AN ECONOMETRIC MODEL OF INDUSTRY, FOREIGN TRADE, AND ECONOMIC DEVELOPMENT OF PHILIPPINES, 1990-2006

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Abstract
We analyze economic development in Philippines for the period 1990-2006, with special focus on inter-sectoral relationships and the role of foreign trade. We analyze the evolution of real value added of Agriculture, Manufacturing, Industry and Services, and we present an econometric model which shows the important and positive impact of manufacturing and foreign trade on economic development.
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1. Introduction

If Philippines is going to eradicate poverty, and to raise the general living standards of population, the country needs to get a great improvement of industrial development and real income per capita during the next decade, in order to have enough resources. Although some positive measures have been taken during the last decades of the 20th century, the question is that industrial production per capita has been too low to reach those objectives. In this article we present some econometric models estimated with data of Philippines, which show the highly positive impact of industry on economic development, through several direct and indirect effects. The results agree with those got for Guisan(2006) and (2007) for other countries and other studies devoted to analyzed the role of inter-sector relationships to explain real economic growth and development.

In the interesting study by Balisacan(2007), this author analyzes the link between poverty reduction and economic growth and how to improve the quality of growth in Philippines. He notices that 2 of every three poor persons in the country live in rural areas and that even poverty in urban areas is largely explained by extreme deprivation in rural areas which induces rural-urban migration. Another interesting analysis by this author is the problem of rapid population growth and the failure of Philippines to achieve a demographic transition to its Asian neighbors during the past three decades. He presents and interesting comparison of the evolution of Thailand and Philippines in this regard.

In section 2 we analyze the evolution of industry in Philippines, in comparison with other Asian countries which have reached a higher degree of development than Philippines, with special reference to industrial development.

Section 3 analyses the evolution of production by sector and foreign trade in Philippines for the period 1990-2007. Section 4 presents and econometric model to explain some of the main features of economic development in Philippines, and finally section 5 presents the main conclusions. We also include an on line Annex with a short

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summary in English of the study by Guisan and Exposito(2008) about poverty and health expenditure in Philippines in comparison with other Asian countries.

2. Comparison of economic development of Philippines and other Asian countries

Table 1 shows Value-added per capita in Manufacturing (VMH) and Services (VSH) in twenty nine Asia-Pacific countries in the years 1999 and 2006, in dollars of year 2000 at Exchange Rates.

Table 1. Value-Added per capita in Manufacturing (VMH) and Services (VSH)
(US dollars per inhabitant at 2000 prices and Exchange Rates)

		VMH 1999	**VMH 2006**	**VSH 1999**	**VSH 2006**	**Dif. VMH**	**Dif. VSH**
1	Australia	2571	2552	13102	15431	-19	2330
2	Bangladesh	48	68	155	201	20	46
3	Bhutan	74	109	267	385	36	118
4	Brunei D.	2743	2599	6340	7012	-144	672
5	Cambodia	36	92	114	192	57	78
6	China	277	543	342	653	265	311
7	Fiji	274	285	1126	1297	11	171
8	Hong Kong, cn	-	986	-	24283	-	-
9	India	61	92	201	320	31	119
10	Indonesia	212	274	297	414	61	118
11	Japan	7760	8842	23492	26851	1082	3359
12	Kiribati	4	4	368	358	0	-10
13	Korea, Rep.	2452	4134	4996	6435	1682	1438
14	Lao PDR	53	91	79	108	38	30
15	Malaysia	1094	1486	1535	1911	392	376
16	Mongolia	20	30	179	289	10	111
17	Nepal	19	18	75	84	-1	8
18	New Zealand	2027	2170	7904	9265	143	1362
19	Pakistan	74	112	249	314	38	65
20	Papua New G.	54	48	164	145	-7	-19
21	Philippines	214	253	506	653	39	147
22	Samoa	179	195	706	985	17	279
23	Singapore	5234	7463	12831	17311	2229	4479
24	Solomon I.	42	22	405	338	-20	-67
25	Sri Lanka	118	148	379	539	30	160
26	Thailand	647	943	965	1233	297	269
27	Tonga	72	76	625	795	5	170
28	Vanuatu	59	44	972	948	-16	-24
29	Vietnam	67	134	148	218	67	70

Note: The last two columns are the differences of the values of years 2006 and 1999. Source: Own elaboration from WDI of WB(2008).

Values in table 1 should be much higher for many countries if we express the values at Purchasing Power Parities instead of at Exchange Rates.

Graph 1 shows the values of VMH and VSH in year 2006 for countries of table 1 with VSH below of 5000 US dollars. The most outstanding values of VMH in this group of countries correspond to Malaysia, Thailand and China.

