A MACRO-ECONOMIC ANALYSIS OF THE EFFECT OF
OFFSHORING AND REHIRING ON THE US ECONOMY

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Abstract. Offshore labor outsourcing (“offshoring”) is a process in which US companies set up overseas production facilities, employing local workers, simultaneously curtailing their production on US soil and laying off part of their US workforce. This is followed by (is intertwined with) rehiring a part of the laid-off workers, to boost production for domestic consumption and/or export. We present a mathematical analysis of the effects of these processes, on such measures as the personal, corporate, government and foreign balances (income minus expenditures). We use an input-output model of the US economy, derived from government databases, as a reference, and investigate the effects of offshoring and rehiring by mathematical extrapolation.

The essence of our findings has been:
1. Primary offshoring results in decreasing (negative) government, personal and foreign balance, and leads to a shifting of private income from payrolls to corporate assets and dividends.
2. Any rehiring is advantageous to the government balance.
3. Rehiring to boost domestic consumption is further decreasing the foreign balance. It also erodes the private balance because part of the incremental income is offset by taxes and lost social income, and because the growth of personal income is outpaced by the growth of personal consumption.
4. Rehiring to boost exports is advantageous to all three balances but just to break even (pay for the foreign cost of offshoring), the export increment has to exceed, by far, the total foreign payroll.
5. A coordinated expansion would be very desirable but requires strong government incentives.

More work is needed to incorporate into the investigation the effect of the reduction (or stabilization) of the price of products and, to some extent, services, arising from offshoring. Also, a further extension of this study would involve the analysis of how various taxation and regulatory strategies would affect the offshoring and rehiring process.

Keywords. Outsourcing; Offshoring; US economy; Government deficit; Foreign trade deficit.

1. INTRODUCTION

Offshore labor outsourcing (“offshoring”) is a process in which US companies set up overseas production facilities, employing local workers, simultaneously curtailing their production on US soil and laying off part of their US workforce. Two immediate effects of this process are obvious:
(i) the growth of corporate profits by the reduction of labor costs
(ii) the loss of US jobs.

Proponents of the process argue that
(i) most of the laid-off workers will find employment, mainly in the US service industries;
(ii) establishing production facilities overseas will open up and expand the local markets for US products;
(iii) the lower price of goods and services, resulting from offshoring, will have a positive effect on the US economy.

Clearly, this is a very sensitive and politically charged issue that has generated significant debate at political forums, in the media and in the economics literature. Three books have been published recently, one written by a US Senator (Dorgan, 2006), one by a leading TV journalist (Dobbs, 2004) and one by a pair of professors of public policy (Hira and Hira, 2005). These books emphasize the negative aspects of the process, accusing the US industry of greed and the politicians of indifference or complicity. They are written in the style of verbal arguments, with the book by the Hira’s containing also some interesting numerical data and a review of the relevant US legislations.

Several studies have also been published that support the opposing views. A report by the McKinsey Global Institute (McKinsey, 2003) looks at the outsourcing of service activities to India, from the point of view of cost saving. It claims that of every dollar saved on US labor, 67 cents will be realized as profit, and another 45 cents of extra value may be produced by rehiring US workers. However, no model is given to support these claims. Two
other reports (Mann, 2003; Global Insight, 2004) look at the IT industry and claim that lower cost, resulting from offshoring, will lead to a general speeding up of the US economy. The main thesis of Kozlow (2006) is that outsourcing is driven by the desire to open up new markets abroad and does not necessarily involve giving up US jobs. These reports allude to model analysis supporting their conclusions but give no detail.

A very broad analysis of the subject has been given by Mankiw and Swagel (2006). The authors had previously served on the Council of Economic Advisers for President G. W. Bush, as chairman and chief of staff, respectively. Reviewing a great number of studies, they came to the conclusions that

- "so far, the extent of offshoring ... is modest" but may increase "as technology develops and global economic integration deepens";
- "offshoring appears to be connected to increased US employment and investment rather than to overall job loss."

While observing the conflicting positions on the subject, we have set out to gain a qualitative and, as much as possible, quantitative understanding of the immediate, short-term effects on the national economy of labor offshoring and of the partial rehiring that follows it. We have used the mathematical tools of modeling and extrapolation. We have considered four scenarios:

1. primary offshoring (in manufacturing)
2. rehiring to boost domestic consumption (of services)
3. rehiring to boost exports (of goods)
4. rehiring with coordinated expansion.

We wish to emphasize here that our interest is not in contrasting manufacturing with services. We are interested in the effect of offshoring on the economy as a whole (and associate offshoring with the manufacturing sector only to simplify the analysis). And we are interested in what happens if rehiring takes place to boost domestic consumption versus export (and associate the former with services and the latter with manufacturing only to simplify the analysis).

We have developed an input-output reference model for the analysis, consisting of four major sectors:

- manufacturing (including all goods-producing industries)
- services
- government
- personal.

The model has been derived, by compression and simplification, from economic data published by BEA, the Bureau of Economic Analysis. The model contains about 50 parameters. An analysis based on a further simplified model with guessed parameters was reported in an earlier paper (Gertler, 2007).

The model describes a reference situation (the US in 2005), with no explicit appearance of offshoring or rehiring. Unfortunately, very little data is available on those processes. Therefore in our analysis we had to resort to mathematical extrapolation, taking the reference situation as a basis.

As economic indicators, we employ various balances (income - expenditures), including:

a. personal balance
b. corporate balance
c. government balance
d. foreign trade balance.

The offshoring – rehiring processes will be characterized by a set of "control" parameters, namely the

- labor offshoring ratio
- foreign-to-domestic labor cost ratio
- social income replacement ratio
- rehiring ratio
- foreign-to-domestic corporate tax ratio.

The main findings of the study have been:

1. Primary offshoring is detrimental to the government and personal and also to the foreign trade balance;
2. Any rehiring is advantageous for the government balance;
3. Rehiring to boost domestic services is detrimental to the personal and foreign trade balances;
4. Rehiring to boost exports is good, but just to break even, the increment of export has to exceed the total wages paid to foreign workers.

In Section 2 below, we will introduce the reference model. In Section 3, the various economic indicators and their relationship will be described. Section 4 gives a description of the offshoring and rehiring scenarios. Primary offshoring is analyzed in Section 5. Section 6 is devoted to rehiring in general, followed by the detailed analysis of the various rehiring scenarios. Section 7 summarizes the assumptions, results an limitations of the study.

2. THE REFERENCE MODEL

2.1. Compressed data-tables

Compressed data-tables for the US economy are shown in Appendix 2. The tables have been derived from extensive data-sets published by BEA (BEA NIPA Tables, BEA IEA Tables, (http://www.bea.gov). The BEA tables used are listed in Appendix 1. Data for the year 2005 has been used, according to the most current edition of BEA tables available in May 2007.

Our tables have been the result of significant simplification; related items have been lumped together, minor items ignored, while carefully maintaining the consistency of the entire set.

The tables divide the economy into four major sectors: manufacturing, services, government and individuals. The manufacturing sector, in addition to manufacturing proper, includes the agricultural, mining and construction industries; the service sector includes the rest of private industry.

The tables for the two industrial sectors show inputs (expenditures) and outputs side-by-side. For the government and personal sectors, expenditures and income are shown. The two sides are in
equilibrium for the industrial sectors while there is a deficit in the two other sectors.

The following assumptions and simplifications have been applied:

1. The tables do not show intra-sector activity, only goods, services and funds moving between sectors. The only exception is new fixed assets that appear on the output side as a separate item and on the input side as two sub-items, parts of the disposition of corporate profits and proprietors' income.

2. Consumption of fixed capital (depreciation) does not appear in the compressed data explicitly. It is handled as replacement of the consumed assets. When provided by the other sector, it is incorporated with the intermediate goods and services. When it involves only intra-sector activity, it is deleted from both the input and output side. Thus capital consumption is included in the value of final products but not in the value of fixed assets (this is a net domestic product approach).

3. There is no data in the BEA tables concerning the distribution of imports among the industries that use them. We computed the ratio of imports in the total intermediates, for goods and services respectively, and assumed that the same ratios applied to the input sides of both the manufacturing and the service sectors. Then we imposed a minor correction to ensure input-output equilibrium for either sector.

