Offshoring Knowledge Worker Jobs-

Boom or Burst for the US Economy?

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Abstract

This paper takes a system dynamics perspective of the contemporary trend of "Offshoring Knowledge Worker jobs from USA" to gain a better and deeper understanding of the results and implications of the trend, its impact on the jobs and workforce dynamics. The results not only support the viewpoint of economists that offshoring is beneficial to the economy, but also highlight another impending phenomena just round the corner, namely the slow rate of growth of workforce. Net U.S. workforce growth is slowing because seventy-one million baby boomers are beginning to retire. In this context, model outputs suggest that offshoring is postponing the undesirable state of U.S. jobs outstripping the U.S. workforce by nearly five years. Thereby, policy-makers have longer to find effective solutions to tackle the impending shortage of workforce in decades to follow. The model suggests that offshoring could not have come at a better time for the US economy.

1.0 Introduction

Often termed as, 'Mega-Trend', 'New Wave', 'An Economic Imperative', or 'A Short Term Solution,' offshore outsourcing has taken the global economy by storm. The mind boggling advances in the information and Internet technology coupled with rapid reduction in communication costs have opened floodgates for a plethora of possibilities in global business practices; have opened doors for new business alliances and outsourcing opportunities that were hitherto considered not feasible or uneconomical. The new practices include offshoring knowledge-worker jobs. Corporations that have successfully offshored knowledge-worker jobs include Microsoft, Intel, Oracle, Cisco, Texas Instruments, GE, and IBM, to name a few (Trends, 2004a pp 36).

Offshoring Jobs: a raging controversy

Consider the following excerpts from think-tanks as well as the mainstream media, as they tell a revealing story. "IBM to export highly paid jobs to India, China" (WSJ, 2003). This story contained a detailed report about, "IBM's plan of moving the work of as many as 4,730 programmers to India, China, and elsewhere." "McKinsey Global Institute estimates that, the volume of offshore outsourcing will increase by 30 to 40 percent a year for the next five years," (Drezner, 2004; McKinsey Global Institute, 2003). Forrester Research estimates that 3.3 million white collar jobs will move overseas by 2015 and Gartner Research firm estimated that by the end of this year (2005), one out of every ten IT jobs will be outsourced overseas (Drezner, 2004). These and many other similar news reports (USA Today, 2004: The Hill, March 3, 2004) have caused considerable

concern for the workers, economists, as well as policy makers, about the possible effects of offshoring.

At the same time, there have also appeared other reports in news that sought to alley the fears raised by above reports and accounts, by sharply contradicting some of the opinions expressed in the reports referred above. Consider the following: "Outsourcing is just a new way of doing international trade," said Prof Gregory N. Mankiw, Chairman of the President's Council of Economic Advisors (Drezner, 2004, Detroit News, 2004), and his statement caused a firestorm of reaction in the US senate. "Researchers estimate that outsourcing has cost the U.S. just 300,000 jobs in 3 years. By contrast, one percent productivity growth eliminates about 1.3 million jobs," (Business Week, March 22nd, 2004). For "Every dollar spent on a business process that is offshored to India, the U.S. economy gains at least $1.12. The largest chunk—58 cents—goes back to the original employer:" finding from a study by McKinsey Global institute (Trends, April 2004a, pp 38; McKinsey Global Institute, 2003; Fortune, Feb 2004). "For every dollar's worth of work shipped abroad, $1.30 to $1.45 is reinvested into the U.S.," a finding from a study by Evalueserve, a market research firm (Trends, April 2004a, pp 38; McKinsey Global Institute, 2003). "…Offshoring is inevitable, often makes good business sense, and can be beneficial to the overall health of our economy in the long run" (Trends, April 2004a, pp 38).

However, there is now a general apprehension in the air that, the offshoring trend, if allowed to continue unabated, may end with disastrous results on the US economy in terms of not only the short-term loss of jobs but a general fall in the long-term growth of

knowledge workers and their skill sets. Dependence on external economies for knowledge-worker positions may turn out to be a permanent dependence. Moreover, the loss of jobs results in a loss of tax revenue, leading to possible erosion of the U.S. Gov. and state governments tax bases. Similar statements can be made for a U.S. knowledge worker who loses job to offshoring and then takes another job at less salary.

A good part of the controversy arises from the fact that, the problem of offshoring is a complex feedback system problem comprised of many factors/variables interacting with each other. It is not easy to get a quick grasp of the 'behavior over time' of the major variables, given the complexity of feedbacks. For example, firms indulge in offshore outsourcing, motivated largely by the cost savings. Reduced costs lead to increased profits for the firms, which in turn, leads to higher investment by the firms and thereby increased jobs in the economy. Will the increases overshadow the initial losses in jobs? Will the GDP of the offshoring economy experience a surge, because of expanded workforce (both onshore and offshore workers combined) contributions? Only a study of the whole system as a feedback system will lead to a correct understanding of the problem.

Systems Thinking and System Dynamics

"Systems thinking is a conceptual framework, a body of knowledge and tools that has been developed over the past fifty years, to make the full patterns clearer, and to help us see how to change them effectively" (Senge, 1990, pp 7). "System dynamics is a methodology for studying and managing complex feedback systems, such as one finds in business and other social systems" (System Dynamics Society, 2005).

Typically, under traditional analytical approach, a problem is studied by dividing it into its component parts. But this is a clear case of a problem that needs to be studied as a whole rather than in parts. Therefore, the offshoring problem needs to be studied holistically using system dynamics rather than by following traditional analytical approach

Purpose of the study and questions to be answered

The purpose of this study is to take a system dynamics perspective of the problem of offshoring knowledge worker jobs from USA, and thereby, seek answers to the following questions,

- Is, offshoring knowledge worker jobs, good or bad for the U.S. economy?
- Is, offshoring knowledge worker jobs, inevitable? Alternatively, is it possible to eliminate it or slow it down?
- What are logical outcomes of this trend in the short run? In the long run?
- What are the factors having significant affect on the outcomes and how may they be controlled? (a.k.a. identifying leverage points)
- What can the U.S. government do to take control of the situation and protect the workforce and the economy, in terms of policy regulation?
- What should the workforce do to prepare itself for the short run and the long run?
- What is the relationship between jobs and workers?

Some researchers up to this time have provided reasonably convincing answers for some of these questions. However, we need further confirmation.

The rest of the paper is organized as follows; In section 2, literature review that provides basis for the assumption of the dynamical model are discussed. Then the model development in Vensim is explained in section 3. Two policy alternatives are simulated- a) where offshoring is banned b) where offshoring is allowed (to a certain extent), in section 4; and the results obtained under the two alternatives are discussed. Finally, in section 5, contributions and limitations of the study are discussed.