Graph 1. Real Valued Added per capita of Manufacturing and Services
(dollars per capita at prices and exchange rates of year 2000
In countries of table 1 with VSH06<5000)

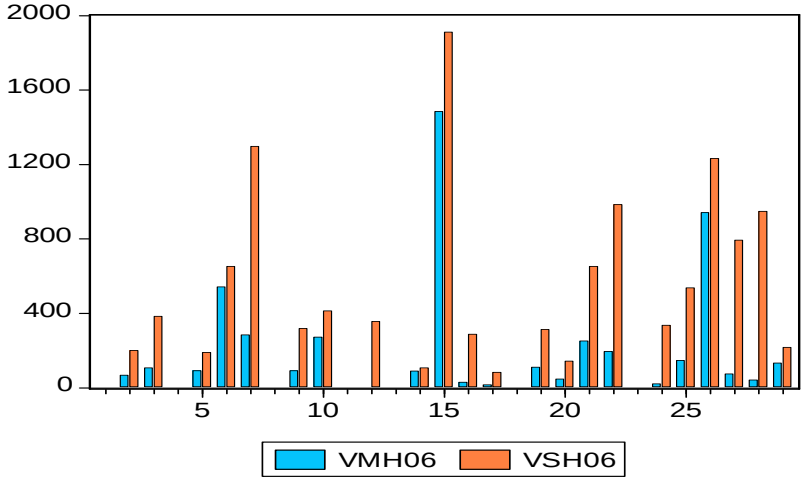


Table 2 shows the evolution of VMH and VNMH in Filipinas in comparison with other Asian countries. Values in dollars per capita at 2005 prices and Purchasing Power Parities (PPP).

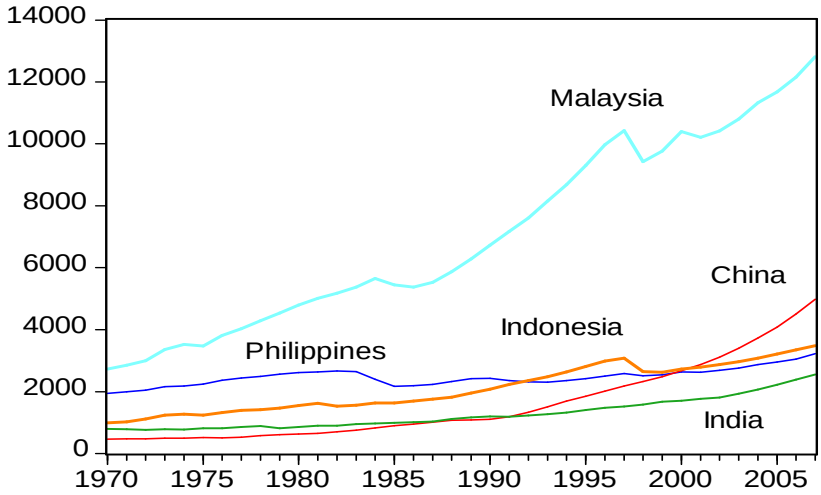
Table 2. Manufacturing and Non Manufacturing Value-Added per capita ($2005 at PPP)

Value-Added per capita	China	India	Indonesia	Malaysia	Philippines
Manufacturing					
1990	363	201	431	1629	604
1995	624	251	680	2453	555
2000	859	267	756	3389	586
2005	1369	355	889	3479	688
Non Manufacturing					
1990	740	1001	1654	5098	1827
1995	1229	1153	2136	6844	1860
2000	1815	1443	1968	7006	2050
2005	2719	1867	2320	8199	2268
Total					
1990	1103	1202	2085	6727	2431
1995	1853	1404	2816	9297	2415
2000	2674	1710	2724	10395	2636
2005	4088	2222	3209	11678	2956

Source: own elaboration from WDI of WB(2008)

Graph 2 shows the evolution of total real Value-Added of per capita in Philippines in comparison with China, India, Indonesia and Malaysia in constant dollars at PPPs (Purchasing Power Parities) of 2005.