4. The BEA tables also lack information about how the production of new fixed assets for the various user sectors (industry, government and individuals) is broken down between the sectors that produce them. We observed that, overall, about 80% of the new fixed assets were produced by the manufacturing sector and 20% by the service sector. We assumed that the same 80/20 ratio was valid separately for each of the user sectors.

5. The change of inventories is ignored.

6. In order to include this activity in the GDP, BEA handles owner occupied housing as part of the service industry, as if owners were renting their homes from themselves (Meyerhouser and Reinsdorf, 2005). We dropped the fictitious rent from our compressed tables and moved the actual expenses to the personal sector.

To compute the Gross Domestic Product (GDP) from the compressed data, one needs to sum up the net value added, or the final consumption, from Appendix 2. Then capital consumption and owner-occupied housing (not included in Appendix 2) need to be added. This is shown in Appendix 3.

2.2. Parametrization of the model

For the industrial sectors, the fundamental model parameters are the net total production values M (for manufacturing) and S (for services). Inputs and outputs are in equilibrium; the total production is the (near) identical sum of either column.

Tables 1 and 2 list the input-side model parameters for the two industrial sectors. These parameters belong to two groups:

<table>
<thead>
<tr>
<th>Table 1. Main input factors in the two production sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total production (B$)</strong></td>
</tr>
<tr>
<td>Production taxes</td>
</tr>
<tr>
<td>Corporate profit</td>
</tr>
<tr>
<td>Proprietors' income</td>
</tr>
<tr>
<td>Employee compensation</td>
</tr>
<tr>
<td>Interest</td>
</tr>
<tr>
<td>From other sector</td>
</tr>
<tr>
<td>Import</td>
</tr>
<tr>
<td>Foreign labor</td>
</tr>
</tbody>
</table>

- the “k” parameters, describing the concerned main input item as a fraction of the total (e.g. $k_{MT} = $profit/production);
- the “m” parameters, describing a sub-item as a fraction of a main input item (e.g. $m_{MT} = $dividends/profit).

The first subscript in each case refers to the sector. The numerical values shown have been derived from the compressed data tables of Appendix 1.

We strived to build the model in such a way that each quantity is defined only once. Most output items are inputs for another sector; as such, they are defined there. The exceptions are personal consumption and export; one of these needs to be defined, the other follows. For the reference situation, the export values (from Appendix 1, in B$) are

\[ EX_m = 664 \quad EX_s = 502 \]

For the government sector, the expenditures need to be defined. Input factors, computed from Appendix 1, are shown in Table 3. On the income side, all items are taxes that follow from the parameters of the other sectors, and from the average tax-rates. For this sector, there is no equilibrium between the two sides; the income side needs to be augmented with borrowing.

For the personal sector, most items follow from data in the other sectors, plus the tax rates. The quantities not defined elsewhere are (in B$)

\[ \text{Net interest} \quad \text{INT}_p = 256 \]
considered when analyzing the effects of offshoring.

The following taxes are considered in the model:

1. **Personal income tax**, levied on all kinds of personal income. The average personal tax-rate, computed from the data of Appendix 1, is
   \[ \tau_p = 0.1418 \]

2. **Social security tax**. This is levied on wages and proprietor's income. Its average rate, computed from Appendix 1, is
   \[ \tau_S = 0.1158 \]

3. **Production tax**. This is a combination of taxes (sales and excise tax, property tax, etc.) and duties associated with production. Its rates, as computed from BEA data, are included in Table 1.

4. **Corporate profit tax**. These are the taxes levied by the US government on corporate profit. Its rates, as computed from BEA data, are included in Table 2.

5. **Foreign corporate tax**. Corporations conducting production and/or service activities abroad pay taxes to the foreign government after their profit realized there. It will be assumed that, while in the US they are taxed on their entire profit, they receive a tax credit after the tax they paid abroad. There is very sporadic information in the BEA data about foreign tax therefore this is not taken into account in the reference model. However, it will be considered when analyzing the effects of offshoring.

### 3. Economic Indicators

In our analysis, the performance of the economy will be characterized by balance measures. We define gross and net balances. For each of the four sectors,

- **Gross Balance** = Income – Expenditures
- **Net Balance** = Income – [Expenditures + Investment]

where **Investment** is the acquisition of new fixed assets (and this is not included in Expenditures). For foreign trade,

- **Gross Balance** = Exports – Imports
- **Net Balance** = [Exports – Imports] + [Receipts – Payments]

Next we will describe how the various balances can be computed with the parameters of the model. Also, we will show that, as long as the production sectors maintain their input-output equilibrium, the net balances obey the relationship

\[ \text{Personal}_B + \text{Corporate}_B + \text{Government}_B = \text{Foreign}_B \]

A note on the model parameters. In the forthcoming analysis, most “k” and all “m” parameters remain the same over the various scenarios. The only exceptions are \( k_{MG}, k_{MD}, \) and \( k_{MF} \); these change their value in the basic offshoring scenario and then remain constant over the rehiring scenarios. To simplify the notation, the parameters without distinction refer to the reference scenario. The symbols \( k^{*}_{MP}, k^{*}_{MD} \) and \( k^{*}_{MF} \) refer to Scenario 1; these will be derived in Section 5. In the forthcoming equations, \( k^{*}_{MP}, k^{*}_{MD} \) and \( k^{*}_{MF} \) mean that those parameters are taken with their reference value in the reference scenario and with their value \( k^{*}_{MP}, k^{*}_{MD} \) and \( k^{*}_{MF} \) in all other scenarios.

### 3.1. Personal balance

The personal income from wages and proprietorship is

\[ \text{PIA} = (k^{*}_{MP} + k_{MB}) M + (k_{SD} + k_{SB}) S + k_{GD} G \]  \hspace{1cm} (1) \]

From dividends and interest, it is

\[ \text{PIB} = m_{MG} k^{*}_{MP} M + m_{MS} k_{SP} S + \text{DIV}_F + \text{INT}_P \]  \hspace{1cm} (2) \]

where \( \text{DIV}_F \) is dividends received from foreign sources and \( \text{INT}_P \) is the net personal interests (including mortgage interest). The employers’ social security contribution (included in PIA) is

\[ \text{PID} = m_{MS} k^{*}_{MB} M + m_{GS} k_{SD} S + m_{GS} k_{GD} G \]  \hspace{1cm} (3) \]

\[ \text{PIA–PID} \] is subject to personal income tax \( \tau_p \) and social security tax \( \tau_S \); \( \text{PIB} \) is subject only to the former. PID is not taxed. Thus the disposable personal income is

\[ \text{PI} = \text{PIA} - (\tau_p + \tau_S) (\text{PIA} - \text{PID}) + (1-\tau_P) \text{PIB} + \text{SOC} - \text{TAX}_{\text{PROP}} \]  \hspace{1cm} (4) \]

where \( \text{SOC} = k_{GD} G \) is the social income (assumed as not taxed) and the last term is personal property tax.
The Gross Personal Balance is then

\[ PBG = PI - PC_M - PC_S \]  

(5)

where \( PC_M \) and \( PC_S \) are the personal consumption of goods and services (these are computed below). Finally, the Net Personal Balance is

\[ PBN = PBG - m_{SF} k_{SF} M - m_{SG} k_{SG} S - \text{FIX}_P \]  

(6)

where the second and third terms are the investments (new fixed assets) of proprietors in manufacturing and services and the last term is the new fixed assets acquired by persons.

**Computation of personal consumption.** The total new fixed assets produced is

\[ \text{FIX} = (m_{MF} k_{MF} M + m_{MS} k_{MS} S) + k_{GF} G + \text{FIX}_F \]  

(7)

where the first two terms are assets produced for the manufacturing and service sectors while the last two terms are those produced for the government and for persons. In lack of more detailed information, and consistent with reference model, we assume that 80% of the total is produced by the manufacturing sector and 20% by the service sector. Then the following output relationships hold for the two industrial sectors:

\[ M = 0.8 \text{FIX} + k_{SM} S + k_{GM} G + PC_M + \text{EX}_M \]  

(8)

\[ S = 0.2 \text{FIX} + k_{MS} M + k_{GS} G + PC_S + \text{EX}_S \]  

(9)

In either equation, the first three terms on the right-hand side are determined by inputs. Of the remaining two (personal consumption and export), depending on the scenario investigated, one is set and the other is obtained from the equation.