2.0 Literature review

Outsourcing and Offshoring differentiated

Outsourcing is not a new idea. In fact, outsourcing has been in vogue for over half a century (Trends, 2004b pp 24). "In manufacturing, purchased items and services account for 60 to 70 of the cost of goods sold," (Chase et al., 1998). Outsourcing is defined as "allotting work to suppliers and distributors to provide needed services and materials and to perform those processes that the organization does not perform itself" (Lee, K.J., and Larry, R.P., 2005). The reasons for outsourcing and risks of outsourcing have long since been known and discussed in the operations management literature. Some of the motivating factors in support of outsourcing are, cost reduction, head count reduction, focus on core competencies, improve efficiency, move toward leanness, innovate and re-engineer processes, etc. On the other hand, there are risks associated with outsourcing such as, loss of control, higher exit barriers, exposure to supplier risk, slow implementation, poor quality, increased cycle or lead time, etc., (Chase et al., 1998).

"Offshoring can be defined as performing work for customers in one country in a different country." The offshored unit can be either "captive" (owned by the same firm that did the work onshore) or outsourced (Matters, et al., 2005). Both forms of offshoring of knowledge worker jobs are the focus of this study.

Preliminary assumptions and Starting Points

From the economics literature on job outsourcing, a few basic assumptions emerge. The assumptions are,

1) Outsourcing jobs saves money for the firms (Mann, 2003, pp 3, 6; Pint E.M. and Baldwin, L.H., 1997, summary- pp vii: Trends, 2004b pp 24)

2) Outsourcing jobs displaces workers (Mann, 2003, pp 6, while arguing that job losses will likely be made up by creation of new jobs).

3) Outsourcing helps in focusing on core competencies of the firm (Pint E.M. and Baldwin, L.H., 1997, summary- pp viii).

4) Firms are rational in their choices and reinvest their profits if they have opportunities to earn further profits, (Bhagwati, J., et al., 2004, pp 13).

5) Reinvestment of profits from offshoring activity by the firms causes generation of additional jobs in the economy, (Bhagwati, J., et al., 2004, pp 13; Mann, 2003, pp 6 and pp 9).

6) Displaced workers behave rationally and accept alternate jobs at the first opportunity.

7) Outsourcing results in improved productivity (Mann, 2003).

These are the underlying causal assumptions for the causal loop diagram development and the subsequent model development.

3.0 Dynamical Model Development

Level of abstraction

Determination of level of abstraction is one of the preliminary steps in model building, (Sage, A.P., 1977). Aggregation and requirements detail have to be balanced. To study, 'offshoring knowledge worker jobs' problem, which is a behavioral complexity issue and a macro level issue at that, we have to adapt to a fairly high level of aggregation. Incidentally, some advantages of a highly aggregated model are, a) fewer data required for validation, b) simulation is fast, and c) formulation is inexpensive (Sage, A.P., 1977).

Causal Loop Diagram

A simplified Causal Loop Diagram derived for this problem is depicted in Appendix A. We can clearly identify two main sectors of the model as, 1) Jobs sector, and 2) Workforce sector. Jobs sector represents the demand for labor and workers sector represents the supply of labor. We include Blue-Collar Jobs and Blue Collar Workers as

well as White-Collar Jobs and High-value Knowledge Workers in our model to facilitate a systemic view of the problem. Typically, knowledge workers earn higher wages than their counterparts in blue-collar jobs, although the distinction is blurring. Since the focus of study is High Value Knowledge Worker Jobs, all other jobs have been 'lumped' into Blue Collar Jobs in this model. Hence, at the start of the simulation the sum total of 'initial' stock of High Value Knowledge Worker Jobs and 'initial' stock of Blue Collar Worker Jobs equals the 'initial' total civilian workforce - (less) the initial unemployed.

Cost savings is the major driver of offshoring

Not withstanding the differences in other aspects, most of the reports on offshoring concur in their finding that; cost savings is the major driver of the current trend of offshoring. (Trends, April 2004a- pp32 and pp36; Drezner, 2004 pp 30; McKinsey, 2003 pp 5). Considering the wide disparities that exist between the GDP of USA and the outsourcee nations, there really is no fear that those economies will advance so far as to eliminate the wage differential that exists now, within a foreseeable future. For these reasons, in the proposed model its assumed that every job that is offshored contributes to increase profitability of the firm offshoring, and that these benefits continue for the entire term of simulation, say next 25 years.

Listed in Table below are the major variables and parameters that comprise the simplified model presented here.

Table Listing of Variables and Parameters

In the Jobs sector

High Value Knowledge Worker Jobs (HVKWJ) –in U.S.
HVKWJ creation rate (annual rate of increase in HVKW Jobs)
HVKWJ offshoring rate (current annual rate of offshoring HVKW Jobs)

Offshored HVKWJ (accumulated stock of HVKWJ offshored over years)
HVKWJ automation rate (annual rate of jobs rendered obsolete by technological advances)
Blue Collar Jobs (BCJ) (all jobs in economy other than HVKWJ)
BCJ creation rate (the annual rate of increase in BC Jobs)
BCJ offshoring rate (current annual rate of offshoring BC Jobs)
Offshored BCJ (accumulated stock of BCJ offshored over years)
BCJ automation rate (annual rate of jobs rendered obsolete by technological advances)
Corporate Tax normal (Income tax rate levied on firms on their profits)
Interest rate normal (Federal Funds rate-manipulated to stimulate job creation)
Profitability (of firms employing workforce-impacts new investment)
New Investment (by firms-directly impacts job creation)

In the Workforce sector

High Value Knowledge Workers (HVKW) - in US
HVKW growth rate (annual rate of increase in HVKW workforce)
HVKW retire rate (annual rate of retirement from HVKW workforce)
HVKW to BCW transition rate (annual rate of movement; voluntary or otherwise)
Blue Collar Workers (BCW) (Civilian workforce filling the BC jobs)
(Initial BCW stock= Total Civilian workforce-HVKW workforce)
BCW growth rate (annual rate of increase in BCW workforce)
BCW retire rate (annual rate of retirement from BCW workforce)
BCW to HVKW transition rate (annual rate of movement- typically, self motivated)
Combined retiree stock (retired from civilian workforce)
Death rate Normal (annual death rate of retirees, based on life expectancy)

Common variables

HVKWJ to HVKW ratio (HVKW jobs to workforce ratio-identifies unemployment/shortage of workforce)
BCJ to BCW ratio (BCJ to workforce rate-identifies unemployment/shortage of workforce)

Constants: In the Jobs sector

HVKWJ creation normal (fraction of jobs per year in relation to existing HVKW jobs)
Rate of automation of HVKWJ (fraction of jobs per year in relation to existing HVKW jobs)
BCJ creation normal (fraction of jobs per year in relation to existing BC jobs)
Rate of automation of BCJ (fraction of jobs per year in relation to existing BC jobs)

Constants: In the Workforce sector

HVKW growth normal (fraction of workers/year in relation to existing workers)
HVKW retirement normal (fraction of workers/year retiring, based on working life-40 years)
HVKWJ offshoring normal (fraction of jobs/year in relation to existing HVKW jobs offshored)

HVKW to BCW transition normal (fraction of workers/year making such transition)
BCW growth normal (fraction of workers/year added to existing BC workers)
BCW retirement normal (fraction of workers/year retiring, based on working life-40 years)
BCJ off shoring normal (fraction of jobs/year in relation to existing BC jobs offshored)
BCW to HVKW transition normal (fraction of workers/year making such transition)

Causal Loop Diagram (CLD) explained

Typical of any job market, the current stocks of jobs are affected by the 'annual job creation rate,' which is influenced by various factors such as 'interest rate,' 'new investment,' and 'automation rate.' Similarly, the jobs are also affected by the 'offshoring rate' and 'automation rate.' The automation rate may represent the loss of jobs on account of other events like 'mergers' and 'takeovers' as well.