Graph 2. Real Gross Domestic Product per capita in 5 Asian countries
(Dollars per inhabitant at constant prices and PPPs of 2005)



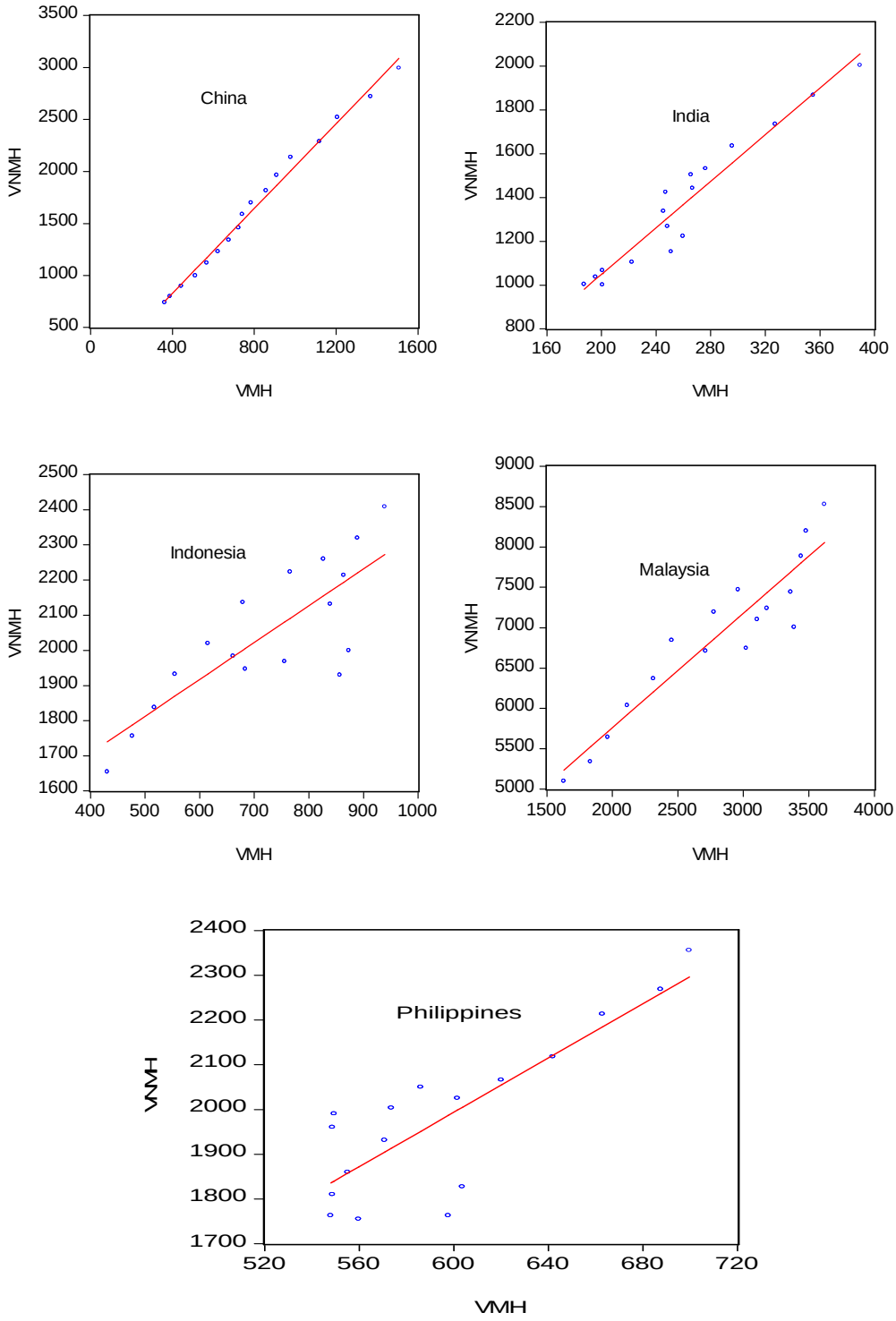
Source: Own elaboration from WDI statistics, WB(2008)

Philippines had in the period 1970-1990 the second highest value of real GDP per capita, after Malaysia, among the group of countries of graph 2, with a positive trend during the period 1970-83. Real value-added per capita of this country decreased for the period 1983-85 and experienced a further stagnation during the period 1985-95, while Malaysia experienced a very important development and China and Indonesia show a higher rate of increase than Philippines. In the period 1995-2007 there is again a positive trend for this important variable in Philippines although with moderate rates of growth.The most outstanding increase of real GDP per capita of Malaysia may be explained mainly by the increase of industrialization.

One of the main factors that explain the differences of economic development is the real value-added of manufacturing per capita, because inter-sectoral relationship are of uppermost importance for economic developing from the supply side as seen in Guisan(2006), Guisan(2007) and other studies.

