Construction and Estimation of the CNMI Centric Model, To Be Used For Forecasting, Economic Impact Calculations, and Policy Analysis for the CNMI economy

Prepared For:

Commonwealth of the Northern Mariana Islands

Submitted By:

Marianas EB-5 Regional Center
P.O. Box 500487
Saipan, MP 96950
670-234-1795

Deliverable #2. Discussion of CNMI Model Structure

October 16, 2013

Table of Contents

1. Summary of Report

The Commonwealth of the Northern Mariana Islands (CNMI) has engaged Michael K. Evans of Evans, Carroll & Associates, Inc. (Evans) to construct and estimate an econometric model that will be used for forecasting, and for economic impact and policy analysis, of the CNMI Economy. This project will include the preparation and delivery of 11 separate reports, as outlined in the contract between CNMI and Evans. This report contains the second deliverable. The first deliverable outlined the structure of the report; this report shows the actual equations and some of the multipliers generated from simulation of the model.

The following items should be kept in mind when perusing this report. In particular, these results are preliminary and are likely to be modified based on the following considerations.

1. Evans has requested several data series that have not yet become available. In particular, the time series data for wages and employment have not yet been delivered. If these data become available, that sector of the model would be expanded. Attempts to interpolate these data were unsuccessful because of massive inconsistencies between the BEA Commerce data, the Economic Census, and the CNMI data.

2. It is expected that the GDP accounts for CNMI for 2011 will become available later this year. This report will presumably include revisions for the 2009 and 2010 data as well. The entire model will be recalculated and reestimated when those data appear, and it is likely that some of the results would be changed.

3. In the previous meeting, the Governor requested that Evans estimate equations showing how much was spent per tourist from Japan, Korea, China, and possibly other countries. Evans replied such equations could be estimated if CNMI sources could provide these expenditure data. So far, these data have not become available. If they do become available during the course of this contract, that section will be added to the CNMI model.

Given these caveats, the remainder of this report shows the 17 stochastic equations that have been estimated to date, and provides some results of model simulations for changes in (a) number of visitors and (b) an exogenous increase in investment, either in the private or public sector. Further simulations can be prepared as requested by CNMI.

2. Basic Framework of Small-Scale Time Series Econometric Model

In Deliverable #1, Evans outlined a model with 19 stochastic equations; that list is repeated here for ease of reference.

C = consumption (separate categories for durables, nondurables, services, and net foreign travel)
IF = fixed investment (no data for inventory investment)
XG = exports of goods (separated into garments and other)
XS = exports of services (3 additional equations for tourism)
MG = imports of goods (3 categories)
MS = imports of services
*GF = Government consumption and investment, Federal
GT = Government consumption and investment, territorial
GDP = gross domestic product (both current and constant dollars)
Empl = employment
WR = average wage rate
CPI = consumer price index
PGDP = implicit GDP deflator
DI = domestic personal disposable income
* Y forn = foreign measures of personal income (mainly U.S. and Japan). May also include employment and unemployment statistics.
* Exogenous variable

In view of the various data limitations discussed above, the following changes have been made to this structure.

1. There are no equations for exports of goods, since with the end of the garment export trade, these exports have almost disappeared. The remaining data are not robust enough to warrant an econometric treatment.

2. Attempts to reconcile the CNMI import data by category with the BEA national income accounts data were unsuccessful, in part because the CNMI data are given in tons instead of dollars. As a result, there is only one equation for imports of goods.

3. Data are not available for wage rates or employment; instead, the model contains three equations for compensation by major sector. The model does contain forecasts for employment, but they are based on ratios for 2010 rather than time-series estimates. If historical data on employment become available, these equations will be added.

As a result of these modifications, the model contains the following stochastic equations, identities, and exogenous variables.

National Income Accounts, Aggregate Demand, const $
1. Consumption of durables
2. Consumption of nondurables
3. Consumption of services
4. Consumption, net foreign travel
5. Private fixed investment
* Exports of goods
6. Exports of services
7. Imports of goods
8. Imports of services
9. Number of visitors from Japan
10. Number of visitors from other countries
Data for amount spent per tourist by country are not yet available
* Federal government purchases
11. Territorial government purchases
ID1. GDP in constant dollars
12. Implicit price deflator
ID2. GDP in current dollars

Wages and Employment
13. Manufacturing compensation
14. Other private compensation (estimated using the implicit wage rate)
15. Government compensation
ID3. Total wages in current dollars
ID4. Total wages in constant dollars
Forecasts for employment of manufacturing, trade, hotels/restaurants, other private, and government are based on the ratio of 2010 employment to the relevant components of real GDP.

Other Variables
16. Taxes on wages and salaries
17. Consumer Price Index
ID5: Disposable income in constant dollars (defined as total compensation less direct and indirect taxes)

The exogenous variables in the model, besides the ones listed above, are primarily foreign variables for Japan, China, and Korea, and include the values of the currencies and real GDP for those countries. Other taxes, which are mainly excise taxes, are also exogenous. The US CPI is also used as an independent variable in the equation for the CNMI CPI. The CNMI minimum wage is also used in the CPI equation.

In terms of the overall structure of the model, the key variable is the number of visitors, which affects the various components of aggregate demand. Each of these equations is now presented individually in the next section.

3. Stochastic Equations in the CNMI Econometric Model

All of the equations have been estimated using the EViews software. The printout for each equation is shown, followed by a definition of the variables and a graph showing the actual and estimated values for the sample period.

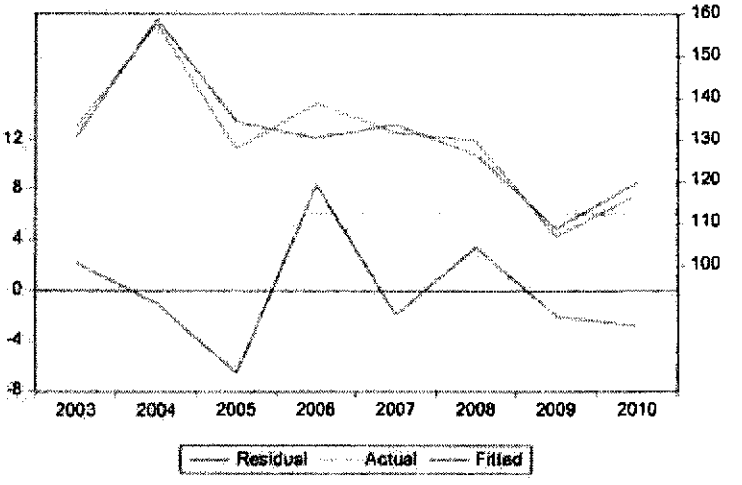
Dependent Variable: CDX
Method: Least Squares
Sample(adjusted): 2003 2010
Included observations: 8 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.213645	24.91630	-0.209246	0.8445
DIX	0.048344	0.057077	0.846997	0.4447
DIX(-1)	0.122049	0.060910	2.003772	0.1156
VISITOTH	0.000351	0.000100	3.509074	0.0247

R-squared	0.907470	Mean dependent var	130.5000
Adjusted R-squared	0.838072	S.D. dependent var	15.01428
S.E. of regression	6.041781	Akaike info criterion	6.742128
Sum squared resid	146.0125	Schwarz criterion	6.781848
Log likelihood	-22.96851	F-statistic	13.07639
Durbin-Watson stat	2.931068	Prob(F-statistic)	0.015549

CDX = expenditures for consumer durables, constant dollars
DIX = disposable income, constant dollars
VISITOTH = number of visitors to CNMI excluding those from Japan

Consumption of durables are a function of current and lagged disposable income, as is standard for consumption functions. The number of visitors except Japan, which are mainly from China and Korea, represent the shopping patterns of these visitors, who prefer to buy the "genuine" articles in U.S. territories rather than "counterfeit" goods in their home countries.