**3.2. Corporate Balance**

The Gross Corporate Balance is the sum of new liquid and fixed assets

\[ \text{CBG} = (m_{MM} + m_{ML}) k_{MF} M + (m_{MS} + m_{ML}) k_{SF} S \]  

(10)

The Net Corporate Balance only contains the liquid assets:

\[ \text{CBN} = m_{MF} k_{MF} M + m_{SF} k_{SF} S \]  

(11)

**3.3. Government Balance**

The total tax income of the government is

\[ \text{TAX} = (\tau_P + \tau_S) (PI_A - PID) + \tau_P \text{PIB} + k_{MT} M + k_{ST} S + m_{MT} k_{MF} M + m_{ST} k_{SM} S + \text{TAX}_{PROP} \]  

(12)

Here the first two terms are personal income and social security taxes, the next four are production taxes and corporate profit taxes, while the last one is personal property tax. The Gross Government Balance is the sum of tax incomes minus the total government expenditures without new fixed assets:

\[ \text{GBG} = \text{TAX} - \text{TAX}_F - (1 - k_{GF}) G \]  

(13)

The tax income has been decreased by \( \text{TAX}_F \), the amount corporations are taxed by foreign governments, reflecting the assumption that they receive full tax credit for this in the US. In the Net Government Balance, the fixed assets are deducted as well:

\[ \text{GBN} = \text{GBG} - k_{GF} G \]  

(14)

**3.4. Foreign Balance**

The Gross Foreign Balance is the difference between the exports and imports of goods and services

\[ \text{FBG} = \text{EX}_M + \text{EX}_S - (k_{MM} M + k_{MS} S) \]  

(15)

The Net Foreign Balance takes into account, in addition, monetary transactions such as foreign labor, taxes paid to foreign governments, dividends, interest (and transfers) paid to and received from abroad

\[ \text{FBN} = \text{FBG} - (k_{MF} M + k_{SF} S) - \text{TAX}_F + \text{DIV}_F + \text{INT}_F \]  

(16)

Here the second term is the cost of foreign labor and the last two terms are net values of dividends and interest (including transfers).

**3.5. Relationship among the balances**

Using Equations (1) through (16), by a series of substitutions and cancellations, one finds

\[ \text{PBN} + \text{CBN} + \text{GBN} = \text{FBN} \]  

(17)

where the net sum of interests and transfers (see Eq. (16)) is

\[ \text{INT}_F = \text{INT}_{TF} - (k_{ML} M + k_{SL} S + k_{GL} G + k_{GF} G) \]  

(18)

Eq. (17) is a very fundamental relationship, expressing that the sum of the three net domestic balances is always equal to the net foreign balance. This reflects the fact that most input items (products, services or payments) to the four domestic sectors are outputs from another domestic sector; those quantities that fall outside this equilibrium must come from (or go to) outside the system.

**4. OFFSHORING AND REHIRING SCENARIOS**

We will consider the following “clean” scenarios:

**Scenario 0 – reference scenario.** No offshoring, ideally all four balances are zero.

**Scenario 1 – primary offshoring.** A part of the US labor force is laid off and replaced with labor in a foreign country; production volume and prices remain unchanged. The profit so arising is subject to foreign and US taxation. For simplicity, this is assumed to be limited to the manufacturing sector.

**Scenario 2 – rehiring in the service sector.** A part of the US labor force, laid off in Scenario 1, is re-hired, mostly in the service sector; in the manufacturing sector only to the extent of providing for the increased needs of services. The entire excess service production is consumed domestically.

**Scenario 3 – rehiring in manufacturing for export.** A part of the laid-off US workers are re-hired, primarily in the manufacturing sector; the entire excess production is exported.
Scenario 4 – balanced rehiring. Rehiring occurs in both sectors in parallel, in such a way that the foreign balance is returned to and maintained at a prescribed level (ideally zero).

In reality, offshoring and rehiring take place overlapping, and rehiring occurs in a mixture of the above strategies.

The offshoring – rehiring process is characterized by the following parameters:

- $\alpha$ - offshoring ratio (the fraction of US labor force (payroll) replaced)
- $\beta$ - foreign-to-US payroll ratio (for the same production)
- $\kappa$ - US social income replacement ratio
- $\lambda$ - ratio of the US labor force rehired; $\lambda = \lambda_M + \lambda_S$
- $\tau_c / \tau_F$ - ratio of foreign-to-domestic corporate tax rates (where $\tau_c = m_{MT}$ or $\tau_F$).

To simplify the computation, we also introduce

- $\sigma$ - service/manufacturing ratio in the reference scenario.

5. ANALYSIS OF PRIMARY OFFSHORING

Here we will investigate the effect of offshoring a part of the labor effort while keeping production and the price of goods at a constant level. This implies that the domestic consumption of goods and services is also constant.

For simplicity, we will assume that labor offshoring applies only to the manufacturing sector.

The foreign operations are considered as extensions of US production: a part of the (manufacturing) labor effort is shifted abroad while the profit from the production activity stays with the US companies. Foreign workers are paid less for the same activity than their US counterparts. With the value of the goods produced remaining the same, the savings in labor cost add to the gross profit. The laid-off US workers are then taken care of by the government, in the form of unemployment compensation or welfare.

The profit arising from the foreign production activity is taxed by both the foreign and the US government. It is assumed that the foreign tax-rate is lower than the US rate, and that the corporations receive US tax credit for the tax they paid abroad. It is also assumed that the foreign profits are not "offshored".

Moving production abroad requires investment in the foreign location. We will estimate this investment as proportional to the profit increment, with the model parameter $m_{MA}$. There are two possible (extreme) sub-scenarios here:

- a. The new fixed assets are purchased abroad
- b. The new fixed assets are produced domestically

In this section, we will only discuss Case a. Case b. effectively implies rehiring; it will be covered among the rehiring scenarios.

In the equations that follow, superscripts indicate scenarios.

With the original domestic labor cost of $DL_M^S = k_{MD} M$, and constant production, the cost of domestic labor after offshoring is

$$DL_M^F = k_{MD} M$$

where

$$k_{MD} = (1 - \alpha) k_{MD}$$

Thus the loss of domestic wages is

$$DL_M^F - DL_M^S = \alpha k_{MD} M = A$$

where $A = \alpha k_{MD} M$ is a shorthand used in the sequel. The cost of foreign labor $FL$ is

$$FL_M^F = k_{MF} M^1 = \beta A$$

where

$$k_{MF} = \beta \alpha k_{MD}$$

The new corporate profit $CP$ is

$$CP_M^F = k_{MP} M^1 = k_{MP} M + (1 - \beta) A$$

where

$$k_{MP} = k_{MF} + \alpha (1 - \beta) k_{MD}$$

The change of corporate profit, $(1 - \beta) A$, is split into

- corporate tax $m_{MT} (1 - \beta) A$ (of which $\tau_c (1 - \beta) A$ is paid to the foreign government),
- dividend $m_{MD} (1 - \beta) A$
- fixed assets $m_{MA} (1 - \beta) A$
- liquid assets $m_{ML} (1 - \beta) A$

Illustrative example. Consider the case when $\alpha = 0.25$ and $\beta = 0.25$. Then the parameters $k_{MD}$, $k_{MF}$ and $k_{MP}$ change as

- from $k_{MD} = 0.2910$ to $k_{MD} = 0.2183$
- from $k_{MF} = 0$ to $k_{MF} = 0.0182$
- from $k_{MP} = 0.0732$ to $k_{MP} = 0.1278$

Notice that the sum of the three parameters remains constant.