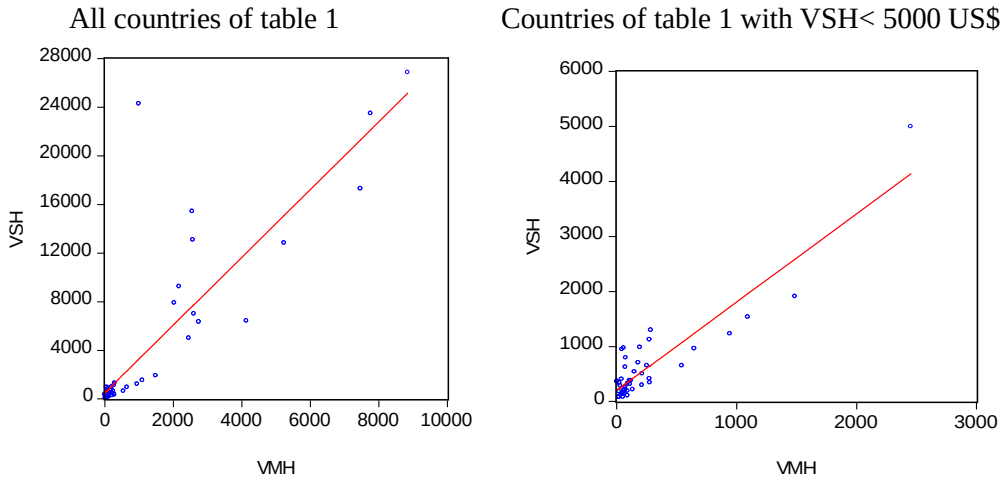
Graph 3 shows the high degree of positive correlation between Value-Added of Manufacturing per head (VMH) and Value-Added of Non Manufacturing per head (VNMH), for the period 1990-2006, with data in constant dollars of year 2005 at Purchasing Power Parities.

Graph 3. Relationship between VNMH and VMH in 5 Asian countries, 1990-2006. US dollars at PPPs 2005



Graph 4 shows that usually there is a very strong positive relationship between real Value-Added in Services per head (VSH) real Value-Added in Manufacturing per head (VMH). Data correspond to the 29 countries of table 1 in US dollars at 2000 prices and Exchange Rates. The main exception to the general rule is the case of Hong-Kong with a very high value of Services in comparison with a more moderate value of Manufacturing, which is explained by the important role of Hong-Kong to trade goods manufacturing in other areas. Other exceptions are explained by tourism activities or other factors, but the general rule is that Manufacturing is a very important factor to foster the increase of real value-added in Services, not only by its direct effects but also because it has important indirect effects which contribute to increase foreign trade with a net positive effect on economic development.

Graph 4. Relationship between VSH and VMH in countries of table 1, year 2006

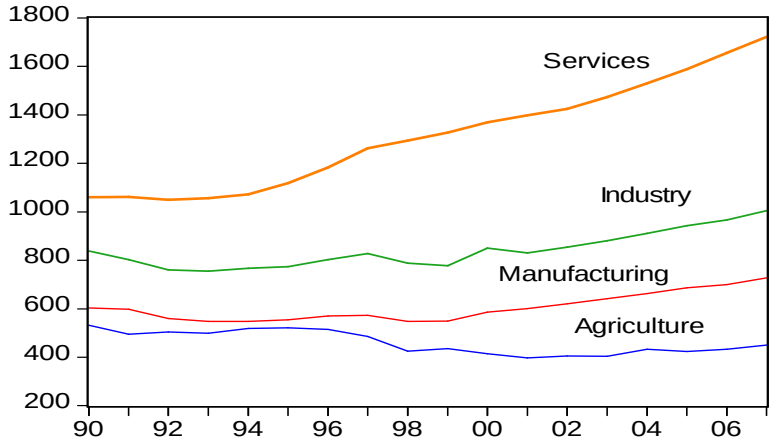


3. Real value-added by sector and foreign trade in Philippines, 1990-2007

Graph 5 shows the evolution of real Value-Added per capita, by sector, in Philippines, for the period 1990-2007. We notice that Manufacturing has increased during the period while Agriculture has decreased. We may notice positive impact of the increase of Manufacturing on other sectors, particularly in Building (included in Industry, together with Manufacturing and Energy) and Services.

Before to present the results of the econometric model estimated for Philippines we present several graphs which show the positive relationship between the capacity to Import, mainly given by the capacity to export, and economic development, as well as the positive relationship between industrial development and the increase of the level of foreign trade. As seen in Guisan and Cancelo(2002), Guisan(2006) and (2007) and other studies, the level of foreign trade has usually a positive impact on real GDP per capita.