In the workers sector, stocks of workforce are affected by the 'growth rate,' 'current stock of work force,' some inter-transition between types of workforce, and the 'retirement rate' from the workforce. The ratio of 'available jobs to available workers' prompts government to manipulate the interest rate in the economy to encourage new job creation or otherwise, depending upon whether a need to give further boost to job creation exists or not. If the ratio of jobs to workers is greater than one, the Fed will likely increase interest rates whereas if the ratio is less than one the Fed would reduce the interest rate and a jobs-to-workers ratio would imply no need to change the current interest rate. This same logic is stored in the jobs-to-workers ratio table lookup in respect of both types of work force in which both ratios (HVKWJ ratio and Blue-collar ratio)are averaged, each with equal weight to create a single ratio. A CLD capturing the causalities discussed above is enclosed as 'Appendix A.' Feedback loops may easily be spotted in the CLD.

Model Development-Stock and Flow Diagram (SFD)

Converting CLDs to SFDs becomes simple if we follow the principles of 'Consistency' and 'Robust loops' in analyzing the CLDs (Burns, 2001). Using Vensim PLE (Ventana, 2005) we can quickly develop the SFD from our CLD. A simplified Stock and Flow Diagram (SFD) developed following the above process and implementing necessary assumptions (discussed in the following) appears in Appendix B. In order to simulate the SFD though, one needs to continue with the further steps of entering the 'units' for all quantities and the equations of the rates and stocks. For example, in the proposed model, the HVKWJ (High-Value Knowledge-Worker Job) is a stock and represents 'jobs' so the unit for this stock is 'job'. The HVKWJ creation rate is the number of HVKW jobs created per year; so the unit for this rate is 'job per year.' HVKWJ Creation Normal is the numerical value of job creation expressed as a fraction of HVKWJ and the unit for HVKWJ creation normal would be 1/year. The model needs initial values for all the quantities before it may be simulated. Details of data used are discussed in the section, 'Data values.'

Redefining variables - additional assumptions

While units of measurement for jobs, workforce, offshored jobs and some other variables and stocks are quite obvious and easy to figure out, a few of the other variables need some careful consideration and handling. Profitability arising on account of offshored Knowledge Worker Jobs and Blue Collar Jobs is not easy to define. What is easy to assume though is that, the initial profitability of employers is unity i.e. 1 (after Tax). It then follows, based on the various economists' / independent research agencies'

reports (Drezner, 2004; Mankiw, G.N., 2004; Business Week, March 2004; and The Economist, 2003), that an increase in outsourcing is motivated by the cost savings. Therefore, it stands to reason that an increase in the offshored job numbers must result in an increase of profitability for the firms offshoring these jobs. On a conservative basis, profitability is defined as initial profitability + (plus) a small fraction of the increase in the offshored jobs taken in proportion to the initially offshored job numbers. This modest estimate of profitability is then allowed to impact the growth in further jobs creation as the practice of 'Plowing back the profits'. Considering the level of aggregation adopted in the model, all employers are assumed to be of the same category and only one income tax rate, termed corporate taxation rate, is modeled. Other economic factors such as inflation and government spending that would otherwise have an impact on interest rate normal, are assumed to remain unchanged through out the period of simulation and hence have not been included in the model.

Data values

Since we are studying this problem in a deterministic simulation model, we need some initial data values and reasonable parameters for use over period the period of interest—25 years. The data values adopted in the model,

1. Total Civilian workforce as of Jan 2004 is the basis for the calculations. (We have to have a starting point and since the problem manifested itself during this year, data at the beginning of this year is consider a logical starting point)

2. 10 Millions workforce is assumed in HVKW workforce (Trends, 2004a pp 38)

3. The balance work force is BCW (all other jobs lumped into BC jobs to support the systemic view)

4. 6% unemployment rate is adopted (DOL-BLS, 2004)

5. Both categories of jobs are shown at 6% short of respective workforce.

6. Currently 10% of HVKW jobs and BC jobs are shown as already offshored (no distinction is made between 'captive' offshoring and 'outsourced' offshoring, both forms of offshoring are combined and considered as 'offshoring' for the purpose of this model).

7. Job creation rate norm of 2% for HVKW and 2% for BCW jobs are assumed.

8. Job automation rate is assumed at 2% p.a.

9. Interest rate adjusted to show how government would manipulate the same to stimulate job creation based on jobs to workers ratio.

10. Initial Interest rate of 4% is adopted (Bank rate.com). This rate is supposed to boost the employment, so an interest table-look-up gives a multiplier for interest rate of 4%, multiplier changes to 1 at interest rate of 6%)

11. Cross transition between workforces is assumed to account for rate of change of technology and BCW improving their skill sets.

The Rand Corporation in its research report entitled, "The 21st Century at Work" reported a very disturbing trend of a rather slow rate of growth in U.S. Workforce over the next few decades. To begin with, in contrast to a healthy 2.6 percentage per annum growth of 1970s, U.S. Workforce grew at disappointing 1.1 percentage per annum during the 1990s. Further, in the coming decades the growth rate is projected at, 1.1 percentage per annum for the decade of 2000-2010, but a much lower 0.4 percentage per annum for the

period 2010-2020, followed by an even lower 0.3 percentage per annum for the decade of 2020-2030, (Rand, 2004). All of these estimates and their effects are amenable for use and testing in the dynamical model under this study and have been used appropriately.

4.0 Simulation-Findings and results

Under the given assumptions, we are able to obtain the results in terms of graphs of major variables showing their behavior over time, and these graphs appear to be consistent with the known patterns of behavior of the respective variables. We are simulating two alternate policies:

Policy-1: Total ban on offshoring of jobs of either category.
Policy-2: Offshoring allowed as at present, with a restraint that not over 2% of jobs be offshored per year.

We could also consider a third, Policy-3 where offshoring is allowed at 3% per annum of existing jobs. For gaining meaningful insights into the relative behavior of variables, the first two alternatives will suffice.

We can see from Fig-1 that, if jobs are not offshored, the HVKWJ will exceed the available workforce by about the year 2008. Similarly, from Fig-2 it may be seen that BCJ are also poised to exceed the available workforce by the end of the year 2009. However, the scenario becomes better; under Policy-2 with restrained offshoring, and HVKWJ exceed the workforce in the year 2013 (Fig-3). Similarly, BCJs take longer to outrun the supply of workforce, at about year 2015 (Fig-4). What happens if we offshore jobs at a rate higher than 2%? A run with offshoring normal at 3% shows that a shortage of HVKWJ and BCJ take much longer to surpass their respective supplies of workforce, that happening in the years 2016 and 2020, respectively.