The social income paid to the laid-off employees is

$$SOC^1 - SOC^o = \kappa A$$

Thus the total change in personal income (that is also the change in personal balance) is

$$PBN^1 - PBN^o = A + (\tau_p + \tau_S) (1 - m_{MS}) A$$

$$+ (1 - \tau_c) m_{MD} (1 - \beta) A + \kappa A$$

where the first term is the lost wages, the second term is the relative gain by not paying taxes after the lost wages, the third term is the gain in after-tax dividends and the last term is the gain in social income. The change in the net corporate balance is

$$CBN^1 - CBN^o = m_{MA} (1 - \beta) A$$

while the change in the government balance is
Here the first term is the lost tax on wages, the second is the tax gain on dividends, the third is the additional social payments and the last one is the increase of corporate tax, reduced by the foreign tax credit. Finally, the change in the net foreign balance is

\[ \text{FBN}^1 - \text{FBN}^0 = - \beta A - \tau_F (1 - \beta) A - \tau_P (1 - \beta) A \]  

(28)

Here the first term is the foreign wages paid, the second term is the foreign corporate tax and the last term is the cost of the fixed assets bought abroad. One can easily check that (25) - (27) satisfy (17).

A qualitative picture of the effects of primary offshoring is given in Figure 1.

![Figure 1. Changes of income flow in primary offshoring](image)

In summary, labor offshoring has the following consequences (Fig. 1):

- The corporate profit increases;
- Wage-earners lose wages but are partially compensated by social income;
- Dividend income grows;
- The government loses income taxes and pays out more social income; gains more corporate taxes (of which a part is lost to foreign governments);
- The foreign trade deficit increases.

The exact proportions of the income flows depend on the control parameters. Table 4 shows what happens if a $1000 worth of US labor is offshored, assuming that \( \beta = 0.25, \kappa = 0.4 \) (or \( \kappa = 0.25 \)), and \( \tau_F / \tau_C = 0.5 \). The numbers in the table indicate that while the corporate profit grows by $750, the foreign trade deficit also increases by $492. Individuals and the government together lose $657; this is divided between the two parties depending on the size of compensation the government pays to the workers who lost their jobs.

![Table 4. BASIC OFFSHORING – THE $1000 STORY](image)

As seen from Equations (25) – (28), all the four balances are proportional to the offshoring ratio \( \alpha \) (via A). Figure 2 shows the...
four balances as functions of $\alpha$, with $\beta = 0.25$, $\kappa = 0.4$ and $\tau_M/\tau_C = 0.5$. The $\alpha = 0$ point is the reference scenario (see Appendix 1). In Table 5, the balances are computed for a few values of $\alpha$.

Table 5. Balance values in basic offshoring (B$T$).

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>PBN</th>
<th>CBN</th>
<th>GBN</th>
<th>FBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>-550</td>
<td>205</td>
<td>-448</td>
<td>-792</td>
</tr>
<tr>
<td>0.1</td>
<td>-576</td>
<td>228</td>
<td>-515</td>
<td>-862</td>
</tr>
<tr>
<td>0.2</td>
<td>-602</td>
<td>252</td>
<td>-582</td>
<td>-931</td>
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<td>0.3</td>
<td>-628</td>
<td>275</td>
<td>-649</td>
<td>-1001</td>
</tr>
<tr>
<td>0.4</td>
<td>-654</td>
<td>298</td>
<td>-716</td>
<td>-1071</td>
</tr>
<tr>
<td>0.5</td>
<td>-680</td>
<td>321</td>
<td>-783</td>
<td>-1141</td>
</tr>
</tbody>
</table>

6. ANALYSIS OF THE REHIRING STRATEGIES

In the following, we will investigate the effects of rehiring a part of the domestic labor force laid-off as a result of labor offshoring. It will be assumed that the two activities, offshoring and rehiring, occur sequentially, in the sense that offshoring creates a base situation for rehiring. Rehiring increases the domestic work-force in the particular sector.

The parameter $\lambda$ characterizes the ratio of the work-force rehired from those laid off. This is divided into two parts, $\lambda_M$ and $\lambda_S$ for the two sectors, so that $\lambda = \lambda_M + \lambda_S$.

The following rehiring scenarios will be considered:

Scenario 1b: rehiring solely for the domestic production of new fixed assets required by primary offshoring;

Scenario 2: rehiring to increase service production for domestic consumption;

Scenario 3: rehiring to increase the production of goods for export;

Scenario 4: rehiring to increase both service production for domestic consumption and the production of goods for export, in a coordinated way, so that the foreign balance is maintained at a prescribed level.

The two production sectors are interconnected; they each produce intermediate goods/services for the other sector and they both participate in the production of new fixed assets for either sector. Therefore even if the expansion of one of the sectors is the objective, the other sector also needs to expand, to the extent dictated by the interconnection.

The rehiring process is governed by three fundamental relationships:

(I) Total rehiring = Labor increment in $M$ + Labor increment in $S$

(II) Excess incremental production in $M$

= Total incremental production in $M$

- incremental consumption of goods by $S$

- incremental consumption of $M$-type fixed assets

(III) Excess incremental production in $S$

= Total incremental production in $S$

- incremental consumption of services by $M$

- incremental consumption of $S$-type fixed assets

The expansion of the sectors is expressed with the growth factors $c_M$ and $c_S$ as

$M_{\text{new}} = c_M M^0$ Incremental production: $(c_M - 1)M^0$

$S_{\text{new}} = c_S S^0$ Incremental production: $(c_S - 1)S^0$

where the superscript refers to the scenario. The following assumptions are used in the analysis:

1. when a sector expands, all of its input components expand by the same factor;

2. the production of any new fixed assets is split between the manufacturing and the service sectors as 80/20.

Expressed with the growth factors, the three fundamental relations are:

(I) Distribution of rehired labor

$\lambda \alpha k_{AB} = D_M(c_M - 1) + D_S(c_S - 1)$ (29)

(II) Excess incremental production in $M$

$\Delta M / M^0 = E_M(c_M - 1) - E_S(c_S - 1) - 0.8$ H (30)

(III) Excess incremental production in $S$

$\Delta S / S^0 = F_S(c_S - 1) - F_M(c_M - 1) - 0.2$ H (31)

The three fundamental relationships (I), (II) and (III) are the same, no matter what rehiring scenario is considered. However, the way they are applied depends on the scenario. In each case, they have to satisfy two constraints, as shown in Table 6.

Table 6. Constraints in various scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>$\tau$</th>
<th>$\Delta M$</th>
<th>$\Delta S$</th>
<th>FBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sc. 1b.</td>
<td>free</td>
<td>0</td>
<td>0</td>
<td>free</td>
</tr>
<tr>
<td>Sc. 2.</td>
<td>set</td>
<td>0</td>
<td>PC$_S$free</td>
<td>free</td>
</tr>
<tr>
<td>Sc. 3.</td>
<td>set</td>
<td>EX$_M$free</td>
<td>0</td>
<td>PC$_S$free</td>
</tr>
<tr>
<td>Sc. 4.</td>
<td>set</td>
<td>EX$_M$free</td>
<td>0</td>
<td>PC$_S$free</td>
</tr>
</tbody>
</table>

Factors in the fundamental equations. The various factors in equations (29), (30) and (31) are explained below. Let us note first that service production in the reference scenario is expressed as $S^0 = \sigma M^0$ and then $M^0$ is cancelled out from each of the equations.
The factors below may be interpreted by multiplying back with \( M^0 \) or \( S^0 = \sigma M^0 \).

In Equation (29),
\[
D_M = k_{MD} M + k_{MB} S
\]
(32)
is the domestic labor (after offshoring) and proprietors' income in the manufacturing sector, while
\[
D_S = k_{SD} + k_{SB}
\]
(33)
is domestic labor and proprietors' income in the service sector.

In Equation (30),
\[
H = \alpha (1 - \beta) m_{MA} k_{MD}
\]
(34)
describes the new fixed assets required by the manufacturing sector in the course of primary offshoring. Further,
\[
E_M = 1 - 0.8 ( m_{SA} k_{SD} M + m_{SB} k_{SB} S )
\]
(35)
where the first term (1) represents the full manufacturing volume and the second term the new fixed assets required by the manufacturing sector. Finally,
\[
E_S = k_{SM} + 0.8 ( m_{SA} k_{SD} S + m_{SB} k_{SB} S )
\]
(36)
where the first term is the intermediate products and the second the new fixed assets the service sector takes from manufacturing.