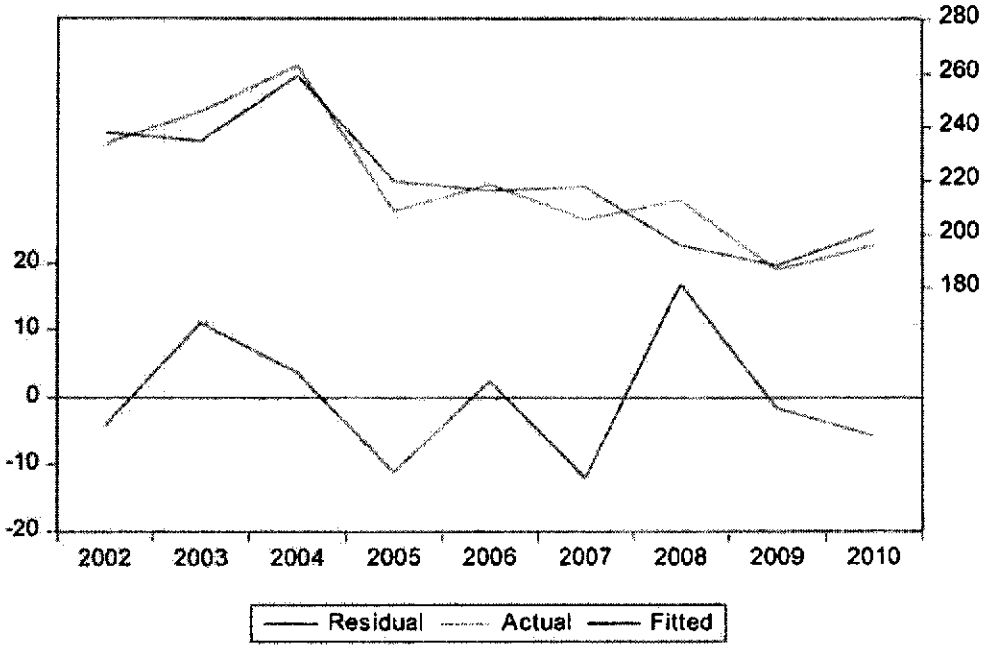
Dependent Variable: CNX
Method: Least Squares
Sample(adjusted): 2002 2010
Included observations: 9 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	66.11548	37.78236	1.749903	0.1307
DIX	0.263867	0.046449	5.680753	0.0013
VISITOTH	0.000222	0.000157	1.413199	0.2073

R-squared	0.843284	Mean dependent var	219.2222
Adjusted R-squared	0.791046	S.D. dependent var	24.36072
S.E. of regression	11.13565	Akaike info criterion	7.919381
Sum squared resid	744.0156	Schwarz criterion	7.985123
Log likelihood	-32.63721	F-statistic	16.14297
Durbin-Watson stat	2.798756	Prob(F-statistic)	0.003849

CNX = expenditures for consumer nondurables, constant dollars
DIX = disposable income, constant dollars
VISITOTH = number of visitors to CNMI excluding those from Japan

This function is similar to the one for consumer durables except that purchase decisions are more closely tied to current conditions, so lagged income is not a significant determinant in this equation.



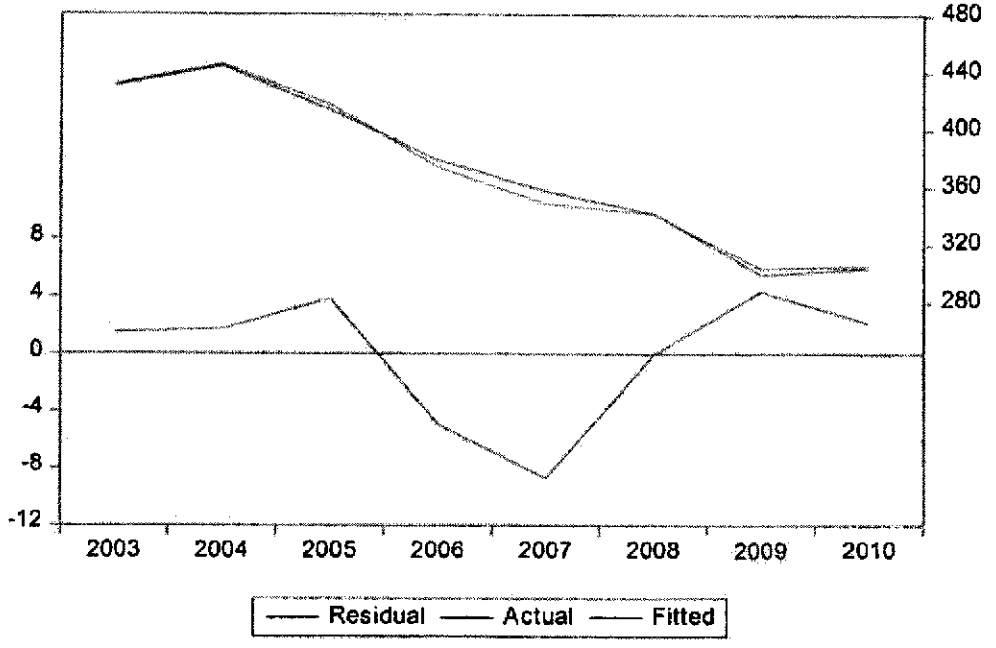
Dependent Variable: CSX
Method: Least Squares
Sample (adjusted): 2003 2010
Included observations: 8 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	34.42247	25.19805	1.366077	0.2437
DIX	0.172699	0.080779	2.137918	0.0993
DIX(-1)	0.365479	0.053673	6.809336	0.0024
CNX	0.456905	0.200229	2.281909	0.0846

R-squared	0.993392	Mean dependent var	371.3750
Adjusted R-squared	0.988436	S.D. dependent var	55.55162
S.E. of regression	5.973751	Akaike info criterion	6.719480
Sum squared resid	142.7428	Schwarz criterion	6.759201
Log likelihood	-22.87792	Hannan-Quinn criter.	6.451579
F-statistic	200.4456	Durbin-Watson stat	1.358503
Prob(F-statistic)	0.000082		

CSX = expenditures for consumer services, constant dollars
DIX = disposable personal income, constant dollars
CNX = expenditures for consumer nondurables, constant dollars

This equation follows the other consumption functions in that current and lagged disposable income are the principal independent variables. The use of CNX reflects the fact that when housing expenditures rise (the main component of CSX), purchases of fuel and household nondurables also increase.