Figure 1: KWjobs vs KW Workforce

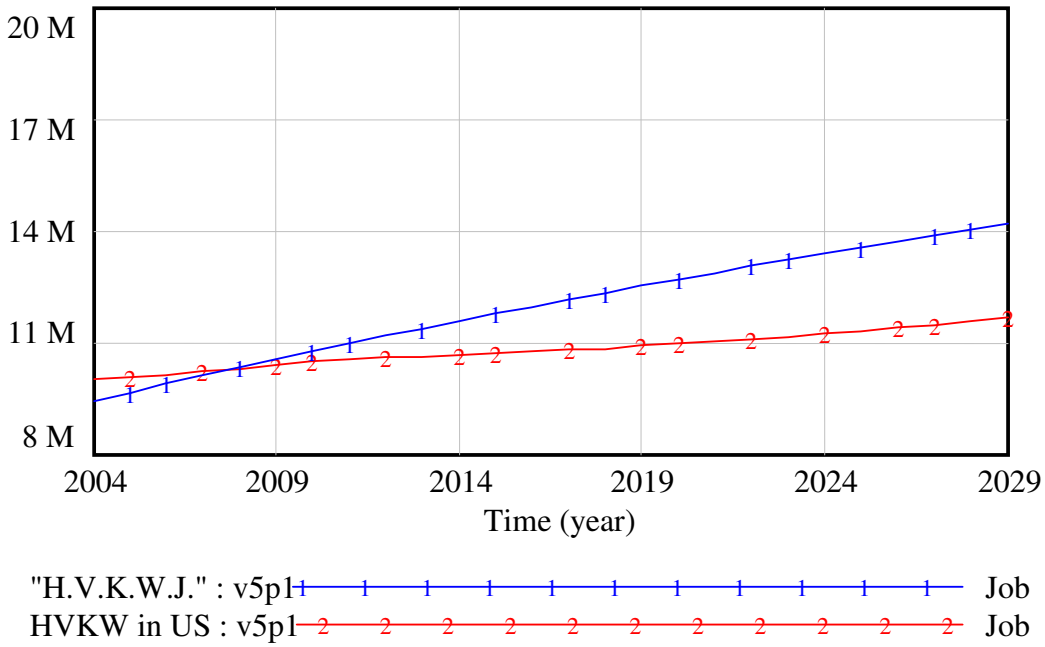


Figure 2: BCJ vs BC Workforce

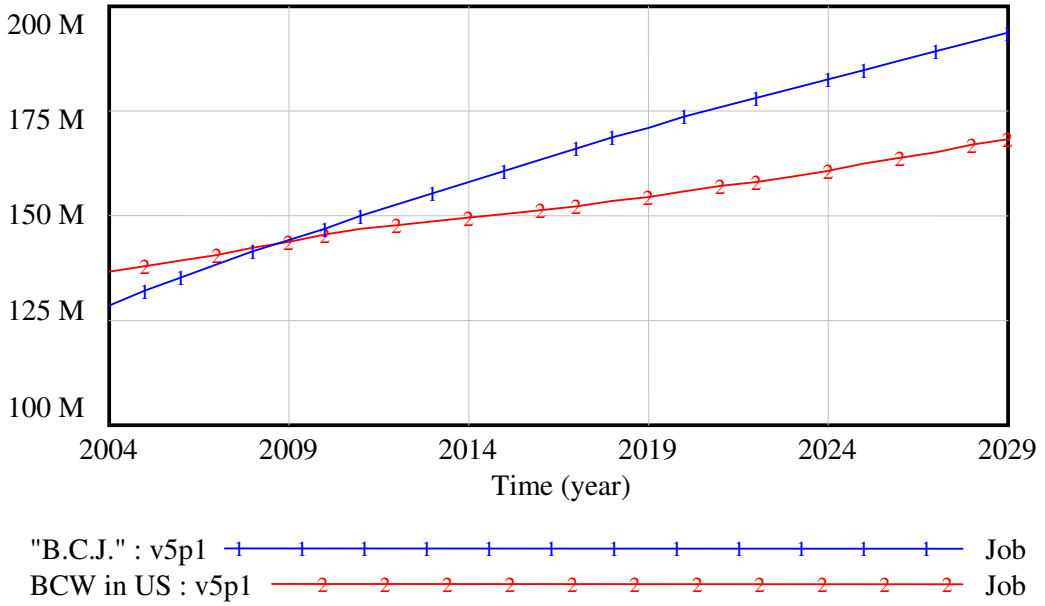


Figure 3: KWjobs vs KW Workforce

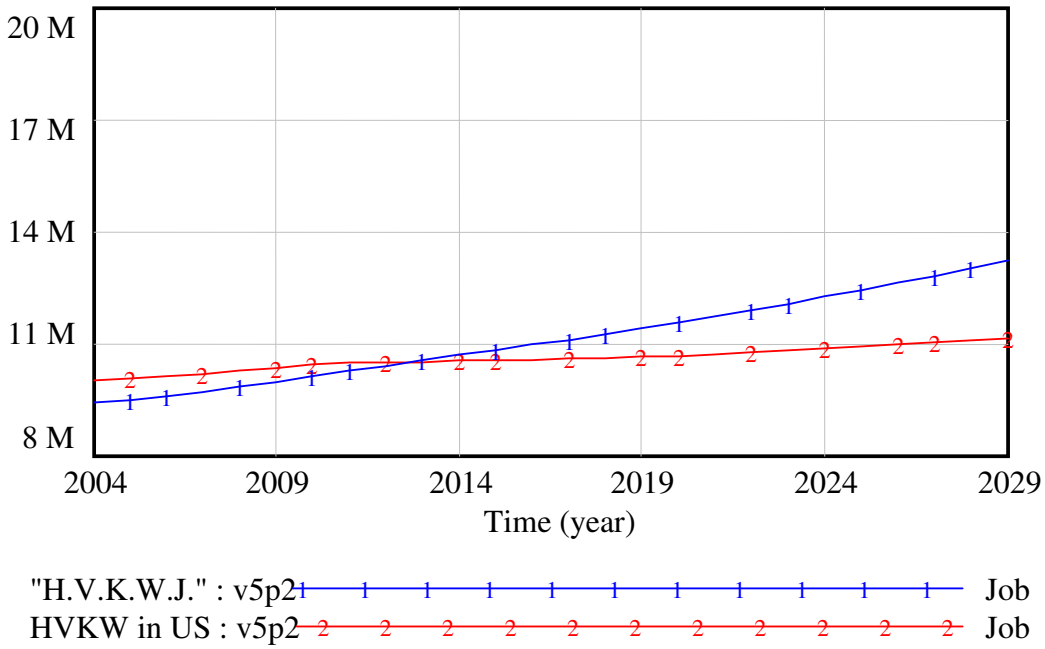
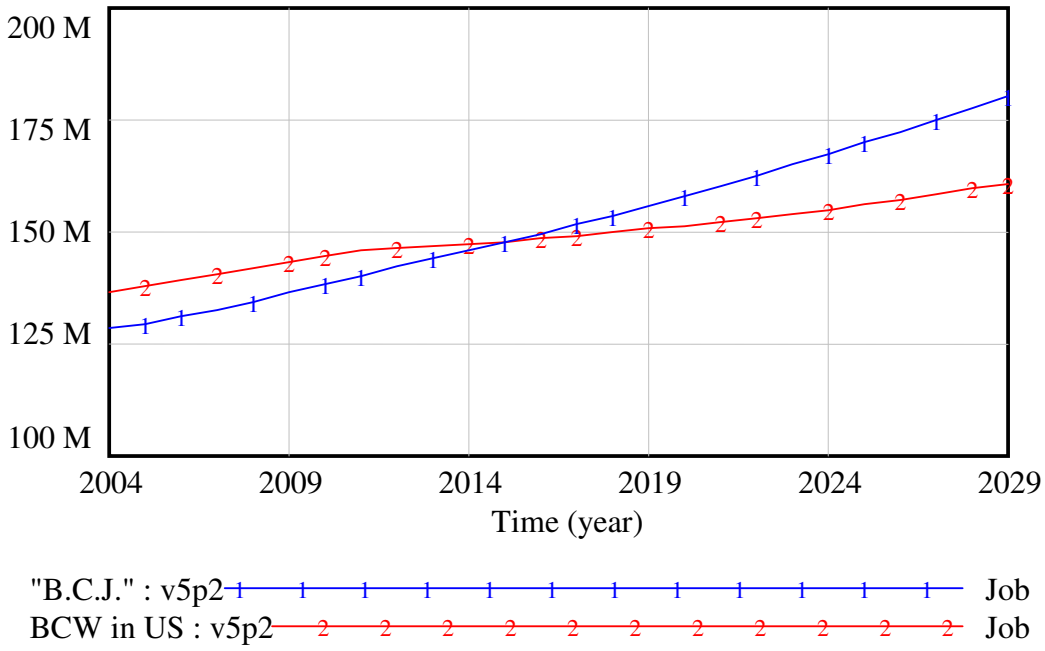