In Equation (31),
\[
F_M = k_{MS} + 0.2 ( m_{MA} k_{MD} M + m_{MB} k_{MB} S )
\]
(37)
where the first term is the intermediate services and the second term the new fixed assets taken by the manufacturing sector from the service sector, while
\[
F_S = 1 - 0.2 ( m_{SA} k_{SD} S + m_{SB} k_{SB} S )
\]
(38)
where the first term (1) represents the full volume of services and the second term the new fixed assets produced by the service sector for itself.

Clearly, the seven factors defined above depend not only on the model parameters but also on the control parameters \( \alpha \) and \( \beta \). Their values, with the model parameters listed in Tables 1 and 2, and \( \alpha = 0.25, \beta = 0.25 \), are
\[
\begin{align*}
D_M = 0.2771 & \\
E_M = 0.9833 & \\
F_M = 0.2923 & \\
H = 0.0075 &
\end{align*}
\]

6.1. Domestic production of new fixed assets for offshoring

This is Scenario 1b. Setting up production facilities overseas requires investment in new fixed assets. In Section 5, it was assumed that these assets are purchased abroad. Alternatively, if they are produced domestically, this effectively requires rehiring in the domestic sectors, without increasing domestic consumption or export.

Now the rehiring ratio \( \lambda \) is not specified explicitly. In the fundamental relationships (II) and (III), the excess incremental productions are \( \Delta M / M^0 = 0 \) and \( \Delta S / M^0 = 0 \). Thus (30) and (31) become
\[
\begin{align*}
\Delta M / M^0 = E_M (c_M - 1) - E_S \sigma (c_S - 1) - 0.8 H = 0 & \quad (39) \\
\Delta S / M^0 = F_S \sigma (c_S - 1) - F_M (c_M - 1) - 0.2 H = 0 & \quad (40)
\end{align*}
\]

These are solved for the growth factors \( c_M \) and \( c_S \), yielding
\[
\begin{align*}
0.2 E_S + 0.8 F_S & = \frac{(c_M - 1)}{E_M F_S - E_S F_M} H \\
0.2 E_M + 0.8 F_M & = \frac{\sigma (c_S - 1)}{E_M F_S - E_S F_M} H
\end{align*}
\]

Once the growth factors are known, the rehiring ratio \( \lambda \) follows from (29). Further, the balances may be computed from (1) – (16).

Illustrative example. If the control parameters are
\[
\begin{align*}
\alpha = 0.25 & \\
\beta = 0.25 &
\end{align*}
\]
then the new fixed assets required by offshoring are
\[
H M^0 = 36.50 B$
\]
The growth factors and rehiring ratio are obtained as
\[
\begin{align*}
(c_M - 1) & = 0.00670 \\
(c_S - 1) & = 0.00193 \\
\lambda & = 0.0535
\end{align*}
\]
The latter means that 5.35% of the laid-off workers are rehired. The growth-factors translate into the production expansions
\[
\begin{align*}
\Delta M & = 32.6 B$ \quad \Delta S = 17.0 B$
\end{align*}
\]

Table 7. Balance values in offshoring (B$).
\[
\begin{array}{cccccc}
\hline
\text{Scenario} & \text{PBN} & \text{CBN} & \text{GBN} & \text{FBN} \\
\hline
\text{Sc. 0} & -550 & 205 & -448 & -792 \\
\text{Sc. 1a} & -615 & 263 & -615 & -966 \\
\text{Sc. 1b} & -607 & 264 & -599 & -941 \\
\hline
\end{array}
\]

In Table 7, the four balances in Scenario 1b (offshoring with domestic production of new fixed assets) are compared to those in Scenario 1a (offshoring, new fixed assets purchased abroad) and the reference scenario. As it can be seen, the domestic production of the new fixed assets ameliorates somewhat the situation created by offshoring but the improvement is not very significant.

6.2. Rehiring to expand domestic service consumption

This is Scenario 2. In this scenario, the bulk of the rehiring occurs in the service sector. The manufacturing sector is expanded only to the extent needed to supply the increased goods-needs of the
service sector. The personal consumption base produced in manufacturing does not change. In services, the entire expansion (less the slight increase in service needs of manufacturing) is available for domestic consumption.

Now the rehiring ratio $\lambda$ is specified explicitly. The excess incremental production in the manufacturing sector is zero. Thus the fundamental equations (I) and (II), that is, (29) and (30), are

$$\lambda \alpha k_M D_M (c_M - 1) + D_S \sigma (c_S - 1) = \Delta M / M$$  \hspace{1cm} (43)

$$\Delta M / M = E_M (c_M - 1) - E_S \sigma (c_S - 1) - 0.8 H = 0$$  \hspace{1cm} (44)

These can be solved for the growth factors $c_M$ and $c_S$, yielding

$$\lambda \alpha k_M E_M + 0.8 H D_S$$  \hspace{1cm} (45)

$$\sigma (c_S - 1) = \frac{\lambda \alpha k_M E_M - 0.8 H D_M}{E_M D_S + E_S D_M}$$  \hspace{1cm} (46)

These are clearly (linear) functions of $\lambda$. Once the growth factors are known, the third fundamental equation (31) is used to obtain the excess service production, that is now the incremental personal consumption of services

$$\Delta S = [F_S \sigma (c_S - 1) - F_M (c_M - 1) - 0.2 H] M^0 = \Delta PC_S$$  \hspace{1cm} (47)

The balances are then computed from equations (1) – (16).

Table 8 shows what happens if 1000 dollars worth of labor is rehired, primarily in the service sector, and the excess production generated is consumed entirely domestically. (Note that of the $1000, $75 goes to the manufacturing sector, to provide for the increased needs of services; of the remaining $925, $789 is added to wages and $136 to proprietors’ income in the service sector.) The numbers clearly show that the government gains by rehiring; the tax income grows and the social burden decreases. Also, the foreign balance further deteriorates because increased production requires increased imports that, in this extreme scenario, are not compensated by more export. What seems counter-intuitive is the behavior of the personal balance. Individuals have a gain of $1000, in the form of new wages and proprietors’ income. Part of this they have to pay as taxes, and they lose the social income they enjoyed before. There is a minor increase in dividend income. With all these considered, the net gain of individuals is $409 (or $559, depending on the level of the lost social income). On the other hand, the excess service production is worth $1502, and this is consumed by individuals. So individuals as a whole, while enjoying more services, actually see their expenditures far outpace their income. Note that a contributing factor here is the implied assumption that no part of the newly generated government surplus (relative to the offshoring scenario) is recycled as personal income but is used to offset the earlier deficit, created by offshoring or present already in the reference scenario.

A better understanding may be gained by considering offshoring and rehiring together. Table 9 shows the main figures if a $1000 worth of domestic labor (in manufacturing) is offshored, followed by

<table>
<thead>
<tr>
<th>Table 8. REHIRING FOR SERVICE – THE $1000 STORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha = 0.25$  $\beta = 0.25$  $\kappa = 0.4$ (0.25)  $\tau_{fC} = 0.5$</td>
</tr>
<tr>
<td><strong>Individuals</strong></td>
</tr>
<tr>
<td>Wages + proprietors</td>
</tr>
<tr>
<td>Income tax</td>
</tr>
<tr>
<td>Social income</td>
</tr>
<tr>
<td>Dividends</td>
</tr>
<tr>
<td>Tax on dividend</td>
</tr>
<tr>
<td>Corporate + production tax</td>
</tr>
<tr>
<td>Foreign tax credit</td>
</tr>
<tr>
<td>Consumption</td>
</tr>
<tr>
<td>Balance</td>
</tr>
<tr>
<td><strong>Foreign</strong></td>
</tr>
<tr>
<td>Import</td>
</tr>
<tr>
<td>Interest</td>
</tr>
<tr>
<td>Wages</td>
</tr>
<tr>
<td>Corporate tax</td>
</tr>
<tr>
<td>- 230</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 9. OFFSHORING AND FULL REHIRING FOR SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha = 0.25$  $\beta = 0.25$  $\kappa = 0.4$ (0.25)  $\tau_{fC} = 0.5$</td>
</tr>
<tr>
<td><strong>Individuals</strong></td>
</tr>
<tr>
<td>Dividends</td>
</tr>
<tr>
<td>Tax on dividend</td>
</tr>
<tr>
<td>Corporate + production tax</td>
</tr>
<tr>
<td>Foreign tax credit</td>
</tr>
<tr>
<td>Consumption</td>
</tr>
<tr>
<td>Balance</td>
</tr>
<tr>
<td><strong>Foreign</strong></td>
</tr>
<tr>
<td>Import</td>
</tr>
<tr>
<td>Interest</td>
</tr>
<tr>
<td>Wages</td>
</tr>
<tr>
<td>Corporate tax</td>
</tr>
<tr>
<td>- 723</td>
</tr>
</tbody>
</table>
full rehiring for domestic service consumption. Compared to the reference scenario, the wage and proprietors’ income of individuals does not change, nor does their social income. There is an increase in dividends. The government gains, primarily due to increased corporate taxes. The main feature of the situation is a major imbalance between personal income and consumption, basically because the offfshored production is consumed domestically. Note that the implied assumption of the government surplus not being recycled into personal income contributes to the imbalance. On the foreign side, foreign wages, increased imports and foreign taxes all contribute to the growth of the deficit, without any export increment to compensate for this.