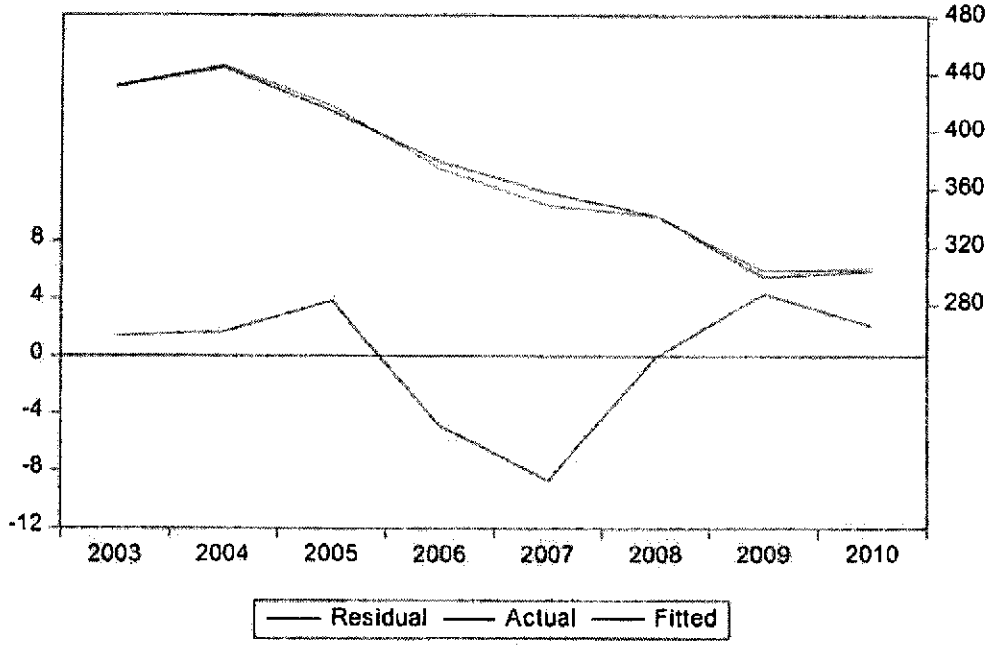
Dependent Variable: CSERVX
Method: Least Squares
Sample(adjusted): 2002 2010
Included observations: 9 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.495684	2.105244	-3.560482	0.0119
VISJAPAN	0.000508	3.24E-06	156.4828	0.0000
VISITXJAP	0.000456	9.61E-06	47.42292	0.0000

R-squared	0.999755	Mean dependent var	207.6667
Adjusted R-squared	0.999674	S.D. dependent var	36.83748
S.E. of regression	0.665373	Akaike info criterion	2.284263
Sum squared resid	2.656326	Schwarz criterion	2.350005
Log likelihood	-7.279184	F-statistic	12257.54
Durbin-Watson stat	1.726719	Prob(F-statistic)	0.000000

CSERVX = Consumption of net foreign travel, constant dollars (subtracted from GDP)
VISITORS = number of visitors to CNMI from Japan
VISITXJAP = number of visitors to CNMI from other countries

This is an unusual equation in the sense that such a term is not usually included in the national income accounts (NIA) for the U. S. or other countries; however, we have added it to keep the nomenclature of the CNMI NIA consistent with the BEA statistics. For practical purposes, this term is almost identical to exports of services, so on a NIA basis, these two terms offset each other.



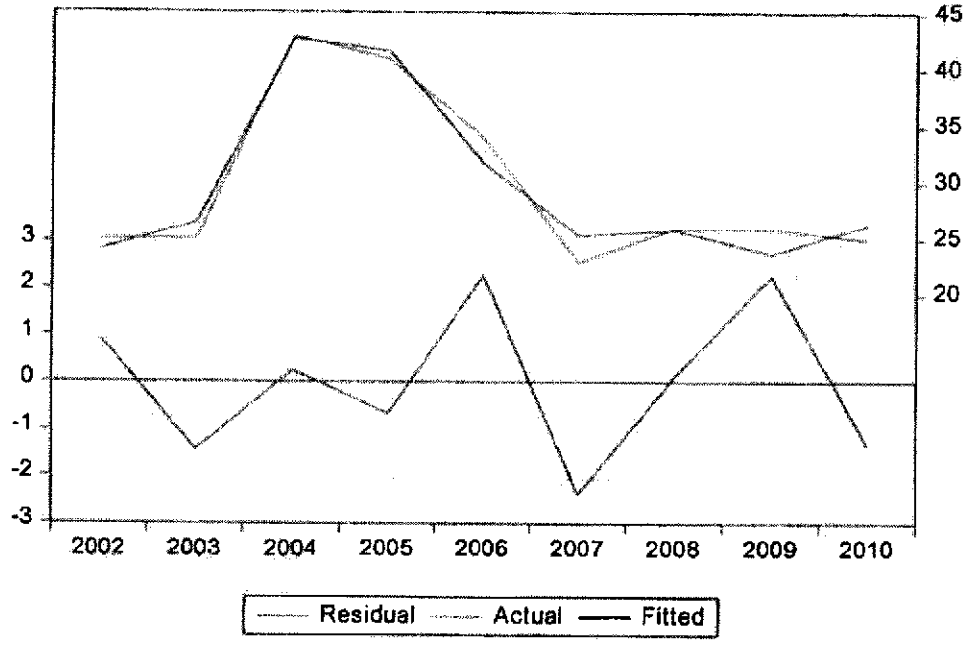
Dependent Variable: IPX
Method: Least Squares
Sample: 2002 2010
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-59.46406	9.811399	-6.060711	0.0018
VISITORS	0.000115	1.56E-05	7.364762	0.0007
VISITORS(-1)	5.99E-05	1.36E-05	4.420022	0.0069
@TREND	2.343109	0.422848	5.541262	0.0026

R-squared	0.953577	Mean dependent var	29.77778
Adjusted R-squared	0.925723	S.D. dependent var	7.595686
S.E. of regression	2.070109	Akaike info criterion	4.594182
Sum squared resid	21.42676	Schwarz criterion	4.681837
Log likelihood	-16.67382	F-statistic	34.23514
Durbin-Watson stat	2.989963	Prob(F-statistic)	0.000930

IPX = private fixed investment, constant dollars
VISITORS = number of visitors to CNMI, unlagged and lagged one year
@TREND = time trend

Fixed investment includes both housing and capital spending; these are not disaggregated in the NIA figures. With the declining population and real per capita income of CNMI over the past decade, the demographic need for housing is minimal, so most of the housing would be built for tourists. With the disappearance of the garment industry, most capital spending is for the tourist trade, so the number of visitors, both current and lagged, are the key independent variables in this equation.



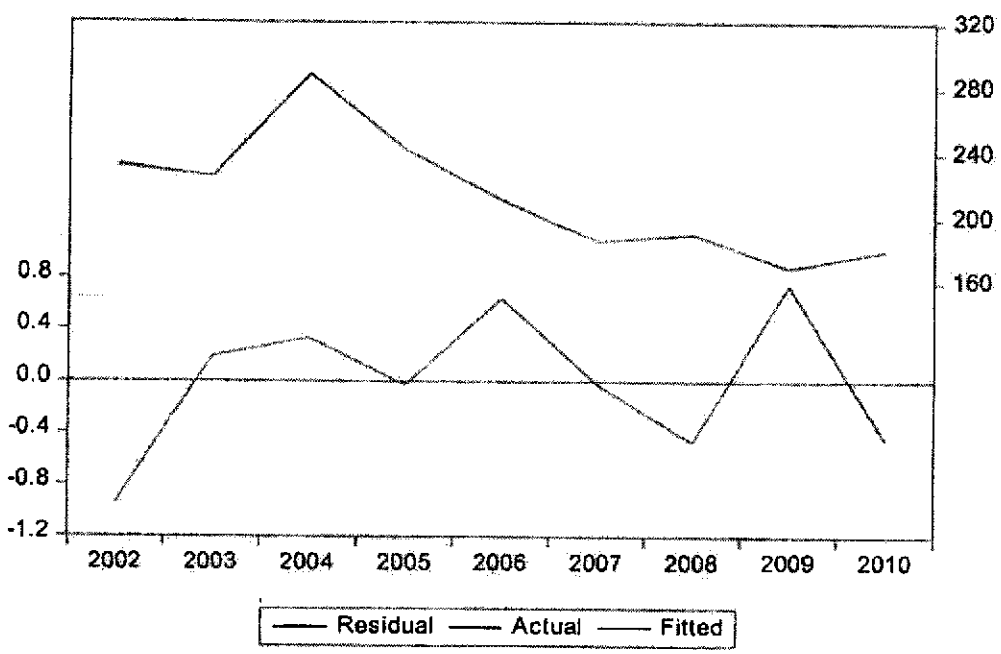
Dependent Variable: XSX
Method: Least Squares
Sample 2002 2010
Included observations: 9 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.707376	2.008792	-2.343386	0.0576
VISJAPAN	5.88E-05	8.64E-06	6.809607	0.0005
VISITOTH	0.000460	9.17E-06	50.13477	0.0000