Graph 5. Real Value-Added per capita and by sector in Philippines, 1990-2007
(Dollars per inhabitant at constant prices and PPPs of 2005)

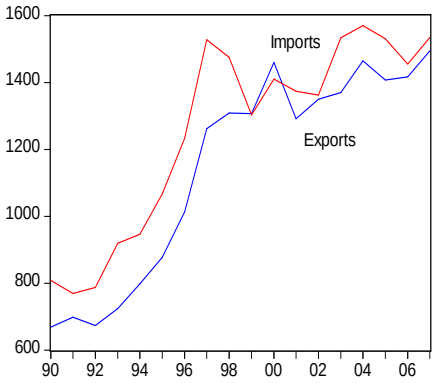


Source: Own elaboration from WDI statistics, WB(2008)

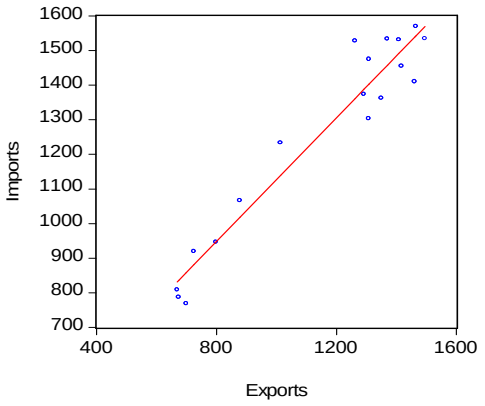
Graph 6.1 shows the evolution of foreign trade in Philippines and graph 6.2 the positive relationship between real values of Imports and Exports. Foreign trade data are in million US$ at 2000 prices and Exchange Rates (ER).

Graph 6. Foreign trade in Philippines, 1990-2007 (US$2000 ER)

6.1. Evolution of Exports and Imports in Philippines (million US$2000 ER)



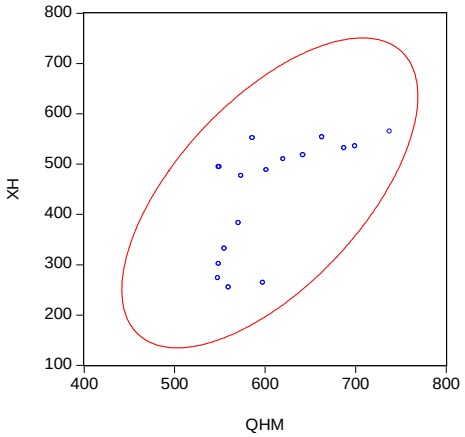
6.2. Relationships between Imports and Exports in Philippines (million US$2000 ER)



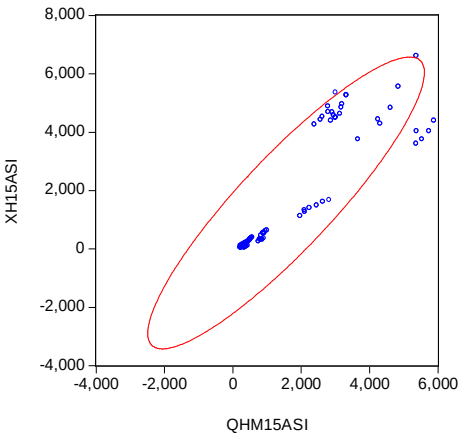
Graph 7 shows the positive relationship between Manufacturing real Value Added per capita (QHM) and real Exports per capita (XH) in Philippines for the period 1991-2007 and graph 9 the same relationship in a set of 15 Asia-Pacific countries for the period 1999-2005: Australia, Bangladesh, Cambodia, India, Indonesia, Japan, Korea, Lao, Malaysia, New Zealand, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam. Data of XH in graph 7 are at US$2005 PPP and in graph

8 at US$2000 PPP, while data of XH in graph 7 are at US$2005 ER and in graph 8 at US$2000 ER.

Graph 7. XH and QHM in Philippines



Graph 8.XH and QHM in 15 Asia-Pacific countries



As seen in Cancelo and Guisan(2002) usually there is a positive impact of manufacturing on foreign trade, although other factors contribute also to explain differences among countries in the values of exports per head, for example the size of the country, because manufacturing usually implies increase in trade (both domestic and foreign) and thus small countries with low levels of domestic trade are more prone to reach high values of foreign trade per capita than big countries.

Of course other factors, besides manufacturing contribute to increase Exports of goods and services. In some countries tourism activities or exports of raw materials produced by the sectors of Agriculture or Energy, may be also important, but usually manufacturing is the main factor explaining the increase of domestic trade and foreign trade.

The following graphs show the positive relationships between the following variables, in Philippines for the period 1991-2007, all in dollars at 2005 prices and purchasing power parities (PPPs) but Imports and Exports are expressed in dollars at constant prices of year 2005 and at exchange rates (ER).