Figure 4: BCJ vs BC Workforce



Further increases in the offshoring rate normal, delays the impending occurrence of jobs outstripping workforce; but the increases also exhibit a rise in short term unemployment to a much higher level than at start, and higher than under policy 1 and 2..

Figure 5: total HVKW Jobs

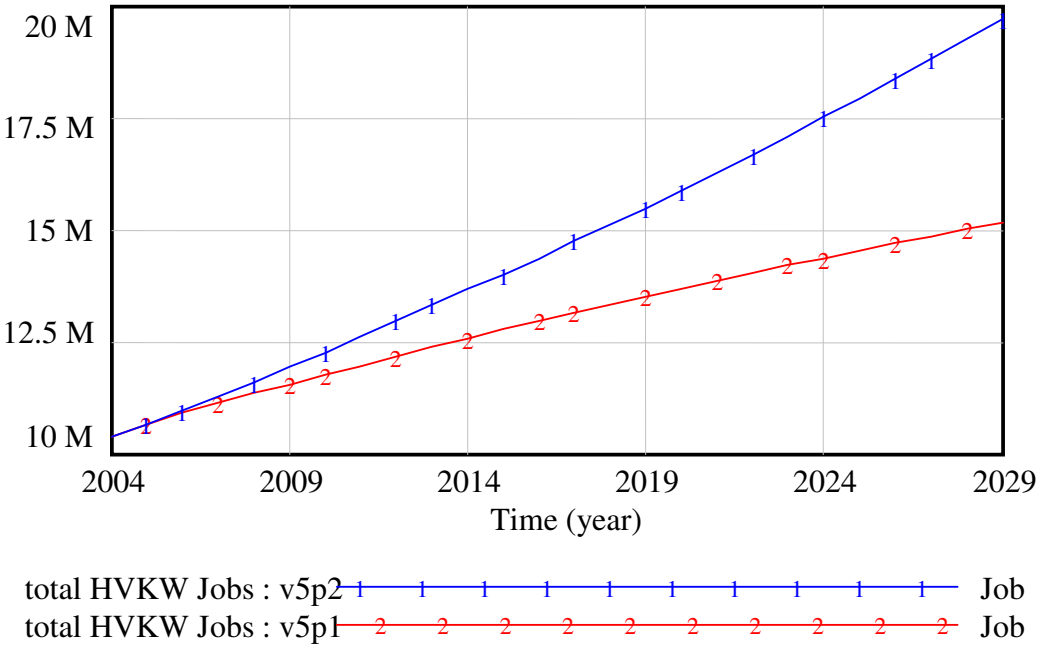


Figure 6: total BCW jobs

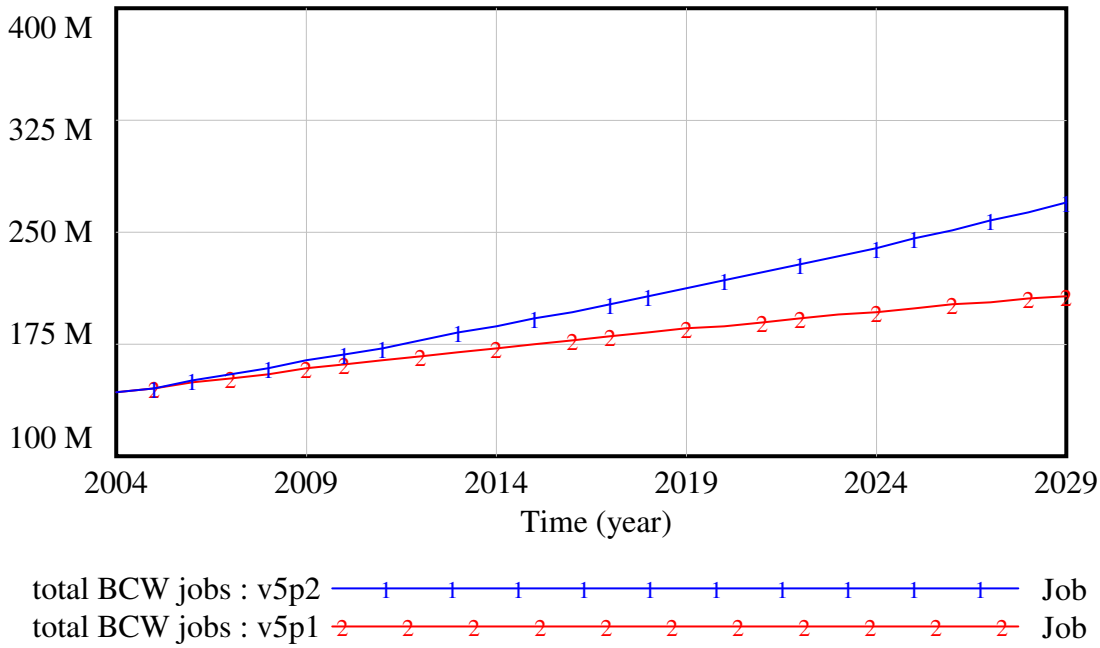


Fig-5 and Fig-6 show the total jobs (onshore plus offshore) contributing to the production of goods and services for US economy. While policy-1 has the immediate benefit of quickly reducing the unemployment, it does also show a lower level of labor contribution to the GDP of US economy. On the other hand, policy 2 shows a very high level of labor contribution, albeit with some slow reduction in initial unemployment.

