, this index coincides with GDP, for a fixed population size, and thus GDP is a special case of this social evaluation index.

Figure 5 (Graph of (4a))

Figure 6 (Graph of (5a))

Figure 7 (Graph of (6a) and (6b))

Figure 8 (Graph of (7a) and (7b)