MH = Imports per capita

QHEB= real value-added per capita in Energy and Building

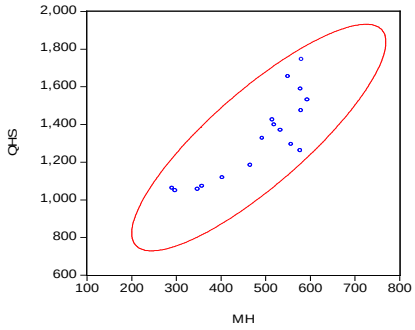
QHM= real value-added per capita in Manufacturing

QHS = real value-added per capita in Services

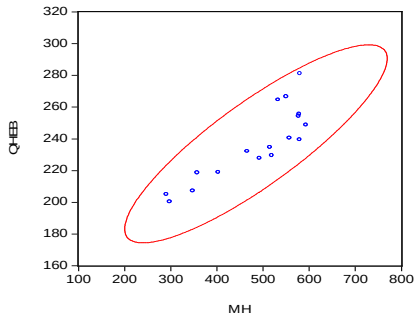
XH = Exports per capita

Graphs 9 and 10 show the positive impact of MH on QHEB and QHS, and graphs 11 and 12 the positive impact of QHM on QHEB and QHS. QHM has both an important direct and positive impact on the development of QHS and other non-manufacturing sectors, and an important indirect and positive impact on the same variables, through the effect of QHM in XH and MH.

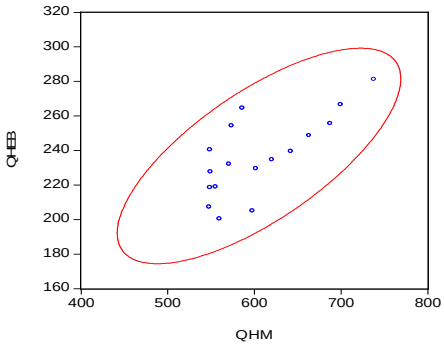
Graph 9. QHS and MH 1991-2007



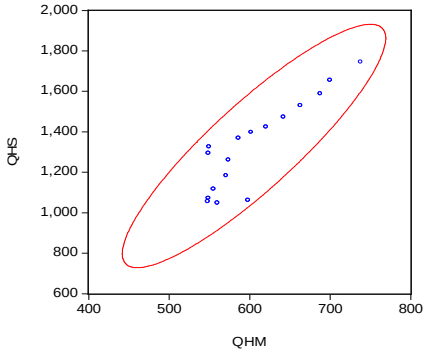
Graph 10. QHEB and MH 1991-2007



Graph 11. QHEB and QHM 1991-2007



Graph 12. QHS and QHM 1991-2007



In the next section we estimate an econometric model for Philippines that has into account the impact of QHM and MH on economic development.

3. Econometric Model of Philippines, 1991-2007

Following the analysis of economic development from the supply side, having into account the great importance of inter-sector relationships, as in Guisan, Aguayo and Exposito(2001) and other studies, we present here some estimations for Philippines.

Exposito and Carballas(2003) estimated a model of inter-sectoral relationships with a pool of 7 East-Asian countries in the period 1988-2000, including Philippines, which shows the highly positive impact of industry on the development of other sectors as well as the positive impact of exports on imports. Here we estimated a set of equations to explain the relationships between manufacturing development, foreign trade and economic development.

Data for the period 1991-2007 have been elaborated from WB(2008). The variables are expressed at constant prices in dollars of year 2005 per capita, well at Purchasing Power Parities (QHM, QHEB, QHS) or at Exchange Rates (XH, MH, TBH). Variables correspond to moment t (t=1991,…,2007) unless they are followed by (-1) which indicates that are lagged variables corresponding to (t-1).

The names of the variables are as follows:

QH for real Value-Added per head, followed by the production sector inicial(s): A (Agriculture), EB (Energy and Building), M (Manufacturing), NM (Non Manufacturing) and S (Services).

MH for real Imports per head.

XH for real Exports per head

TBH = Foreign Trade Balance per head (XH-MH)

The equations selected to express the impact of QHM and MH on economic development are the following ones:

$$QHS = F (D(QHM), D(MH), QHS(-1)) \quad (1)$$

$$QHEB = f(QHM, DMH, QHEB(-1)) \quad (2)$$

$$MH = f(XH, MH(-1) TBH(-1)) \quad (3)$$

$$XH = f (XH(-1) D(QHM)+D(QHEB)+D(QHS) \quad (4)$$

There is some degree of interdependence because XH influences, through its effect on MH, the values of QHS and QHEB, and at the same time the latter variables influences the value of XH.

