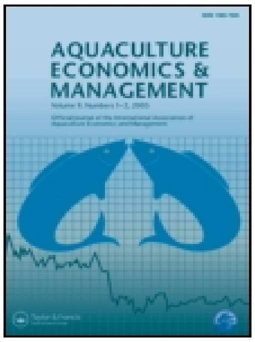

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THE EFFECTS OF EXPORT PRICES ON THE DEMAND AND SUPPLY FOR FISH IN THE PHILIPPINES

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□ *This paper describes the effects of changes in export prices on Philippine fish demand, supply, prices and trade. The analysis uses a multi-commodity-model of the fisheries sector that is based on the AsiaFish model. The results indicate that higher export prices lead to higher output and exports for the fisheries sector. However, such changes also cause a decline in the domestic consumption of fish.*

Keywords fish trade, supply & demand, AsiaFish model

INTRODUCTION

Understanding the effects of various factors on the international trade in fish is very important to the Philippine economy. One reason is that fisheries is a consistent source of foreign exchange for the country. Posting a trade surplus in fish since the 1980s, net exports of fish amounted to 156.6 million U.S. dollars in 2001 (Food & Agriculture Organization, 2002). This pattern takes special significance when taken in the context that the Philippines is a net food importer in which positive net exports can only be sustained for the fisheries sector (see Costales & Garcia, 2002).

As international trade in fish ultimately flows back to households and domestic fishers and fish farmers, such insights are also relevant in evaluating production and consumption. On the production side, fisheries contributed nearly 3.9% of GDP in 2001 (National Economic Development Authority, 2002). It also accounted for about 4.4% of total employment in the first quarter of 2004 (National Statistics Office, 2004). On the consumption side, fish and fish products are among the most important sources of animal protein. It accounted for about 46% of total household expenditures on meat products (National Statistics Office, 2000).

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Moreover, the share of fish in total meat expenditures is higher for poorer income groups.

This paper presents an analysis of the factors that affect international trade in fish in the Philippines. In particular, it uses a multicommodity model to evaluate the effects of changes in fish export prices on the domestic demand, supply and trade of different fish types.

The analysis is relevant to fisheries authorities in the country because export prices respond to changes in international fish prices and domestic macroeconomic interventions, e.g., exchange rate policy. While domestic fisheries authorities may not have a strong say in influencing such matters, the simulation results in this paper at least allows them to identify the winners and losers from export price changes. This in turn allows them to formulate appropriate measures within the fisheries sector in order to enhance the gains or soften the impact of losses on the various stakeholders. To the extent that the fisheries authorities can influence international prices and domestic macroeconomic policies, the results from this paper may be used to support their advocacies. For example, changes in export prices could be the result of the changes in the trade policies of Philippine export markets. In this regard, the results from study might be used by the fisheries authorities in presenting their case in multilateral trade negotiations.

The rest of the paper is organized as follows. The next two sections describe the basic structure and empirics of the model. This is followed by a discussion of the simulation results from the export price changes. The final section presents the policy implications and limitations of the analysis.

THE BASIC STRUCTURE OF THE MODEL

The fisheries supply and demand model of the Philippines follows the specification of the AsiaFish model (Dey et al., 2005, this issue). As such, this section begins by describing the structure of the model. However, the discussion will be limited to an overview of the model and the interested reader is simply encouraged to consult the original paper (i.e., Dey et al., 2005, this issue) for the details. The rest of the section describes how the AsiaFish model is adapted to Philippine data. In particular, it explains the disaggregation of the Philippine model.

The AsiaFish Model

The AsiaFish model is designed for generating detailed results on supply, demand, trade, and prices for the fisheries sector. It is a partial equilibrium model that assumes that the quantities and prices of nonfish commodities are determined outside of the system. Despite this assumption however, the model is flexible enough to evaluate the effects on the fisheries sector of changes in the environment for nonfish commodities and various socioeconomic variables.