Figure 3 shows the four balances (in B$) for the entire economy, as functions of the rehiring ratio \( \lambda \). The trends described above are clearly seen: the government balance improves and the personal balance deteriorates significantly, while there is a modest decline in the foreign balance. In Table 10, numerical values are shown for a few selected values of \( \lambda \). Note that \( \lambda = 0.0535 \) is the point corresponding to Scenario 1b; in Scenario 2, it is where the domestic consumption of services really starts to pick up.

Table 10. Balance values in rehiring for domestic service consumption (B$). \( \alpha = 0.25, \beta = 0.25, \kappa = 0.4, \tau_F / \tau_C = 0.5 \).

<table>
<thead>
<tr>
<th>( \lambda )</th>
<th>PBN</th>
<th>CBN</th>
<th>GBN</th>
<th>FBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sc. 0</td>
<td>-550</td>
<td>205</td>
<td>-448</td>
<td>792</td>
</tr>
<tr>
<td>Sc. 1a</td>
<td>-615</td>
<td>263</td>
<td>-615</td>
<td>966</td>
</tr>
<tr>
<td>0.05</td>
<td>-606</td>
<td>264</td>
<td>600</td>
<td>941</td>
</tr>
<tr>
<td>0.10</td>
<td>-625</td>
<td>265</td>
<td>585</td>
<td>945</td>
</tr>
<tr>
<td>0.20</td>
<td>-664</td>
<td>266</td>
<td>556</td>
<td>953</td>
</tr>
<tr>
<td>0.30</td>
<td>-703</td>
<td>267</td>
<td>526</td>
<td>961</td>
</tr>
<tr>
<td>0.40</td>
<td>-742</td>
<td>268</td>
<td>496</td>
<td>969</td>
</tr>
<tr>
<td>0.50</td>
<td>-781</td>
<td>269</td>
<td>467</td>
<td>977</td>
</tr>
</tbody>
</table>

In summary,
1. The government gains by rehiring since its tax income grows and its social burden shrinks.
2. Individuals as a group see their expenses outpace their income
   - because a part of the new income is lost to tax and the replacement of social income
   - and because the increase in consumption exceeds even the gross increase of income.
3. The foreign balance further deteriorates because increased production requires increased imports that are not compensated by more export.

6.3. Rehiring to expand the export of goods

Under this strategy, the bulk of the rehiring takes place in the manufacturing sector. Services are only expanded to the extent required to meet the service needs of expanded manufacturing. The entire increment of the manufacturing output, except the slight increase feeding back through services, is exported. The total volume available for domestic consumption (from manufacturing and from services) remains steady.

The rehiring ratio \( \lambda \) is set and the excess service production is zero. So the two fundamental equations (29) and (31) are

\[
\lambda \alpha k_{KS} = D_M (c_M - 1) + D_S \sigma (c_S - 1) \quad (48)
\]

\[
\Delta S / M^P = F_S \sigma (c_S - 1) - F_M (c_M - 1) - 0.2 H = 0 \quad (49)
\]

Solving these for the growth factors yields

\[
\lambda \alpha k_{KS} F_S - 0.2 H D_S = \frac{\sigma (c_S - 1)}{F_M D_S + F_S D_M} \quad (50)
\]

\[
\frac{\lambda \alpha k_{KS} F_M + 0.2 H D_M}{F_M D_S + F_S D_M} \quad (51)
\]

Then the export increment can be computed from (30) as

\[
\Delta M = [E_M (c_M - 1) - E_S \sigma (c_S - 1) - 0.8 H] M^P = \Delta E_{XM} \quad (52)
\]

Figure 4 shows the four balances as functions of \( \lambda \) in this scenario, and Table 11 contains the numerical values for a few selected values of \( \lambda \). Again, \( \lambda = 0.0535 \) is the point where rehiring just satisfies the fixed asset requirements of offshoring; the export starts to pick up at this point.

Clearly, this rehiring strategy is very advantageous; it shrinks, in parallel, both the personal and the government deficits and, of course, also the foreign deficit. The difficulty, though, is that it relies on the assumption that setting up operations overseas and hiring local workers will generate and expand the market there for US goods. A closer analysis reveals that, to achieve the extended export objectives, the export increment has to exceed, by far, the total earnings of foreign workers employed in the US overseas operations.
Figure 4. Balances in rehiring for the export of goods, as functions of $\lambda$ (B$). ($\alpha = 0.25$, $\beta = 0.25$, $\kappa = 0.4$, $\tau_F/\tau_C = 0.5$)

Table 11. Balance values in rehiring for the export of goods (B$).
$\alpha = 0.25$, $\beta = 0.25$, $\kappa = 0.4$, $\tau_F/\tau_C = 0.5$.

<table>
<thead>
<tr>
<th>$\lambda$</th>
<th>PBN</th>
<th>CBN</th>
<th>GBN</th>
<th>FBN</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>-608</td>
<td>264</td>
<td>-600</td>
<td>943</td>
</tr>
<tr>
<td>0.10</td>
<td>-600</td>
<td>266</td>
<td>-585</td>
<td>919</td>
</tr>
<tr>
<td>0.20</td>
<td>-585</td>
<td>268</td>
<td>-555</td>
<td>870</td>
</tr>
<tr>
<td>0.30</td>
<td>-570</td>
<td>271</td>
<td>-524</td>
<td>822</td>
</tr>
<tr>
<td>0.40</td>
<td>-555</td>
<td>273</td>
<td>-594</td>
<td>774</td>
</tr>
<tr>
<td>0.50</td>
<td>-540</td>
<td>276</td>
<td>-463</td>
<td>726</td>
</tr>
</tbody>
</table>

Figure 5. Foreign balance, export of goods and foreign labor, relative to the reference scenario (B$).
$\alpha = 0.25$, $\beta = 0.25$, $\kappa = 0.4$, $\tau_F/\tau_C = 0.5$.

Figure 5 shows the relative values of foreign balance, export of goods and foreign labor, with the reference scenario as basis. Under the control parameters considered, basic offshoring created a 174 B$ dip in the foreign balance and 88.56 B$ worth of foreign payroll. To eliminate the foreign deficit cost of offshoring, $\lambda = 0.363$ rehiring ratio is needed in the export only scenario. At this point, the export increment, relative to the reference scenario, is 228 B$. At the same time, the total foreign payroll is 93.5 B$. Considering that the foreign workers must primarily spend on food and lodging, that are generally not US products, a very strong market amplifying effect is necessary for this strategy to work.

In summary:
1. Rehiring for the expansion of export is a very advantageous strategy because it improves simultaneously the personal, government and foreign balances.
2. However, for it to work, the overseas production presence of US companies must generate a market for US products which exceeds, by far, the total earnings of local workers employed by US companies.

6.4. Rehiring for balanced expansion

This scenario is a combination of Scenarios 2 and 3. Both the service and the manufacturing sectors are expanded; the new jobs are split between the two sectors in such a way that the foreign trade balance is restored to and maintained at a specified level. We assume that the entire production increment of the manufacturing sector, after satisfying the increased needs for goods in services, is exported. Also, the entire incremental production of the service sector, after satisfying the increased service needs of manufacturing, is available for domestic consumption. As we pointed out earlier, this assumption serves to simplify the analysis (reduce the number of parameters); in reality, incremental export and consumption will appear in both sectors – but we are basically interested in the performance of the entire economy, not the particular sectors.