Figure 7: unemployment under the two policies

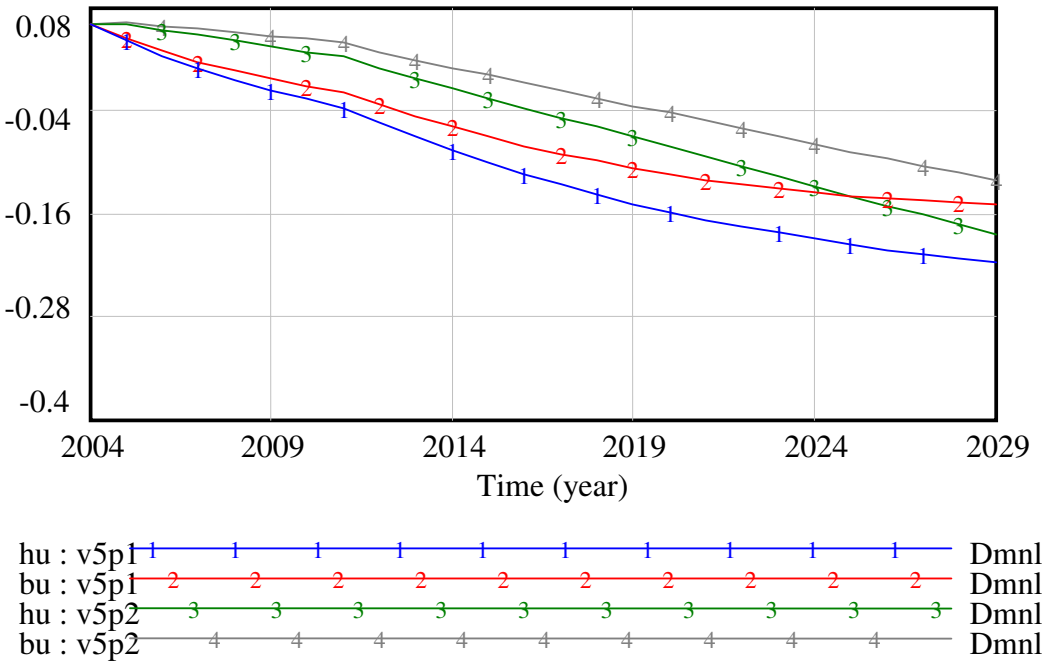


Figure 7 depicts the U.S. unemployment rate for the policies under consideration. Curves 1 and 2 depict the trends in unemployment for high-value and blue-collar workers under policy 1. Curves 3 and 4 depict the trends in unemployment for high-value and blue-collar workers under policy 2. Starting at 6% in 2004, Fig -7 shows that unemployment drops or remains as it is, for the first 2 to 3 years but then declines steadily thereafter.

Discussion

Let us revisit the questions we raised in section 1 and try to address each one. Is *offshoring knowledge-worker jobs good or bad for the economy?* The model results, though tentative, appear to endorse the view that offshoring is good and makes good business sense, notwithstanding some initial job losses in the economy. However, some

restraint on the rate of offshoring may be advisable, unless off course, the firms offshoring the jobs do not displace any of their current employees.

Is, offshoring knowledge worker jobs, inevitable? Alternatively, is it possible to eliminate it or slow it down? The answer to the first part of the question is in the affirmative. We do not really need to refer to our model results to answer this question. When the market leaders in the global market are benefiting from offshoring, be it captive offshoring or outsourced offshoring, there is enormous pressure on the medium and small firms to fall in line or face the risk of total elimination from the supply chain (in the absence of a viable alternative policy). As for the second part of the question, one can only speculate that improvements in the productivity (perhaps by technological advances) may obviate the need for human labor to a great extent, thereby reducing the need for offshoring in the same proportion as the reduction in local employment. But the other drivers of offshoring, namely, the opportunity to focus on core competencies, convenience of maintaining a round-the-clock customer service (with time zone differences), and the benefits of global networking will continue to keep offshoring alive for a long time to come.

What are logical outcomes of this trend in the short run? In the long run? Unrestrained offshoring will lead to a sharp increase in unemployment in the short run. If the profits are not reinvested (resulting in the generation of new jobs in the U.S.), the job market may not revive soon enough to compensate for the jobs sent offshore.

What are the factors having significant affect on the outcomes and how may they be controlled? What leverages exist? We cannot honestly answer this question at this stage

with the current model. However, by developing an index of performance based on a predefined value system and the use of sensitivity and optimization techniques we shall identify such leverage points (Burns, J.R., and Malone, D.W., 1974).

What can the government do to take control of the situation and protect the workforce and the economy, in terms of policy regulation? From all the evidence we have from literature as well as our model results, we can safely conclude that a 'total ban on offshoring' is detrimental to the long term benefits of the economy. This view is further reinforced by the projections of slow rate of workforce growth by RAND Corporation (RAND, 2004). Since there is evidence to the effect that new jobs will emerge as the result of offshoring benefits, the U.S. government should provide facilities to workforce to train / retrain workers to take up those new jobs.

What should the workforce do to prepare itself for the short run and the long run? Wherever possible, employees should negotiate with employers to provide insurance coverage for loss of jobs. Obviously, all jobs that create (an information product of) value which can be transmitted over the Internet, can be performed from remote locations thus are candidates for offshoring (Drezner, 2004 pp-25). For the long run protection, workers need to train themselves for specialist jobs and be prepared to work longer and make their service worth the employer's money.

What is the relationship between jobs and workers? Limiting our discussion to knowledge worker jobs, we can say that, offshoring has now shown that job growth need not necessarily be curtailed by the availability of workforce in the local economy. So also, jobs need not necessarily remain in the economy just because there is workforce available

to perform. In an open market free trade environment, firms will not hesitate to offshore the jobs as long as there are other profitable options.

Possible additional insights

What additional insights may be gained with the help of this kind of model? The answer is, we can simulate several different parameter settings and the likely results. Here are a couple of scenarios and the ways to simulate them.

Scenario 1: Technological developments and productivity gains eliminate a higher rate of jobs than at present – we may alter the HVKWJ automation rate and BCJ automation rate suitably (say 3% p.a.) on a continuous basis or alternatively consider a 'one-time' job elimination of a suitable percentage(say 5% to 10%) in a given year and run the model

Scenario 2: Current and future workforce is willing to work longer (before retiring) than their peers to make up for the slow rate of growth in workforce – we may increase the parameters 'HVKW working lifetime' and 'BCW working life time' suitably to study the effects.

Scenario 3: Companies do not re-invest their profits stemming from offshoring, in additional U.S. jobs, such profits being short-lived anyway. We can set the HVKW projects investment rate and the BCJ projects investment rate to 0 and re-run the model, to represent such behavior.