The general structure of the model is as follows. The domestic supply of a particular fish type is sourced from domestic and foreign agents (imports). This is then allocated among households (consumption), firms (intermediate demand) and foreign agents (exports). The prices of fish types in the domestic market are derived by a series of equilibrium conditions. This means that domestic prices are determined through the interaction of supply and demand. In instances where the fish categories in the supply and demand sides do not match, the model also has a set of linking equations that facilitate the disaggregation of the relatively aggregated categories to satisfy the equilibrium conditions.

This model is divided into producer, consumer and trade cores. The producer core distinguishes between fresh and processed fish output. It also recognizes that fresh fish can come from different domestic sources. For example, tilapia might be sourced from capture fisheries or aquaculture.

In the case of fresh fish, it is assumed that output supplies and input demands are determined jointly within each domestic source. This results in a series of equations in which the dependent variables are determined simultaneously by fish prices, input prices, and technology. Where necessary, the equations may also be adjusted for non-price determinants of output supply and input demand.

In the case of processed fish, the model assumes that a fixed ratio of fresh fish output is allocated for intermediate use. These then serve as inputs in the production of processed fish. The conversion of inputs to outputs is assumed to follow a fixed proportions technology.

The consumer core describes the behavior of households. The model is flexible enough to accommodate household demands disaggregated by region and/or income class. Each region/income class has a representative household that determines how much fish to consume.

The decision process of each representative household is specified as a three-stage budgeting framework. The first stage is represented by an equation that determines the demand for food. It assumes that food expenditures depend on the prices of food and nonfood products, income, and other socioeconomic factors. The second stage determines the representative household's demand for fish as a whole. It specifies fish expenditure as being dependent on aggregate fish prices, prices of nonfish food prices, real food expenditure, and other socioeconomic factors.

The final stage captures the demands for the different types of fish. This is formulated as a Quadratic Almost Ideal Demand System (QUAIDS) in which the expenditure shares of the different fish types are expressed as a function of fish prices, real fish expenditure, and other socioeconomic variables.

The trade core of the model is composed of a series of export supply and import demand equations.[1] It follows the tradition of Applied General Equilibrium (AGE) models which impose the Armington assumption, i.e., domestic and foreign goods (fish types) are treated as differentiated products. The equations suggest that the export supply of a particular fish type is a function of its (a) price in foreign markets relative to domestic markets, and (b) domestic output. On the other hand, the import demand for a particular fish type depends on (a) the price of imports relative to domestic goods, and (b) domestic demand.

The Disaggregation of the Philippine Model

The demand side of the model separates the Philippines into rural and urban regions. Each region is assumed to have a representative household that earns income and purchases goods and services.

Following the three staged budgeting framework of the model, the first stage specifies household spending on food (see Figure 1). In the second stage, food products are explicitly disaggregated into fish, cereals, beverages, (other) meat, and fruits & vegetables. Food items which are not explicitly specified in the model are lumped together in an item called Ofood.

In the third stage, households are assumed to consume nine types of fish. These are anchovies, roundscad, squid, shells, milkfish,

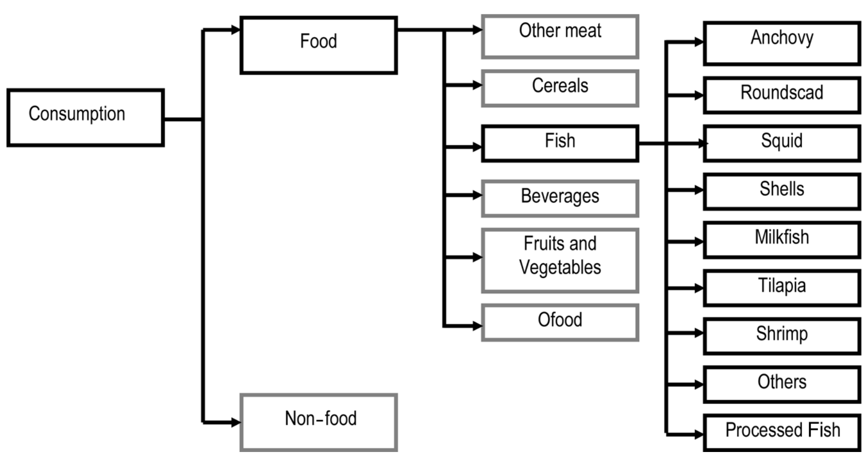

FIGURE 1 Three-stage budgeting framework for the Philippine model.

tilapia, shrimp, processed fish, and other fish. The last fish type represents the residual fish consumption that is not captured in the model disaggregation.