Now two constraints are specified; the rehiring ratio $\lambda$ and the target foreign balance $FBN_{TARGET}$. The basic equation (i) is now best utilized as

$$\lambda = \lambda_M + \lambda_S \quad (53)$$

where $\lambda_M$ and $\lambda_S$ are parts of the total rehiring ratio corresponding to the two sectors and, from (29) they are related to the growth factors as

$$\lambda = \frac{D_M}{\alpha k_{MD}} (c_M - 1) + \frac{D_S}{\alpha k_{MD}} \sigma (c_S - 1) \quad (54)$$

Assuming a particular split of $\lambda$, the growth factors $c_M$ and $c_S$ can be computed from (54). Then (30) and (31) yield $\Delta EX_M$ and $\Delta PC_S$ as

$$\Delta M = [ E_M (c_M - 1) - E_S \sigma (c_S - 1) - 0.8 H ] M^p = \Delta EX_M \quad (55)$$

$$\Delta S = [ F_S \sigma (c_S - 1) - F_M (c_M - 1) - 0.2 H ] M^p = \Delta PC_S \quad (56)$$

Finally, the constraint on the foreign balance is

$$FBN = FBN_{TARGET} \quad (57)$$
In these latter equations, several terms are proportional to $M$ and $S$ and thus are subject to expansion in accordance with the growth factors. Given $\lambda$ and $FBN_{\text{TARGET}}$, we want to find the split $\lambda_M$, $\lambda_S$ that satisfies (54) and (57). This can be done in closed form, via the appropriate substitutions, but leads to quite complex expressions. Alternatively, a numerical search can be used. Once the split of $\lambda$ has been found, the other balances may be computed the usual way, using equations (1) – (14).

Note that for each set of parameters, and a target foreign balance chosen, there is a critical value of $\lambda$, $\lambda^*$, under which the target may only be reached at the expense of reducing domestic consumption relative to the reference scenario. While this is correct mathematically, it may be practically unacceptable. The closest one may get then to the target is by substituting Scenario 4 with Scenario 3 for the range $0 < \lambda < \lambda^*$. In the case when $\lambda^* > 1$ then the target can not be reached with any rehiring.

Figure 6 shows the four balances under rehiring for balanced expansion. The target foreign balance has been set at -700 B$. Recall that this an improvement; in the reference scenario it was $FBN=-792$B$ that deteriorated in Scenario 1a to $FBN=-966$B$. At this target, the critical rehiring ratio is $\lambda^* = 0.555$. For $\lambda < \lambda^*$, the target is not reached; the plot is identical with Scenario 3. The plot also shows the incremental personal consumption $\Delta PCS$; this is constant at low $\lambda$ values and starts to pick up once we have passed $\lambda^*$. Also when $\lambda > \lambda^*$, the reduction of government deficit is accompanied by an increase of personal deficit; this is unavoidable when the foreign balance is constant and the corporate balance is slightly increasing. While only a positive foreign balance would allow all the other three balances to be positive, changing the tax rates might re-distribute the deficit between the government and individuals.

The following scenarios have been considered:
1. Primary labor offshoring (in manufacturing)
2. Partial rehiring to boost domestic consumption (of services)
3. Partial rehiring to boost exports (of goods)
4. Partial rehiring with coordinated expansion to maintain a specified foreign balance.

When analyzing expansion scenarios, we assumed that all inputs to a sector expand proportionally.

The essence of our findings has been:
1. Primary offshoring results in decreasing (negative) government, personal and foreign balance, and leads to a shifting of private income from payrolls to corporate assets and dividends.
2. Any rehiring is advantageous to the government balance.
3. Rehiring to boost domestic consumption is further decreasing the foreign balance. It also erodes the private balance because part of the incremental income is offset by taxes and lost social income, and because the growth of personal income is outpaced by the growth of personal consumption.
4. Rehiring to boost exports is advantageous to all three balances but just to break even (pay for the foreign cost of offshoring), the export increment has to exceed, by far, the total foreign payroll.
5. A coordinated expansion would be very desirable but requires strong government incentives.
Our study has been subject to a number of obvious limitations, namely:

1. The model is built on data from a single year (2005). Many of the parameters exhibit substantial variability from one year to another. To improve the reliability of the model, three (or five) year averages should be computed.

2. The model describes a reference situation, with no information on the offshoring process itself. The analysis relies entirely on mathematical extrapolation. Ideally, such extrapolations should be supplemented and corroborated with analysis of real offshoring data. The availability of such data, however, is extremely limited.

3. An undoubted consequence of offshoring is the reduction (or stabilization) of the price of products and, to some extent, services, both on the domestic market and in export. This certainly has a significant impact on the entire economy. A future challenge is to take this into account in our analysis.

A further extension of this study would involve the analysis of variation in tax regulations and strategies, analytically and by simulation. For this, the model and the extrapolation mechanism developed in this work provide an ideal framework.

We entered this exercise without any preconception and with no bias for or against free market principles. We were solely driven by curiosity: a desire to understand and explain the processes of offshoring and rehiring. Offshore outsourcing of US production activities is an integral part of the general process of globalization. It does not seem possible (or even desirable) to stop this process, though it may be influenced. The purpose of our analysis has been to help understand, and quantify, what the positive and negative effects of the process are. It may also contribute to the assessment of any future action that policy makers might wish to contemplate.

REFERENCES

Dorgan, B.L. (2006), Take This Job and Ship It, St. Martin’s Press.

Appendix 1. BEA tables used for the reference model

National Income and Product Accounts (BEA NIPA Tables)

1.1.5. Gross Domestic Product
1.1.3. National Income by Sector, Legal Form and Type
1.1.6. Sources and Uses of Private Enterprise Income
2.1. Personal Income and Its Disposition
2.3.5. Personal Consumption and Expenditures
3.1. Government Current Receipts and Expenditures
3.15. Govt. Consumption Expenditures & Gross Investment
4.1. Foreign Transactions in The National Income Accounts
5.2.5. Gross and Net Domestic Investment by Major Type
5.3.6. Real Private Fixed Investment
6.2. D. Compensation of Employees by Industry
6.3.D. Wage and Salary Accruals by Industry
6.12. D. Non-farm Proprietors’ Income by Industry
6.13. D. Non-corporate Capital Consumption Allowances
6.15. D. Net Interest by Industry
6.17. D. Corporate Profits Before Tax by Industry
6.18. D. Taxes on Corporate Income by Industry
6.20. D. Net Corporate Dividend Payments by Industry
6.21. D. Undistributed Corporate Profits by Industry
6.22. D. Corporate Capital Consumption Allowances
7.11. Interest Paid and Received by Sector and Legal Form

Industry Economic Accounts (BEA IEA Tables)
The Use of Commodities by Industries

See comments 1 – 6 below.

### MANUFACTURING SECTOR

<table>
<thead>
<tr>
<th>INPUTS</th>
<th>OUTPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production tax</td>
<td>Fixed assets</td>
</tr>
<tr>
<td>Profit</td>
<td>677</td>
</tr>
<tr>
<td>corp. tax</td>
<td>for industry</td>
</tr>
<tr>
<td>dividend</td>
<td>215</td>
</tr>
<tr>
<td>fixed assets</td>
<td>for government</td>
</tr>
<tr>
<td>liquid assets</td>
<td>128</td>
</tr>
<tr>
<td>Proprietors’ income</td>
<td>for individuals</td>
</tr>
<tr>
<td>fixed assets</td>
<td>334</td>
</tr>
<tr>
<td>Payroll</td>
<td>Personal consumption</td>
</tr>
<tr>
<td>s.s. contribution</td>
<td>1737</td>
</tr>
<tr>
<td>Interest</td>
<td>For service sector</td>
</tr>
<tr>
<td>Net value added</td>
<td>1330</td>
</tr>
<tr>
<td>From service sector</td>
<td>For government</td>
</tr>
<tr>
<td></td>
<td>458</td>
</tr>
<tr>
<td>Import</td>
<td>Export</td>
</tr>
<tr>
<td></td>
<td>664</td>
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### SERVICE SECTOR