A Word of Caution

First, we have to remind ourselves that the parameters values we used are subject to some error or uncertainty. Hence, the results we obtained have to be interpreted subject to the inherent errors in parameter values, stock initial values and model structure. A more serious practitioner is advised to refer to, "Error Analysis of Nonlinear Simulations: Applications to World Dynamics" (Burns, 1975). Notwithstanding that, the results may not be accurate in terms of numerical values, in terms of actual number of jobs (HVKW or BC) or the exact year when jobs outnumber the workforce, we still have useful insights that we obtain from the model in terms of the behavior of the variables.

5.0 Contributions and Limitations of the paper

Contributions

The study has provided simple and easy to grasp explanations for some of the complex questions raised in the introduction section by capturing the structure and dynamics of the jobs, workforce and the related variables in Causal Loop Diagrams, Stock and Flow Diagrams, and 'behavior over time' graphs. We have tested the RAND Corporation's estimates of civilian workforce growth over next 25 years and found them to be reliable, assuming a top-heavy workforce that has many workers nearing retirement. But there are other aspects of workforce dynamics that make offshoring appear to be a "blessing in disguise."

Short run symptoms often do not tell the entire story. Typical system dynamics problems are better understood under a systemic study rather than symptomatic analysis of individual symptoms. Sometimes, seemingly opposing results are possible simultaneously, like in this case, the simultaneous growth in offshored jobs as well as total jobs within the US economy.

It is very important to note that the workforce stock should be built up sufficiently in advance to meet the demand when the demand does start building up. If the workforces get disappointed with the initial trend, and do not prepare themselves to meet the demand when it arises, the economy could face a serious shortage of skilled workforce. In such eventuality, policy makers may have very little options; either to resort to a greater level of off shoring or to allow additional temporary workforce into US economy.

Limitations

As discussed under section 'level of abstraction' this problem is best studied at macro level with a high level of aggregation. Therefore, the model lacks sufficient detail to explain regional job market dynamics within U.S.[1] between different categories of jobs. Similarly, the results/outputs of the model are to be understood and interpreted subject to the assumptions made in developing the model. In the current model, job-creation is allowed to go on, despite backlog in filling existing jobs. We have not addressed this issue in this model to emphasize the trend of economy's ability to create more jobs. One might also contemplate the situation of offshoring at higher rates starting the year where jobs

[1] Some demographers expect a net loss of jobs in the northern U.S., but a net gain in the southern U.S.

surpass the workforce. However, in reality job creation takes a hit if available jobs are not filled for over six months/a year.

In this context, any student of system dynamics will surely remember Jay W Forrester's comments, "Computer models of social systems and laboratory tests do not guarantee against failure, but they do identify many weaknesses which can be corrected before they usually cause full-scale failure," (Forrester, J.W., 1971). In addition, as Forrester states (Forrester, J.W., 1971, preface viii) "all models are tentative. New insights will continue to appear," so the proposed model may need to be revised to accommodate some new dynamic factors or significant events that affect the assumptions of the model.

It is also important to remember that, the primary objective of this paper is to gain a better and deeper understanding of the problem of offshoring and its effects on the U.S. economy. Accordingly, the proposed model's results are to be interpreted primarily for understanding the complex behavior of the variables/factors involved.

References

Bankrate.com, Bank lending rate as reported on line at web site at URL http://www.bankrate.com/goocalf/ratewatch/leading-rates.asp

Bankrate.com, Unemployment rate reported online at web site at URL http://www.bankrate.com/goocalf/ratewatch/key-economics.asp

Bhagwati, J., Panagaria, A., and Srinivasan, T.N., (2004) "The Muddles over Outsourcing," a working paper, Columbia University, NY.

Burns, J.R., (1975) "Error Analysis of Nonlinear Simulations: Applications to World Dynamics" IEEE Transactions on Systems, man and Cybernetics, Vol. SMC-5, No.3, May 1975.

Burns, J.R., (2001) "Simplified Translation of CLDs into SFDs," System Dynamics Conference, Atlanta.

Burns, J.R., and Malone, D.W., (1974) "Optimization Techniques Applied to the Forrester Model of the World" IEEE transactions on Systems, Man, and Cybernetics, Vol. SMC-4, No2, March 1974.

Business Week, Special Report, March 22, 2004 (40-42)

Chase, R.B., Acquilano, N.J., and Jacobs, R.F., (1998) in *Production and Operations Management,* eighth edition, Irwin McGraw Hill.

Detroit News, (2/23/04) "Economy doesn't suffer when some jobs disappear" By George Will, in Editorials and Opinions, quoting Mankiw, G.N., Chairman President's Council of Economic Advisors, at URL: http://www.detnews.com/2004/editorial/0402/23/a09-71102.htm

Drezner, D.W., (May/June 2004) "Outsourcing Bogeyman," Foreign Affairs, Vol. 83 No 3. May / June 2004, pp 24.

D.O.L., Bureau of Labor statistics, "Occupational Outlook handbook" published 2003, at URL http://stats.bls.gov/oco/oco2003.htm

DOL-BLS, Bureau of Labor Statistics, at http://www.bls.gov/data/ , 2004 (report on Civilian workforce and unemployment).

Forrester, J.W., (1971) "Counterintuitive behavior of social systems," MIT literature collection, D4468-2.

Forrester, J.W., and Senge, P.M., (1979) "Tests for Building Confidence in System Dynamics Models," MIT Literature collection, D-2926-7, 1979.

Forrester, J.W., (1971) *World Dynamics*, Cambridge, Mass, Wright-Allen.

Fortune, 23rd February 2004, "Rage Against Offshoring is Off Target" by David Kirkpatrick. © Copy right 2004 by Time Warner, Inc.

ITAA (Information Technology Association of America) report, (2004) "The comprehensive Impact of Offshore IT Software and Service Outsourcing on the U.S. Economy and the IT Industry," prepared by Global Insight (USA), Inc, March.

Lee J. Krajewski, Larry P. Ritzman (2005) in, *Operations Management- Processes and Value Chains,* seventh edition, Pearson Prentice Hall.

Mann, C. L., (2003) "Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth," International Economic Policy Briefs, Institute of International Economics, December, at URL http://www.iie.com/publications/pb/pb03-11.pdf

Matters, R., Matters, K.K., Pullman, M., and Walton, S., (2005) *Successful Service Operations Management*, 2nd edition, Thomson.

McKinsey Global Institute, (2003) "Offshoring: Is It a Win-Win Game?" San Francisco, August.

RAND Corporation, (2004) "The 21st Century at Work," Prepared for the US Department of Labor.

Sage, A.P., (1977) *Methodology for large scale systems*, McGraw Hill.

Senge P.M., (1990) *The Fifth Discipline, The art & practice of the learning organization,* Double day currency, 1st edition.

System Dynamic Society Home page, 2005, at URL http://www.systemdynamics.org/index.html

The Economist, (2003) "Relocating the back office," Dated 12/13/03 pp 67-69.

The Hill, (2004) "'Benedict Arnold' CEOs fund Kerry," by Sam Dealey, 3rd March.

Trends E-magazine, (2004a) “Offshoring ‘Knowledge Work’,” April.