R-squared	0.999787	Mean dependent var	214.1111
Adjusted R-squared	0.999715	S.D. dependent var	37.63789
S.E. of regression	0.634889	Akaike info criterion	2.190468
Sum squared resid	2.418502	Schwarz criterion	2.256209
Log likelihood	-6.857104	F-statistic	14054.74
Durbin-Watson stat	2.238710	Prob(F-statistic)	0.000000

XSX = exports of services, constant dollars
VISJAPAN = number of visitors from Japan
VISITOTH = number of visitors from other countries

As noted above, there is no equation for exports of goods, since that sector represents only a tiny fraction of GDP. Exports of services are closely related to the number of visitors; as discussed earlier in this section, these figures are essentially the same as those for net foreign travel.



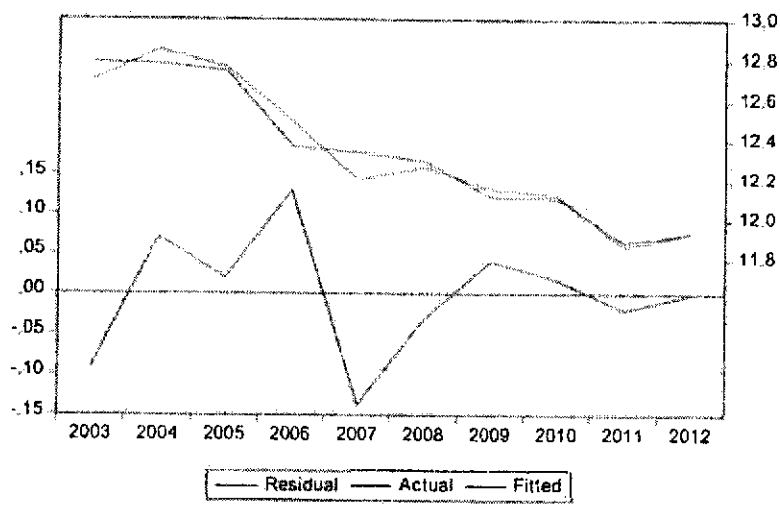
Dependent Variable: LOG(VISJAPAN)
Method: Least Squares
Sample (adjusted): 2003 2012
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.55130	15.11435	-0.896585	0.4045
LOG(JAPGDPX)+LOG(JAPGDPX(-2))	2.164271	1.241057	1.743892	0.1318
@TREND	-0.081071	0.017161	-4.724298	0.0032
DUMJAL	0.406309	0.154000	2.638369	0.0386

R-squared	0.951288	Mean dependent var	12.34072
Adjusted R-squared	0.926932	S.D. dependent var	0.347701
S.E. of regression	0.093988	Akaike info criterion	-1.602134
Sum squared resid	0.053002	Schwarz criterion	-1.481100
Log likelihood	12.01067	Hannan-Quinn criter.	-1.734908
F-statistic	39.05756	Durbin-Watson stat	2.485116
Prob(F-statistic)	0.000248		

VISJAPAN = number of visitors from Japan
JAPGDPX = index of Japan GDP in constant prices
DUMJAL = dummy variable for ending of flights by Japan Airlines to CNMI
@TREND = time trend

As shown in the graph, the number of visitors from Japan has declined almost steadily since 2005. Some of this represents the end of JAL flights to the area; the remaining fluctuations are tied to the level of Japanese real GDP. The downward trend also represents a cultural shift, since the number of visitors continued to decline long after the one-time shift associated with the ending of JAL flights. The equation is estimated in logarithmic form, indicating a steady rate of decline; if it were in levels form, the estimated actual drop would soon push this figure into the negative range.



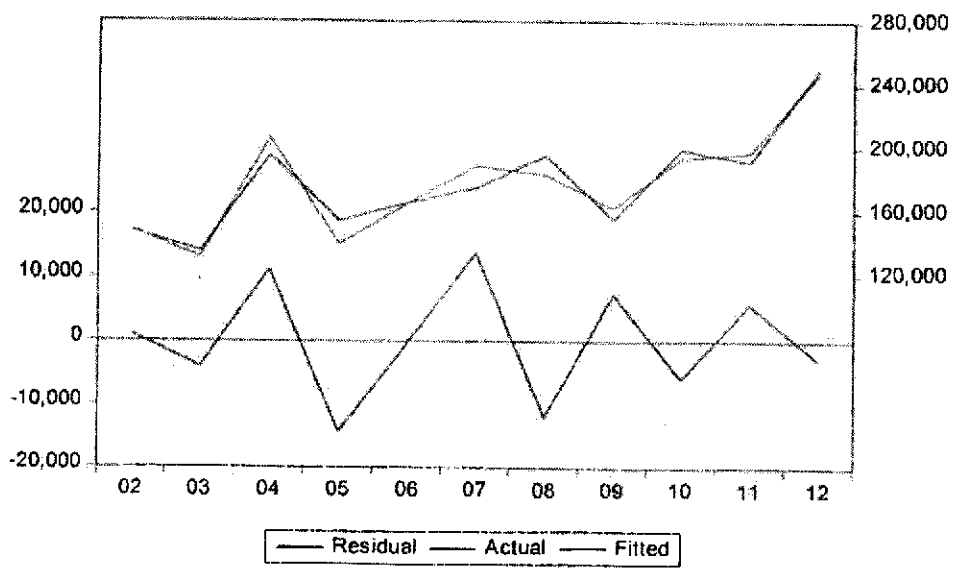
Dependent Variable: VISITOTH
Method: Least Squares
Sample: 2002 2012
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3842438.	845251.8	-4.545909	0.0061
YUAN	267904.7	59680.42	4.488988	0.0065
WON	604.3362	139.2359	4.340375	0.0074
D(CHINAGDP)	154.2265	38.68785	3.986432	0.0105
D(KOREAGDP)	1.414201	0.272816	5.183719	0.0035
KOREAGDP(-1)	0.762044	0.145758	5.228153	0.0034

R-squared	0.928417	Mean dependent var	178946.5
Adjusted R-squared	0.856834	S.D. dependent var	33700.94
S.E. of regression	12751.50	Akaike info criterion	22.04714
Sum squared resid	8.13E+08	Schwarz criterion	22.26417
Log likelihood	-115.2593	Hannan-Quinn criter.	21.91033
F-statistic	12.96984	Durbin-Watson stat	3.357605
Prob(F-statistic)	0.006884		

VISITOTH = number of visitors from other countries
CHINAGDP = index of China GDP in constant prices
KOREAGDP = index of Korea GDP in constant prices
WON = index value of Korean Won
YUAN = index value of Chinese Yuan

Most of the visitors excluding Japan are from China and Korea; the number from Russia is starting to pick up but the time series is not robust, and the number from the U. S. has remained relatively stable and low throughout the decade. Hence the key variables are the level and change in Chinese and Korean GDP, and the value of those two currencies.