Adhering to the standard manner in which Philippine fisheries production data is presented, the supply side of the model identifies commercial fisheries, municipal fisheries, and aquaculture as the three domestic sources of fresh fish. Aquaculture represents all types of fish farming (e.g., fishponds, fish cages, etc.) in different environments (freshwater, brackish water, and marine). On the other hand, the other sources represent capture fisheries. These are distinguished primarily by the size of the vessels that capture the fish and the location wherein fish is caught. "Commercial fisheries" refer to the catch/harvest of operations beyond 15 kilometers from the shore using boats weighing more than 3 gross tons (Bureau of Agricultural Statistics, 2002). It follows naturally that "municipal fisheries" refer to the catch of boats that weight 3 gross tons or less and within 15 kilometers from the shore.

As noted in the previous section, each of these sources is made up of different fish types. Commercial fisheries are the source of grouper, tuna, anchovies, roundscad, squid, shrimp, other shells, and other capture fish. On the other hand, Municipal Fisheries are the source of anchovies, carp, catfish, grouper, milkfish, other capture fish, other shells, roundscad, shrimp, squid, tilapia, and tuna. Finally, aquaculture is assumed to produce carp, catfish, milkfish, mussels and oysters, other aquaculture fish, other shells, shrimp, and tilapia. Such a disaggregation reflects a special feature of the fisheries sector. It shows that a particular fish type can be produced or harvested from different sources. For example, shrimp and other shells appear in all sources. Tilapia and milkfish, on the other hand, are sourced from aquaculture and municipal fishing.

The fact that fish can come from different sources introduces a modeling problem. It raises the question of whether a fish type from a particular source is perceived to be same as its counterpart coming from another source. For example, are consumers indifferent between grouper from municipal fishing and grouper from commercial fishing? If the answer is yes, then the outputs of grouper from the different sources can be added to form a fish type called grouper. If not, then grouper from municipal fishing and commercial fishing should be treated as separate fish types.

In the Philippine model, fish types coming from different sources are modeled as perfect substitutes. This means that consumers are indifferent among the sources of fish species. While such an approach exposes the model to the risk of oversimplifying the supply side, the benefits from doing so appear to outweigh the potential costs. The reasons are as follows. First, demand side data in the Philippines is generally more aggregated than supply side data. And while the model has the facility to address this issue, it becomes extremely complicated for certain fish types. Grouper for example does not appear as a separate fish type in the demand data of the Philippines. It is actually combined with other fish species in the fish type called "other fish." Hence, disaggregating grouper by origin requires two layers of equations. It therefore adds complexity into what is already a complicated model. Second, the output from one source is sometimes too small to warrant its explicit treatment. For example, the output of milkfish from municipal fisheries is less than one-hundredth of the output of its counterpart from aquaculture.

Figure 2 shows that there are 9 and 15 fish types in the demand and supply sides of the model, respectively. It highlights the relatively aggregated demand-side data for the Philippines. A closer inspection reveals that two fish types in the demand side are actually composites of the eight fish types in the supply side. The fish type shells in the demand side is a composite of mussels and Oysters and Other Shells in the supply side. On the other hand, the fish type Other fish in demand is a composite of other capture, other aquaculture, carp, catfish, grouper, and tuna in the supply side.

As mentioned earlier, the mismatch in the fish types of the supply and demand sides is handled by a series of equations that allow the composites to be disaggregated into their components (for more details, see Dey et al., 2005). This facilitates equilibrium conditions to be imposed for the 15 fish types in the model.