Trends E-magazine, (2004b) “Outsourcing will Become a Source of Strategic Advantage”.

USA Today, (2004) “Workers asked to train foreign replacements,” April 6, by Stephanie Armour.

Ventana Systems Inc., (2005), at URL http://www.vensim.com/download.html 3/15/05.

Wall Street Journal, (2003) “IBM to Export highly paid jobs to India, China,” Dec 15, by William M Bulkley.

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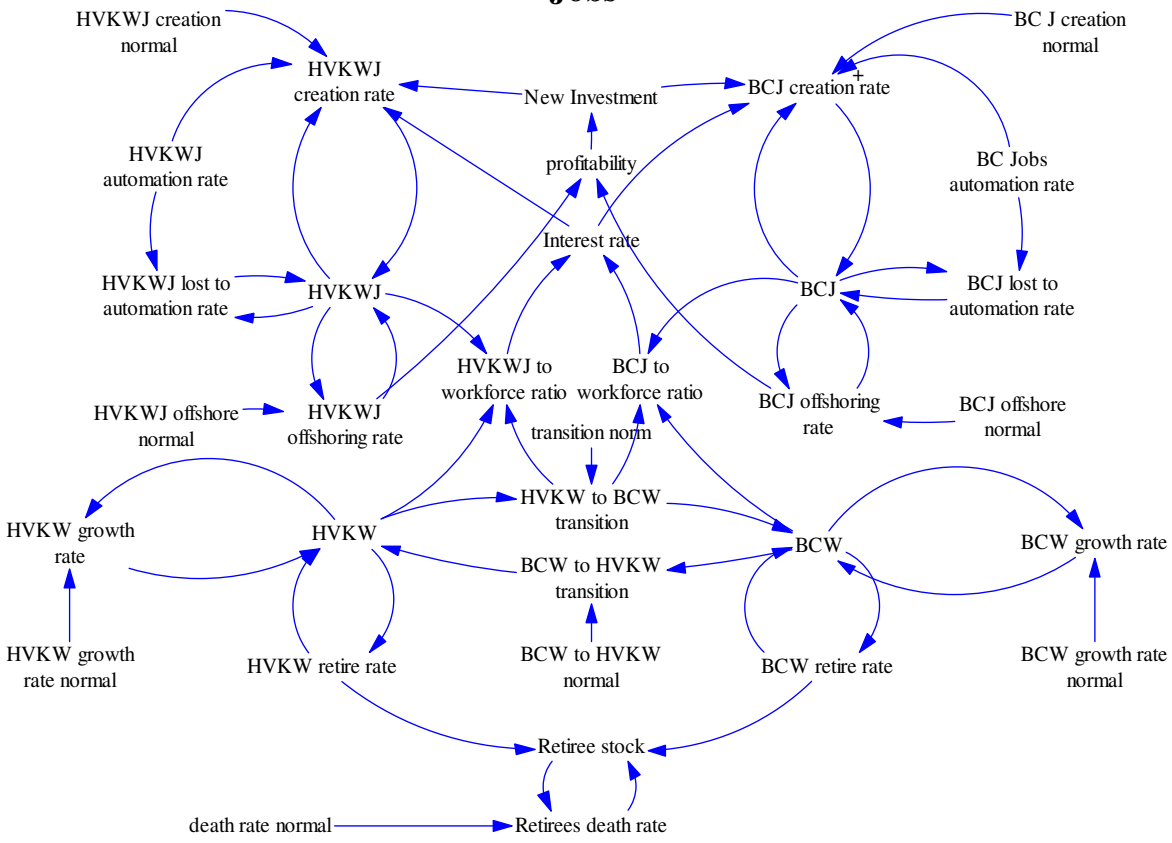
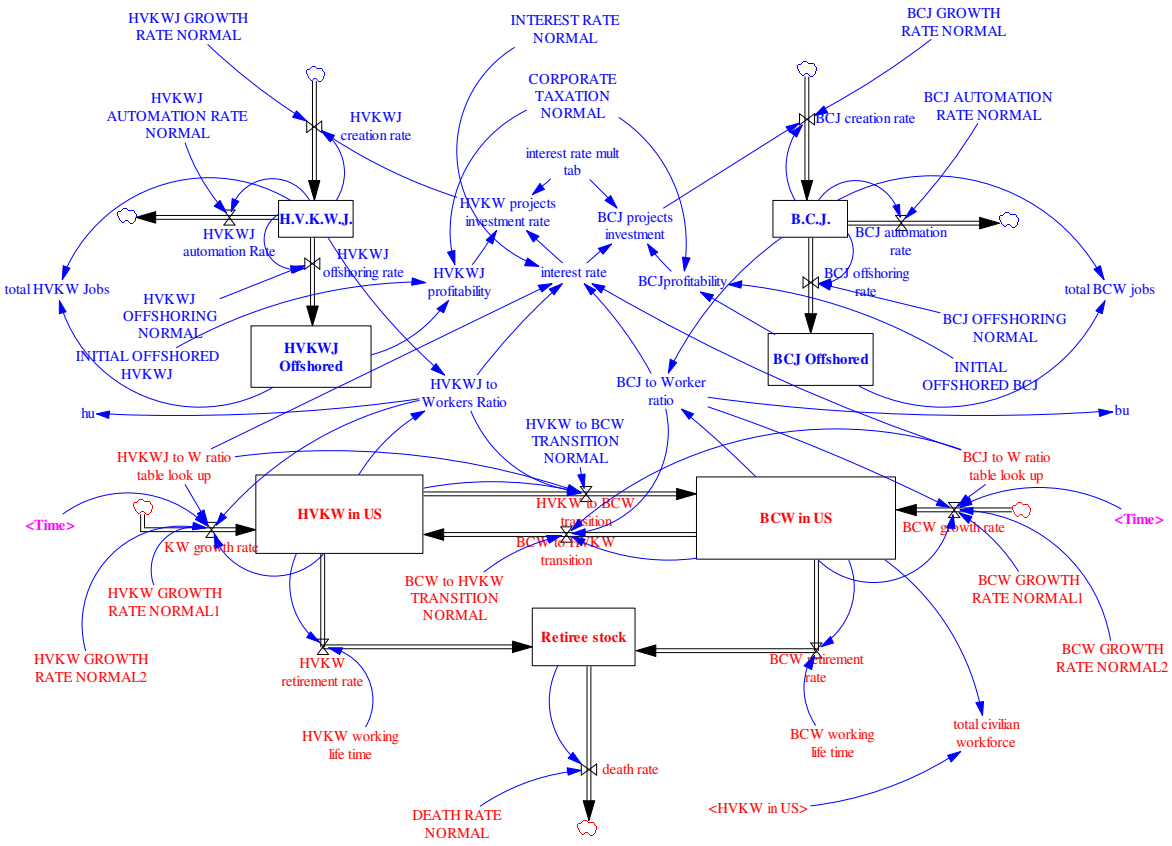
Appendix A

CLD: Offshoring Knowledge Worker Jobs



Appendix B

System Dynamics Perspective of Offshoring Knowledge Worker Jobs from USA



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