First of all we present the estimation by Least Squares, which estimators have some degree of inconsistency in case of interdependence, and secondly we present the estimation by Two Stage Least Squares, which are consistent in case of interdependence.
When there is some degree of autocorrelation we estimate by Generalized Least Squares instead of Least Square, by adding and AR(1) term to the equation.

Equation 1. GLS (LS with AR(1))
Dependent Variable: QHSPH
Method: Least Squares. Sample(adjusted): 1992 2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QHSPH(-1)	1.037113	0.013389	77.46084	0.0000
D(QHMPH)	0.370568	0.195753	1.893040	0.0827
D(MHPH)	0.175367	0.068522	2.559266	0.0250
AR(1)	0.806119	0.170953	4.715433	0.0005

R-squared	0.997435	Mean dependent var	1347.114
Adjusted R-squared	0.996794	S.D. dependent var	217.5047
S.E. of regression	12.31600	Akaike info criterion	8.071994
Sum squared resid	1820.208	Schwarz criterion	8.265141
Log likelihood	-60.57595	Durbin-Watson stat	1.303626

Equation 2. LS

Dependent Variable: QHEB				
Method: Least Squares. Sample(adjusted): 1991 2007				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QHM)	0.327630	0.179008	1.830251	0.0886
D(MH)	0.207146	0.081915	2.528783	0.0241
QHEB(-1)	0.985165	0.016340	60.29013	0.0000
R-squared	0.674756	Mean dependent var		236.8636
Adjusted R-squared	0.628293	S.D. dependent var		23.00874
S.E. of regression	14.02792	Akaike info criterion		8.278761
Sum squared resid	2754.955	Schwarz criterion		8.425799
Log likelihood	-67.36947	Durbin-Watson stat		2.469949

Equation 3. LS
Dependent Variable: MH
Method: Least Squares. Sample: 1991 2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(XH)	1.069947	0.261231	4.095781	0.0011
TBH(-1)	0.398721	0.268027	1.487614	0.1590
MH(-1)	1.024286	0.025951	39.46982	0.0000
R-squared	0.920466	Mean dependent var		484.5461
Adjusted R-squared	0.909104	S.D. dependent var		104.7953
S.E. of regression	31.59467	Akaike info criterion		9.902639
Sum squared resid	13975.12	Schwarz criterion		10.04968
Log likelihood	-81.17243	Durbin-Watson stat		1.972746

Equation 4. LS
Dependent Variable: XH05ERPH
Method: Least Squares. Sample(adjusted): 1991 2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.
XH(-1)	0.983586	0.026358	37.31593	0.0000
D(QHM)+D(QHEB)+ D(QHS)	0.399338	0.155936	2.560904	0.0217
R-squared	0.930621	Mean dependent var		442.7496
Adjusted R-squared	0.925995	S.D. dependent var		113.4223
S.E. of regression	30.85519	Akaike info criterion		9.806618
Sum squared resid	14280.64	Schwarz criterion		9.904643
Log likelihood	-81.35625	Durbin-Watson stat		1.387804

Secondly we estimate the equations by TSLS, which is usually preferable in case of interdependence because guarantee the consistency of the estimators of parameters while LS may be affected by some degree of inconsistency.

Equation 1. TSL
Dependent Variable: QHS
Method: Two-Stage Least Squares. Sample(adjusted): 1992 2007
Instrument list: QHS(-1) QHM(-1) MH(-1) XH(-1) QHEB(-1) QHM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QHS(-1)	1.027145	0.004399	233.4911	0.0000
D(QHM)	0.678453	0.256141	2.648753	0.0201
D(MH)	0.098679	0.157060	0.628289	0.5407
R-squared	0.993336	Mean dependent var		1347.114
Adjusted R-squared	0.992311	S.D. dependent var		217.5047
S.E. of regression	19.07263	Sum squared resid		4728.947
Durbin-Watson stat	0.555408			

Equation 2. TSLS
Dependent Variable: QHEB
Method: Two-Stage Least Squares. Sample(adjusted): 1992 2007
Instrument list: QHS(-1) QHM(-1) MH(-1) XH(-1) QHEB(-1) QHM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QHEB(-1)	0.993804	0.016877	58.88409	0.0000
D(QHM)	0.282123	0.172847	1.632212	0.1266
D(MH)	0.188624	0.110622	1.705127	0.1119
R-squared	0.692997	Mean dependent var		238.8444
Adjusted R-squared	0.645766	S.D. dependent var		22.21595
S.E. of regression	13.22240	Sum squared resid		2272.813
Durbin-Watson stat	2.695864			