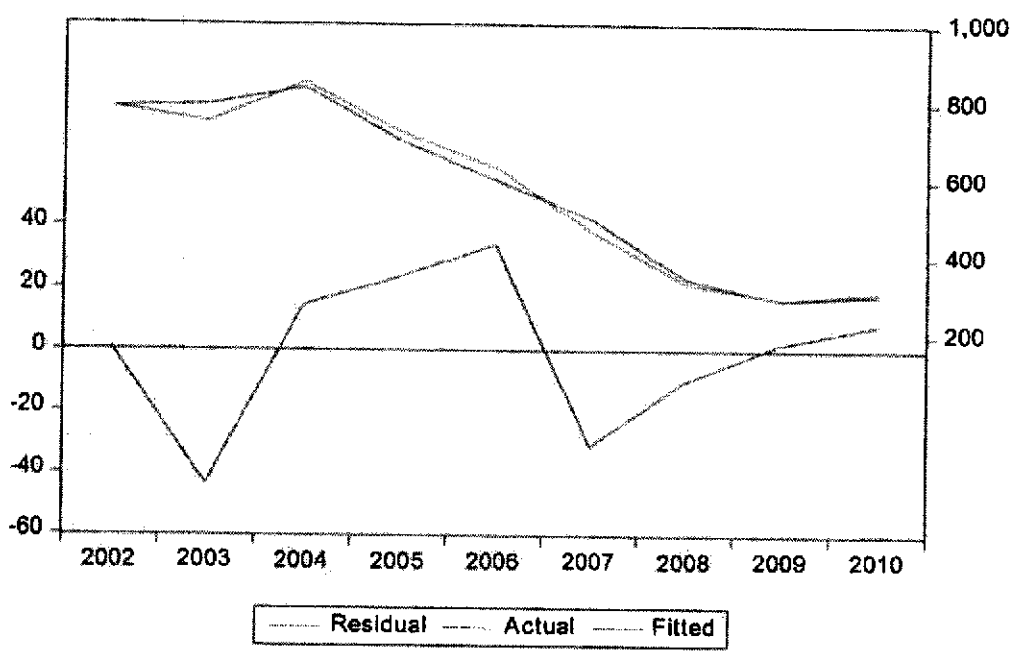
Dependent Variable: MGX
Method: Least Squares
Sample: 2002 2010
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.01658	189.3854	-0.058170	0.9555
XGX	0.387856	0.153231	2.531189	0.0446
WX	0.690804	0.439101	1.573221	0.1667

R-squared	0.987498	Mean dependent var	575.2222
Adjusted R-squared	0.983331	S.D. dependent var	222.3959
S.E. of regression	28.71303	Akaike info criterion	9.813780
Sum squared resid	4946.627	Schwarz criterion	9.879522
Log likelihood	-41.16201	Hannan-Quinn criter.	9.671910
F-statistic	236.9693	Durbin-Watson stat	2.098428
Prob(F-statistic)	0.000002		

MGX = imports of goods, constant dollars
XGX = exports of goods, constant dollars
WX = compensation of employees, constant dollars

Imports of goods are ordinarily related to the various components of aggregate demand, but the relative paucity of data does not permit a refined equation; hence we have used compensation of employees to represent the general measure of aggregate demand. The relationship with exports of goods is much clearer, since the raw materials must be imported, so that term is treated separately.



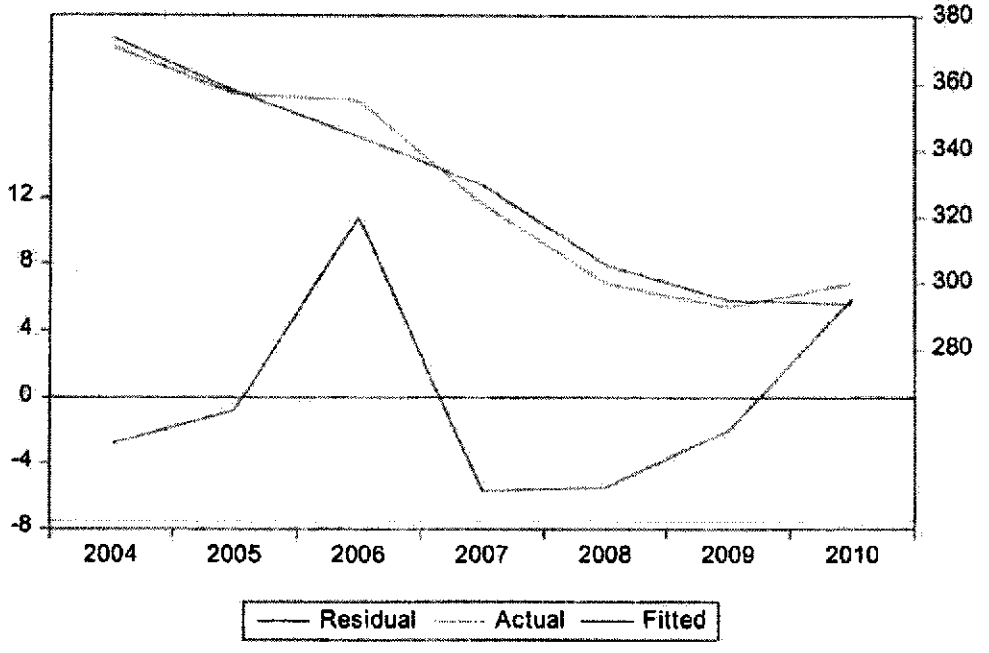
Dependent Variable: GSLX
Method: Least Squares
Sample (adjusted): 2004 2010
Included observations: 7 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	171.9986	17.34121	9.918491	0.0006
WX	0.193135	0.046075	4.191746	0.0138
WX(-1)+WX(-2)	0.039796	0.025687	1.549247	0.1962

R-squared	0.963292	Mean dependent var	328.5714
Adjusted R-squared	0.944937	S.D. dependent var	32.21209
S.E. of regression	7.558698	Akaike info criterion	7.180802
Sum squared resid	228.5357	Schwarz criterion	7.157621
Log likelihood	-22.13281	Hannan-Quinn criter.	6.894285
F-statistic	52.48353	Durbin-Watson stat	2.138213
Prob(F-statistic)	0.001348		

GSLX = Government consumption and investment, territorial
WX = wages and salaries, constant dollars

Much of government spending is exogenous, but to the extent it is endogenous, purchases are tied to the state of the domestic economy over the past two years. Here again the individual determinants of aggregate demand are not sufficiently refined to create a precise equation, so the total wage bill is used as a proxy for these terms.