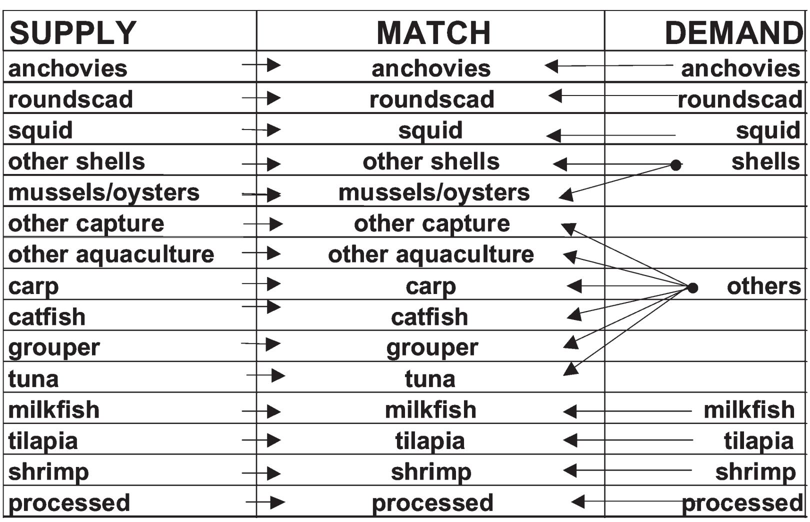

FIGURE 2 Disaggregation of the Philippine model.

EMPIRICAL MODEL

The fish supply and demand model of the Philippines needs a substantial amount of data. It also requires the information to be consistent, adhering to basic accounting identities deemed relevant to fisheries and any other commodity. Aside from data, the model also needs parameters for its behavioral equations. This section describes the process by which these data and parameters were assembled. It also explains how information from different sources were adjusted to ensure a consistent data set.

The Data Set

In the Philippine model, the base data set was assembled for the year 2000. The choice of the year was determined primarily by the availability of detailed consumption data.

In constructing the data set, the objective was to organize the information for each fish type in to a balance sheet. Such a balance sheet clearly indicates the sources and destination of output.

Each balance sheet assumes that the total supply of each fish type (S) is equal to imports (M) and the sum of outputs from *Commercial Fishing* (Q_{CF}), *Municipal Fishing* (Q_{MF}) and *Aquaculture* (Q_A). That is, $S = M + Q_{CF} + Q_{MF} + Q_A$. On the other total demand (D) is the sum of exports (X), intermediate demand (ID), rural household demand (HD_R) and urban household demand (HD_U). In other words, $D = X + ID + HD_R + HD_U$. In the end, it must be the case that $S = D$ *or* $M + Q_{CF} + Q_{MF} + Q_A = X + ID + HD_R + HD_U$.

The construction of the data set requires making adjustments to the raw data because of two reasons. First, there is no single source for all the data needed in the model.[2] For example, consumption data was obtained from the National Statistics Office while production data was taken from the Bureau of Agricultural Research. Second, some of the raw data had to be transformed in order to suit the requirements of the model. For example, consumption data from the National Statistics Office is based on survey information. As this does not constitute information for the entire country, the approach adopted was to compute per capita consumption for each fish type. This was then multiplied with regional and national population data in order to compute their respective levels of consumption. Combined, it is therefore optimistic to expect that the balance sheet identities will hold.

The basic principle in adjusting the data was to retain as much as possible the original values for which relatively reliable or at least model consistent data was available. In this regard, the absence of data on intermediate demand made it a logical candidate for making adjustments.

Intermediate demand was calculated as a residual. That is, a value for this variable was chosen to ensure that $S = D$. In instances wherein the computed intermediate demand is negative, its value was set to zero and consumption data was adjusted to ensure that the balance sheet identity holds.

Table 1 shows a summary balance sheet for the different fresh fish types in the model. It identifies supply by source (aquaculture, commercial fishing, municipal fishing, and imports) and demand by destination (exports, rural household consumption, urban household consumption, and intermediate demand). Moreover, the balance sheets were constructed for the quantities (in million kilograms) and values (in million pesos).[3]

The Parameters of the Model

The model requires parameters for the behavioral equations of its producer, consumer and trade cores. The original objective of the modeling exercise was to estimate the relevant elasticities and response parameters for the consumer and producer cores and to borrow elasticities for the trade core. Once obtained, these elasticities will be transformed to suit the specification of the equations in Dey et al. (2005).[4] The intercept terms of all the relevant equations will then be calibrated to ensure that the model replicates the base data set. All the parameters and elasticity estimates used in the production and consumer cores of model are presented in Appendix 2.