Equation 3. TSLS
Dependent Variable: MH
Method: Two-Stage Least Squares. Sample(adjusted): 1992 2007
Instrument list: QHS(-1) QHM(-1) MH(-1) XH(-1) QHEB(-1) QHM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MH(-1)	1.021685	0.027359	37.34417	0.0000
D(XH)	0.900631	0.398821	2.258234	0.0418
XHMH(-1)	0.287162	0.327035	0.878076	0.3958
R-squared	0.895894	Mean dependent var		496.6603
Adjusted R-squared	0.879877	S.D. dependent var		95.14759
S.E. of regression	32.97695	Sum squared resid		14137.23

Durbin-Watson stat	1.850415

Equation 4. TSLS
Dependent Variable: XH
Method: Two-Stage Least Squares. Sample(adjusted): 1992 2007
Instrument list: QHS(-1) QHM(-1) MH(-1) XH(-1) QHEB(-1) QHM

Variable	Coefficient	Std. Error	t-Statistic	Prob.
XH(-1)	0.987664	0.029860	33.07680	0.0000
D(QHM+QHS+QHEB)	0.352206	0.180664	1.949509	0.0716

R-squared	0.920283	Mean dependent var	453.9185
Adjusted R-squared	0.914589	S.D. dependent var	107.0524
S.E. of regression	31.28621	Sum squared resid	13703.58
Durbin-Watson stat	1.563399		

Although some coefficients do not appear as significant at 5% level, mainly due to the small size of the sample and to some problems of multicollinearity, the results show a clear support to the positive impact that manufacturing has on the development of other sectors. As per imports the coefficients are significant in the LS equations 1 and 2 but not in the TSLS. In spite of this result we should consider the important positive effect of imports on economic development having into account the international experiences, as seen in Guisan(2006) and (2007) and other studies.

5. Conclusiones

It should be important for Philippines to foster manufacturing in order to increase real income per capita and to eradicate poverty. The analysis of data in this study as well the results of the econometric models estimation support the important role of QHM in the evolution of other sectors from the supply side, due to its positive direct and indirect effects on the evolution of QHS and other variables. The question is how to increase manufacturing per capita given that it mainly depends on investment per capita and the capacity of domestic savings is not very high. It is important in this regard to favor the socio-economic conditions, including human capital, social capital, infrastructures and other ones, to favor both domestic investment and international cooperation and investment.

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Annex 1. Economic Development and poverty eradication

Note on the situation of poverty and health expenditure in Philippines in comparison with other countries (forthcoming soon in English a summary of the article in Spanish by Guisan and Exposito(2008).

Annex 2. Notes on the effects of exports and imports on economic development

Several interesting studies, as those by Karras(2003) and Konya(2004) have analyzed the effect of Exports on economic development. It is generally found that some degree of openness to foreign trade has a positive effect on economic development. It is not only due to the role that Exports may have to increase the demand but mainly to the role that Exports has to allow the increase of Imports and the net positive effect that an increase of Exports and Imports, usually has on economic development.

Note on the role of Exports in the econometric inter-sectoral model

In the models estimated by Guisan(2006) and (2007), and in other studies, production of services depends positively on the increase of Imports of intermediate goods and negatively on the increase of Exports. For a given level of equal increase of Imports and Exports the net result is generally positive because on average the positive effect of Imports more than compensate the negative effect of Exports from the supply side. The following equation show the result of the estimation of the effects of MH and XH in Philippines. Although the coefficient of XH is not significant its value its negative and the total effect of the same increase in exports and imports has a net positive effect on the evolution of real value-added of services per capita and on economic development.

Equation 1c. Sector services with other sectors, trade and AR(1)
Dependent Variable: D(QHS05PPPH)
Method: Least Squares. Sample(adjusted): 1992 2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QHA05PPPH)+D(QHEB05PPPH)	0.104392	0.083579	1.249024	0.2376
D(QHM05PPPH)	0.540284	0.168837	3.200028	0.0085
MH05TCPH	0.327100	0.112093	2.918116	0.0140
XH05TCPH	-0.194904	0.127601	-1.527444	0.1549
AR(1)	0.950547	0.106357	8.937320	0.0000

R-squared	0.857010	Mean dependent var	42.72199
Adjusted R-squared	0.805013	S.D. dependent var	26.96034
S.E. of regression	11.90496	Akaike info criterion	8.042095
Sum squared resid	1559.010	Schwarz criterion	8.283528
Log likelihood	-59.33676	Durbin-Watson stat	1.452039

Inverted AR Roots	.95