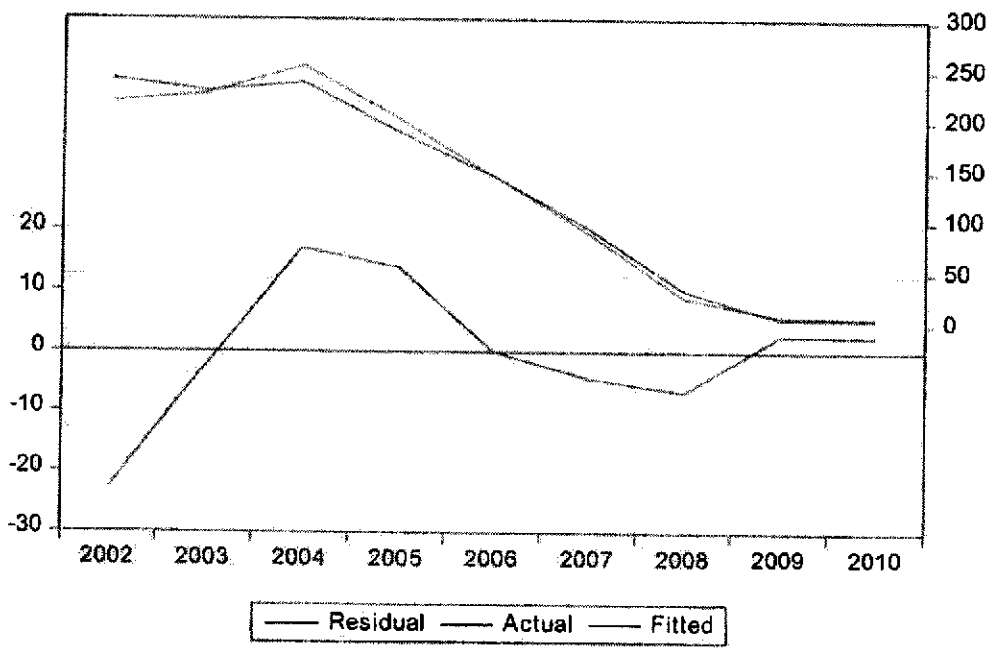
Dependent Variable: WMX
Method: Least Squares
Sample(adjusted): 2002 2010
Included observations: 9 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.169141	7.127477	0.023731	0.9817
XGX	0.282703	0.012495	22.62466	0.0000

R-squared	0.986509	Mean dependent var	131.1548
Adjusted R-squared	0.984582	S.D. dependent var	100.4411
S.E. of regression	12.47168	Akaike info criterion	8.077927
Sum squared resid	1088.799	Schwarz criterion	8.121755
Log likelihood	-34.35067	F-statistic	511.8754
Durbin-Watson stat	1.018001	Prob(F-statistic)	0.000000

WMX = manufacturing compensation, constant dollars
XGX = exports of goods, constant dollars

Wages in manufacturing are closely tied to exports of goods; most of this represents the garment trade, and after that closed, the remaining wages and salaries were less than 10% of the pre-2007 figures.



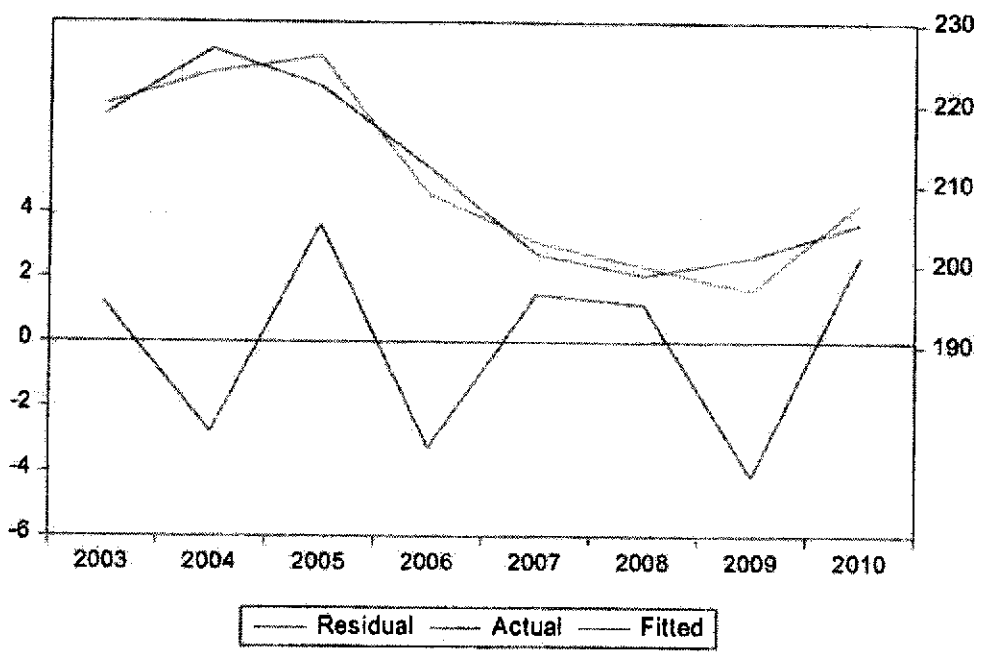
Dependent Variable: WGSL
Method: Least Squares
Sample (adjusted): 2003 2010
Included observations: 8 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	50.80762	41.22208	1.232534	0.2852
GSLX	0.105628	0.078887	1.338984	0.2516
PGDP(-1)	0.566496	0.262908	2.154729	0.0975
(2*VISITORS+VISITORS(-1))/3	0.000148	4.46E-05	3.323354	0.0293

R-squared	0.929582	Mean dependent var	210.8750
Adjusted R-squared	0.876769	S.D. dependent var	11.14114
S.E. of regression	3.911018	Akaike info criterion	5.872325
Sum squared resid	61.18424	Schwarz criterion	5.912046
Log likelihood	-19.48930	Hannan-Quinn criter.	5.604425
F-statistic	17.60128	Durbin-Watson stat	3.314858
Prob(F-statistic)	0.009076		

WGSL = compensation for government workers, territorial
GSLX = territorial government purchases, constant dollars
VISITORS = number of visitors to CNMI
PGDP = implicit GDP deflator

Wages of government workers are related to the constant-dollar purchases of the government and the GDP deflator, since wages are in current dollars. Also, to some extent, an increase in visitors boosts the need for local services and hence raises the wage bill, at least in current dollars.



The previous two equations explained wages in manufacturing and territorial government; wages for the Federal government are exogenous. The next equation explains all other private sector wages. Ordinarily this would be divided into several sectors and correlated with the appropriate components of aggregate demand, but the data are not sufficiently robust to support such an approach.

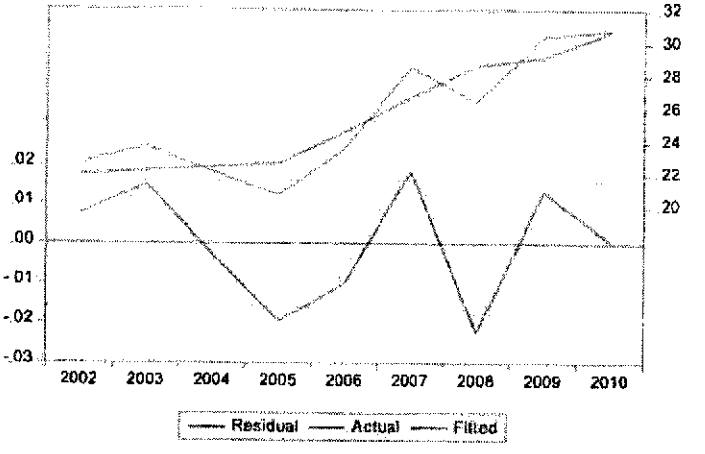
From a theoretical structure, wages should be proportional to output; since output is measured in constant prices, this ratio would have an upward trend representing the average increase in wage rates. Since no time-series data are available for wage rates, they are assumed to be correlated with the CPI. The equation in this form is:

Dependent Variable: IMPLWR
Method: Least Squares
Sample (adjusted): 2002 2010
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.015140	0.044760	-0.338255	0.7451
CPI	0.003002	0.000494	6.081771	0.0005