The estimates of the demand side parameters were derived using the data from the Family Income and Expenditure Survey (National Statistics Office, 2000).[5] For each region, the process begins by estimating food and fish expenditure functions. Using prices and quantities of the individual fish types and the fitted values from fish expenditure function, the next step in the process is to estimate the parameters of the QUAIDS system. In general, the own price and income elasticities for food, fish and the various fish types showed the expected signs and magnitudes.

The parameter estimates for supply functions on the producer side of the model were unsatisfactory. The parameters either had questionable signs or were not statistically significant. To overcome this problem, the approach adopted was to consult the literature and experts for plausible values of the elasticities. In general, the selected values reflect two patterns of the price elasticities that were either estimated or used in other modeling exercises.[6] The first is that the own price elasticities of fish tend to be quite small, i.e., inelastic. The other is that price elasticities for fish types in aquaculture tend to be higher than their counterparts in capture fisheries.

For the trade core, the relevant parameters needed are the (a) elasticity of transformation between goods destined for domestic and foreign (exports) markets, and (b) elasticity of substitution between fish types

TABLE 1 Balance Sheet for Fresh Fish Types in the Model, 2000

Items	Milkfish	Roundscad	Squid	Tilapia	Anchovy	Shrimp	Shells	Others	Total
Values (m Php)									
Production									
Aquaculture	11,844.18	0.00	0.00	4,328.07	0.00	11,874.71	517.43	559.66	29,124.05
Commercial fisheries	0.00	9,370.97	1,111.08	0.00	1,370.94	2,596.90	88.63	16,626.34	31,164.86
Municipal fisheries	9.19	1,249.47	2,467.91	1,349.86	1,475.83	3,644.60	7,415.27	17,697.26	35,309.39
Imports	0.01	0.00	319.41	0.00	0.00	0.37	7.16	1,866.59	2,193.54
Exports	9.96	352.86	349.98	0.12	0.00	5,829.07	908.32	3,820.56	11,270.86
Household demand									
Rural	2,467.68	3,263.96	503.02	1,607.18	922.91	1,007.93	297.91	3,402.81	13,473.41
Urban	9,051.33	6,627.31	1,303.40	4,070.63	1,263.87	4,448.09	591.16	3,829.79	31,185.59
Intermediate demand	324.42	376.32	1,741.99	0.00	659.99	6,831.50	6,231.09	25,696.68	41,861.99
Balance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Quantities (m kg)									
Production									
Aquaculture	209.99	0.00	0.00	92.58	0.00	41.48	36.15	13.66	393.86
Commercial fisheries	0.00	225.86	14.52	0.00	38.35	9.07	1.44	657.24	946.49
Municipal fisheries	0.16	30.12	32.26	28.87	41.28	12.73	120.65	679.87	945.95
Imports	0.00	0.00	17.62	0.00	0.00	0.01	0.07	135.26	152.96
Exports	0.09	4.55	1.60	0.00	0.00	12.06	5.30	54.09	77.69
Household demand									
Rural	43.77	79.93	10.70	34.38	25.82	4.20	6.71	165.08	370.58
Urban	160.54	162.29	27.72	87.07	35.35	18.55	13.31	185.79	690.63
Intermediate demand	5.75	9.22	24.37	0.00	18.46	28.48	133.00	1,081.07	1,300.36
Balance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

sourced from domestic and foreign (imports) producers. As no attempt was made to estimate these elasticities, the values used in the model were borrowed from the Applied General Equilibrium model of Cororaton (2000). Hence, all the simulations of the model assume elasticities of substitution and transformation of 1.10 and 1.50, respectively.

Solving the Model

Given its current level of disaggregation, the Philippine supply and demand model for fisheries has 419 equations. This is still quite small as many of more comprehensive applied general equilibrium models easily have thousands of equations.[7]

Using the values of the exogenous variables, and with the actual values of the endogenous variables serving as initial values, the model is solved using the Minos option of the Generalized Algebraic Modeling System (GAMS) software. The base year in the model is 2000.