<table>
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<th>INPUTS</th>
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<tr>
<td>Production tax</td>
<td>Fixed assets</td>
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<tr>
<td>Profit</td>
<td>151</td>
</tr>
<tr>
<td>corp. tax</td>
<td>for industry</td>
</tr>
<tr>
<td>dividend</td>
<td>51</td>
</tr>
<tr>
<td>fixed assets</td>
<td>for government</td>
</tr>
<tr>
<td>liquid assets</td>
<td>17</td>
</tr>
<tr>
<td>Proprietors’ income</td>
<td>for individuals</td>
</tr>
<tr>
<td>fixed assets</td>
<td>83</td>
</tr>
<tr>
<td>Payroll</td>
<td>Personal consumption</td>
</tr>
<tr>
<td>s.s. contribution</td>
<td>6464</td>
</tr>
<tr>
<td>Interest</td>
<td>For manufacturing sector</td>
</tr>
<tr>
<td>Net value added</td>
<td>1402</td>
</tr>
<tr>
<td>From manufacturing sector</td>
<td>301</td>
</tr>
<tr>
<td>Export</td>
<td>Export</td>
</tr>
<tr>
<td></td>
<td>502</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>8820</td>
</tr>
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</table>
### GOVERNMENT

<table>
<thead>
<tr>
<th>EXPENSES</th>
<th>INCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payroll 1216</td>
<td>Production + property tax 922</td>
</tr>
<tr>
<td>s.s. contribution 58</td>
<td>Corporate tax 400</td>
</tr>
<tr>
<td>From manufacturing sector 458</td>
<td>Personal income tax 1203</td>
</tr>
<tr>
<td>From service sector 301</td>
<td>Social security tax 881</td>
</tr>
<tr>
<td>Govt. services 1975</td>
<td>Interest + transfers 200</td>
</tr>
<tr>
<td>Interest + transfers 385</td>
<td>Total 3606</td>
</tr>
<tr>
<td>Subsidies 72</td>
<td></td>
</tr>
<tr>
<td>Social payments 1481</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong> 3913</td>
<td><strong>Gross balance</strong> - 307</td>
</tr>
<tr>
<td>Fixed assets 145</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong> 4058</td>
<td><strong>Net balance</strong> - 452</td>
</tr>
</tbody>
</table>

### PERSONAL

<table>
<thead>
<tr>
<th>EXPENSES</th>
<th>INCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax on wages + propr. income 1966</td>
<td>Wages + propr. income 8081</td>
</tr>
<tr>
<td>Mortgage interest 406</td>
<td>Dividends 576</td>
</tr>
<tr>
<td>Other interests 329</td>
<td>Social security income 1481</td>
</tr>
<tr>
<td>Tax on (dividends + net interest) 119</td>
<td>Interest income 991</td>
</tr>
<tr>
<td>Property tax 137</td>
<td><strong>Total</strong> 11129</td>
</tr>
<tr>
<td><strong>Subtotal</strong> 2957</td>
<td></td>
</tr>
<tr>
<td>Consumption of goods 1737</td>
<td></td>
</tr>
<tr>
<td>Consumption of services 6464</td>
<td><strong>Gross balance</strong> - 29</td>
</tr>
<tr>
<td><strong>Total</strong> 11158</td>
<td></td>
</tr>
<tr>
<td>Fixed assets (personal + propr.) 518</td>
<td><strong>Net balance</strong> - 547</td>
</tr>
<tr>
<td><strong>Total</strong> 11676</td>
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</table>
FOREIGN TRANSACTIONS

<table>
<thead>
<tr>
<th></th>
<th>IMPORT/PAYMENT</th>
<th>EXPORT//INCOME</th>
<th>BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing sector</td>
<td>1228</td>
<td>664</td>
<td></td>
</tr>
<tr>
<td>Service sector</td>
<td>674</td>
<td>502</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>1902</td>
<td>1166</td>
<td><strong>- 736</strong></td>
</tr>
<tr>
<td>Dividend</td>
<td>82</td>
<td>279</td>
<td></td>
</tr>
<tr>
<td>Interest</td>
<td>331</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>9</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Taxes</td>
<td>87</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>509</td>
<td>454</td>
<td><strong>- 55</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2411</td>
<td>1620</td>
<td><strong>- 791</strong></td>
</tr>
</tbody>
</table>

OVERALL BALANCES

<table>
<thead>
<tr>
<th></th>
<th>GROSS BALANCE</th>
<th>INVESTMENT</th>
<th>NET BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing sector</td>
<td>127</td>
<td>49</td>
<td>78</td>
</tr>
<tr>
<td>Service sector</td>
<td>243</td>
<td>116</td>
<td>127</td>
</tr>
<tr>
<td>Government</td>
<td>-307</td>
<td>145</td>
<td>- 452</td>
</tr>
<tr>
<td>Personal</td>
<td>- 29</td>
<td>518</td>
<td>- 547</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>34</td>
<td>828</td>
<td>- 794</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Foreign transactions</th>
<th>GOODS+SERVICES</th>
<th>MONETARY</th>
<th>NET BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- 736</td>
<td>- 55</td>
<td><strong>- 791</strong></td>
</tr>
</tbody>
</table>

1. The tables do not show intra-sector activity, only goods, services and funds moving between sectors. The only exception is new fixed assets.

2. Consumption of fixed capital (depreciation) does not appear in the compressed data explicitly, rather it is handled as replacement of the consumed assets. When provided by the other sector, it is incorporated with the intermediate goods and services. When it involves only intra-sector activity, it is deleted from both the input and output side. (Net domestic product approach.)

3. There is no data in the BEA tables concerning the distribution of imports among the industries that use them. We computed the ratio of imports in the total intermediates, for goods and services respectively, and assumed that the same ratios applied to the input sides of both the manufacturing and the service sectors. Then we imposed a minor correction to ensure input-output equilibrium for either sector.

4. The BEA tables also lack information about how the production of new fixed assets for the various user sectors (industry, government and individuals) is broken down between the sectors that produce them. We observed that, overall, about 80% of the new fixed assets were produced by the manufacturing sector and 20% by the service sector, and assumed that the same 80/20 ratio was valid separately for each of the user sectors.

5. The change of inventories is ignored.

6. BEA handles owner occupied housing as part of the service industry, as if owners were renting their homes from themselves. We dropped the fictitious rent from our compressed tables and moved the actual expenses to the personal sector.
### Appendix 3. Computation of the GDP from compressed data (year 2005, in B$)

<table>
<thead>
<tr>
<th>Value Added</th>
<th>Net value added</th>
<th>Capital consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing¹</td>
<td>2236</td>
<td>387</td>
</tr>
<tr>
<td>Services</td>
<td>6794</td>
<td>795</td>
</tr>
<tr>
<td>Government</td>
<td>1216</td>
<td>252</td>
</tr>
<tr>
<td><strong>--------</strong></td>
<td><strong>10246</strong></td>
<td></td>
</tr>
<tr>
<td>Households²</td>
<td>568</td>
<td>209</td>
</tr>
<tr>
<td><strong>--------</strong></td>
<td><strong>10814</strong></td>
<td><strong>1643</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Final Outputs</th>
<th>Goods</th>
<th>Services</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal consumption</td>
<td>1737</td>
<td>6464</td>
<td>8201</td>
</tr>
<tr>
<td>Government services</td>
<td></td>
<td></td>
<td>1975</td>
</tr>
<tr>
<td>New fixed assets produced³</td>
<td>677</td>
<td>148</td>
<td>825</td>
</tr>
<tr>
<td>Exports</td>
<td>664</td>
<td>502</td>
<td>1166</td>
</tr>
<tr>
<td>Imports⁴</td>
<td>- 1627</td>
<td>- 275</td>
<td>- 1902</td>
</tr>
<tr>
<td><strong>--------</strong></td>
<td><strong>-------</strong></td>
<td><strong>-------</strong></td>
<td><strong>10263⁵</strong></td>
</tr>
</tbody>
</table>

**GDP = 10814 + 1643 = 12457**

¹ Includes agriculture, mining, construction, manufacturing
² Owner-occupied housing (included in the GDP by BEA)
³ Total is factual, distribution is estimated
⁴ A discrepancy of 17 relative to net value added