R-squared	0.840865	Mean dependent var	0.255170
Adjusted R-squared	0.818132	S.D. dependent var	0.037241
S.E. of regression	0.015882	Akaike info criterion	-5.254174
Sum squared resid	0.001766	Schwarz criterion	-5.210346
Log likelihood	25.64378	Hannan-Quinn criter.	-5.348754
F-statistic	36.98794	Durbin-Watson stat	2.607408
Prob(F-statistic)	0.000500		

IMPLWR = implicit wage rate, which is defined as the total private sector wage bill excluding manufacturing divided by constant-dollar consumption + fixed investment + exports of services
CPI = consumer price index



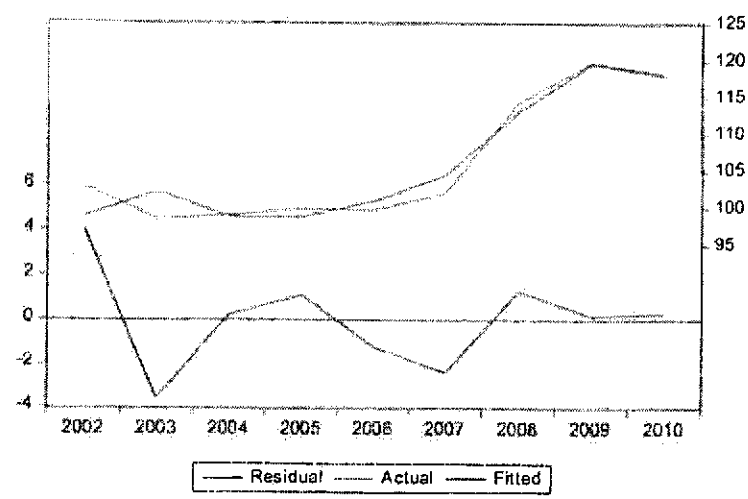
Dependent Variable: PGDP
Method: Least Squares
Sample: 2002 2010
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	106.1347	29.54040	3.592865	0.0157
XGX/GDPX	-22.07468	14.38315	-1.534760	0.1854
CDX/GDPX	-253.0078	137.2980	-1.842764	0.1247
CNX/GDPX	190.7557	126.2022	1.511509	0.1911

R-squared	0.935777	Mean dependent var	106.1427
Adjusted R-squared	0.897243	S.D. dependent var	8.772266
S.E. of regression	2.812015	Akaike info criterion	5.206782
Sum squared resid	39.53713	Schwarz criterion	5.294437
Log likelihood	-19.43052	Hannan-Quinn criter.	5.017622
F-statistic	24.28452	Durbin-Watson stat	2.407127
Prob(F-statistic)	0.002080		

PGDP = implicit GDP deflator
XGX = exports of goods, constant dollars
CDX = consumption of durables, constant dollars
CNX = consumption of nondurables, constant dollars
GDPX = gross domestic product, constant dollars

To a certain extent, the implicit GDP deflator is an artificial construct that is included in the model only to close the gap between current and constant dollar GDP. It has a non-significant negative correlation with both the CNMI and the US CPI. Most of the shifts, as can be seen from the above equation, reflect the changes in the proportion of consumption and exports of goods. Since exports of goods and consumer durables have a lower price index than services, a shift toward goods lowers the implicit deflator; nondurables (such as fuel) have a higher price index, so an increase in that component of GDP raises the deflator.



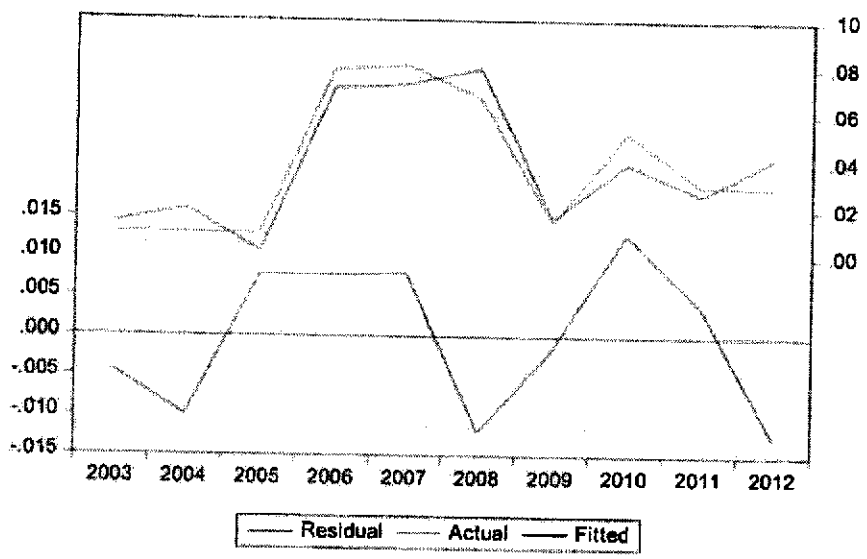
Dependent Variable: @PCH(CPI)
Method: Least Squares
Sample (adjusted): 2003 2012
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.016922	0.010857	-1.558589	0.1701
@PCH(USCPI)	1.381919	0.333222	4.147147	0.0060
DCPI	0.027729	0.008275	3.350913	0.0154
@PCH(MINWG)	0.310512	0.061432	5.054564	0.0023

R-squared	0.896725	Mean dependent var	0.038696
Adjusted R-squared	0.845088	S.D. dependent var	0.029215
S.E. of regression	0.011499	Akaike info criterion	-5.804013
Sum squared resid	0.000793	Schwarz criterion	-5.682979
Log likelihood	33.02006	Hannan-Quinn criter.	-5.936787
F-statistic	17.36578	Durbin-Watson stat	1.798462
Prob(F-statistic)	0.002314		

CPI = consumer price index for CNMI
USCPI = consumer price index for US
DCPI = dummy variable for 2005 and 2006
MINWG = CNMI minimum wage rate

The equation for the CNMI CPI is tied to the U. S. CPI and the minimum wage rate; the coefficient for the U.S. CPI is greater than unity, indicating a more rapid rate of price increase on CNMI than the U. S. over the sample period. A 1% increase in the minimum wage boosts the CPI by about 0.3%, according to this equation. The dummy variable represents data anomalies in 2005 and 2006, which may have been due to errors in some of the original data.



The final five equations in the model are not estimated stochastically, but simply relate 2010 employment in manufacturing, trade, hotels and restaurants, all other private, and government to the relevant components of GDP. These equations are as follows. As noted above, if time series data become available, these equations will be estimated stochastically.

EM = XGX * 39 / 17

ETR = (CDX + CNX) * 3495 / 313

EHR = XSX * 5779 / 180

EOTH = (CSX + IPX) * 12220 / 331

EG = GSLX * 5277 / 300

E = EM + ETR + HER + EOTH + EG

4. Forecast and Simulation Results

The first table in this section represents a simulation of the model for 2011 and 2012. This is not really a forecast because one of the key variables, namely the number of visitors, is already known. On the other hand, the GDP account figures have not yet been released, so in that sense these results represent a forecast. According to the model, real GDP for CNMI rose only 0.9% in 2011 but soared 6.0% in 2012, largely on the basis of a 20% increase in visitors.

All of the endogenous variables are shown in this table. As noted earlier in this report, these results will be fine-tuned when the 2011 GDP account data – and the 2009 and 2010 revisions – become available.

These variables are true simulations in the sense that no constant adjustments have been added to any of the equations. On the other hand, given that data for visitors are available for 2011 and 2012 and have been included in the regression equations, they are not quite true forecasts.

Table 4-1. Simulated Model Values for 2010, 2011, and 2012

Variable	2008	2009	2010	2011	2012
Current $ GDP	851	725	732	735	765
% change	-1.8	-14.8	0.9	0.4	4.1
Constant $ GDP	744	605	621	626	663
% change	-12.4	-18.7	2.6	0.9	6.0
Implicit GDP Deflator	114	120	118	117	115
Consumer durables	130	107	118	118	140
Consumer nondurables	213	187	196	195	220
Consumer services	342	304	304	310	330
Net foreign Travel	184	164	176	154	185
Fixed investment	26	26	27	26	33
Exports of goods	116	19	17	17	17
Exports of services	190	170	181	159	190
Imports of goods	337	295	304	304	342
Imports of services	56	44	46	44	56
Fed govt purchases	14	19	19	19	19
Territorial govt purchases	300	293	293	293	304
Wage Bill	518	514	526	523	578
Mfg wages	30	10	6	6	6
Other private wages	273	290	301	301	349

Fed govt wages	15	17	15	16	17
Territorial govt wages	200	197	205	201	206
Income taxes on wages	25	24	26	26	28
Other taxes	107	98	91	90	95
Consumer price index	101	102	106	109	114
Disposable Income (Const $)	337	327	348	348	395
% change	-18.9	-3.2	6.4	0.0	13.6
Visitors from Japan	213299	191111	181743	145825	153421
Other visitors	183972	162845	199922	192181	250707
Total visitors	397271	353956	381666	338006	404128
% change	2.1	-10.9	7.8	-11.4	19.6
Total Employment	NA	NA	26171	25645	28374
% change	NA	NA	NA	-2.0	10.6
Mfg Employment	NA	NA	39	39	39
Trade employment	NA	NA	3506	3485	4024
Hotel/restaurant employment	NA	NA	5275	4563	5553
Other private employment	NA	NA	12191	12405	13405
Government employment	NA	NA	5160	5153	5353

We next turn to the simulation properties of the model. For the purposes of this report, we have prepared two simulations. In both cases, the changes are made in 2010, and we then measure the three-year effects.

In the first case, the number of foreign visitors rises by 20,000; since the average visitors spends about $500, that is equivalent to a $10 million exogenous boost to the economy. In the second case, fixed investment rises by $10 million. Hence the two "shocks" to the economy are roughly equal in magnitude.

In this table, the _1 indicates the simulation with the 20,000 extra foreign visitors; _0 is the baseline solution. All terms are as defined in the previous section.

Table 4-2. Economic Impact of a 20,000 Increase in Foreign Visitors

GDPX_1	633.0	643.3	683.1
GDPX_0	620.8	626.1	663.4
% change	2.0%	2.7%	3.0%
VISITORS_1	401666	358006	424128
VISITORS_0	381666	338006	404128
% change	5.2%	5.9%	4.9%
E_1	26975	26759	29587
E_0	26171	25645	28374

% change	3.1%	4.3%	4.3%
DIX_1	359.8	363.8	412.5
DIX_0	347.6	347.5	394.7
% change	3.5%	4.7%	4.5%
CDX_1	125.3	126.8	150.2
CDX_0	117.7	117.5	140.4
% change	6.5%	7.9%	7.0%
CNX_1	204.0	203.3	229.2
CNX_0	196.3	194.5	220.0
% change	3.9%	4.5%	4.2%
CSX_1	309.2	321.7	343.4
CSX_0	303.6	310.4	330.1
% change	1.9%	3.6%	4.0%
IPX_1	29.0	29.1	36.5
IPX_0	26.7	25.6	33.0
% change	8.6%	13.6%	10.6%
MGX_1	313.4	316.1	355.3
MGX_0	304.0	303.7	341.7
% change	3.1%	4.1%	4.0%
MSX_1	50.7	51.8	63.8
MSX_0	46.2	44.4	56.1
% change	9.6%	16.7%	13.7%
GSLX_1	295.9	297.0	309.3
GSLX_0	293.3	293.0	304.3
% change	0.9%	1.4%	1.7%

This shows an increase of about $12 million in the first year, $17 million in the second year, and $20 million in the third year, for a $10 million shock. Hence the three-year multiplier would be about 2.0.

Table 4-3 shows similar results for a $10 million boost in capital spending.

Table 4-3. Economic Impact of a $10 Million Increase in Capital Spending

Variable	2010	2011	2012
GDPX_1	630.5	637.6	675.6
GDPX_0	620.8	626.1	663.4
% change	1.6%	1.8%	1.8%
VISITORS_1	381666	338006	404128
VISITORS_0	381666	338006	404128
% change	0.0%	0.0%	0.0%
E_1	26605	26154	28908
E_0	26171	25645	28374
% change	1.7%	2.0%	1.9%
DIX_1	351.2	352.2	399.8
DIX_0	347.6	347.5	394.7
% change	1.1%	1.3%	1.3%
CDX_1	117.9	118.2	141.2
CDX_0	117.7	117.5	140.4
% change	0.2%	0.6%	0.6%
CNX_1	197.2	195.8	221.4
CNX_0	196.3	194.5	220.0
% change	0.5%	0.6%	0.6%
CSX_1	304.6	313.1	333.3
CSX_0	303.6	310.4	330.1
% change	0.4%	0.9%	1.0%
IPX_1	36.7	35.6	43.0
IPX_0	26.7	25.6	33.0
% change	37.5%	39.0%	30.3%
MGX_1	306.7	307.1	345.4
MGX_0	304.0	303.7	341.7
% change	0.9%	1.1%	1.1%
MSX_1	46.9	45.2	57.0
MSX_0	46.2	44.4	56.1
% change	1.4%	1.9%	1.6%
GSLX_1	294.1	294.1	305.7
GSLX_0	293.3	293.0	304.3
% change	0.2%	0.4%	0.5%

The results are somewhat smaller than for the increase in the visitors, with a three-year multiplier of about 1.2 compared to 2.0. The major reason is that most of the intermediate goods required for capital spending must be imported, whereas for tourism, the amount spent on services is almost entirely domestic; the import coefficient is much lower. Also, a $1 million increase in tourist spending would create more new jobs than a $1 million increase in capital spending.

Of course it is possible that if the investment were used for hotels and other tourist attractions, the number of tourists would also rise; as the model is built, the number of tourists depends on foreign income and similar variables. On the other hand, "build it and they will come" is not necessarily a valid model either. In the case of tourism, a separate study outside the scope of the macro model would be required to determine how many additional tourists might be attracted if new hotels and other tourist facilities were built. At least historically, there has been no significant correlation between the number of available hotel rooms and the number of foreign visitors. Additional airline scheduling, for example, would have a significant impact on tourism, but whether airlines will decide to add flights is not something determined econometrically.

While many other simulations are possible, the general picture shown here is that the larger the import component, the lower the multiplier. Also, the model does not contain a separate endogenous manufacturing sector, as it is unlikely that export manufacturing will return to CNMI, now that the minimum wage has been pushed so far above the prevailing wage in many countries in East Asia.

CNMI would probably like to know the answers to such questions as how much tourism would rise in response to such exogenous factors as greater advertising, an increase in tourist attractions, improved infrastructure, and additional airline flights. If these questions are to be answered econometrically, as opposed to surveys and other snapshot analysis, historical data would be required to see what has happened in the past. Currently we are unaware of such data.