SIMULATION RESULTS

This section presents simulation results using the Philippine version of the AsiaFish model. In particular, it describes the effects of an increase in the export prices of fish on aggregate fish output, consumption and trade. With a view towards explaining the aggregate results and presenting a disaggregated analysis, this section also discusses the effects on selected fish types.

Since the intent of this paper is to show the direction of the responses of key variables, the experiment was deliberately kept simple. It confines the analysis to an across-the board one percent increase in export prices. Moreover, the experiment was only conducted for one period only.

Aggregate Results

Table 2 shows the aggregate results from the experiment. It shows that higher export prices tend to raise exports and output. Such results arise because higher export prices raise the incentive to sell to foreign markets which, other things held constant, provides a stimulus to produce/harvest more fish.

The results also indicate that, on the basis of aggregate quantities, the expansion in the output of fresh fish is likely to come from capture fisheries (i.e., municipal fisheries and commercial fisheries). In fact, the output of *aquaculture*, as a whole, is unlikely to be affected by the change. Table 2 also shows that the revenues from all the sources of fish are likely to increase. The largest increase here is for municipal fishing at 0.36%. The

TABLE 2 Aggregate Results for the Experiment

	Baseline		Effect*	
	Quantities (m kg)	Values (m Php)	Quantities	Values
Output	2,633.17	10,7542.17	0.04	0.36
Imports	154.27	2,270.56	−0.19	−0.18
Exports	131.60	15,828.09	0.61	1.69
Household demand	1,355.48	52,122.65	−0.17	−0.14
Rural	499.88	16,752.95	−0.13	−0.09
Urban	855.60	35,369.70	−0.19	−0.16
Intermediate demand	1,300.36	41,861.99	0.05	0.29
Memo:				
Fresh fish output	2,286.29	95,598.30	0.04	0.33
Aquaculture	393.86	29,124.05	0.00	0.33
Commercial	946.49	31,164.86	0.04	0.30
Municipal	945.95	35,309.39	0.04	0.36

Note: *The values are expressed in percent deviations from the baseline.

proportionately large response of the values relative to quantities suggests that fish prices as whole are higher.

Table 2 also indicates that the quantity of fish consumed by households is likely to decline by 0.17%. This implies that an increase in export prices tends to reallocate the additional and existing output away from households and into foreign markets. Moreover, the regional results indicate that the decline applies to both rural and urban households.

The difference between the percentage changes in the value (−0.14%) and quantity (−0.17%) of household consumption suggests that the consumer price of fish as a whole has risen by about 0.03%. This is not a surprising result. The reason is that the induced increase in exports, ceteris paribus, means that fewer goods are available for the domestic market. This in turn creates an excess demand for goods in the domestic market. As a result, domestic prices increase.

As expected, higher export prices induce an increase in the quantity and value of total fish exports. This however leads to a decline in the quantity and value of imports. Combined, this implies that the increase in export prices leads to higher (net) foreign exchange earnings from trade in fish.

Disaggregated Results

Table 3 shows the effects of higher export prices on quantities of output (*qscat*) and producer prices (*pp*) of fish types. It indicates that the increase in export prices have mixed effects on the outputs of individual fish types. It shows that the outputs of shrimp (0.22%), tuna (0.20%), and other shells (0.15%) are likely to experience the largest increases. In contrast, the outputs of carp (−0.13%), mussels & oysters (−0.11%), and other

TABLE 3 Effects of a 1% Change in Export Prices on Output, by Fish Type

	Baseline*		Effect (% deviation from control)	
	Output	Price	Output	Price
Total of which,	2,286.29	na	0.04	na
Anchovy	79.6	35.8	−0.01	−0.01
Carp	15.7	26.2	−0.13	−0.22
Catfish	3.1	58.6	−0.12	−0.25
Grouper	12.5	201.3	0.05	0.19
Milkfish	210.2	56.4	−0.02	−0.03
Mussels & oysters	31.2	6.8	−0.11	−0.10
Other aquaculture fish	2.0	109.9	−0.14	−0.22
Other capture fish	1,086.9	19.1	0.00	0.00
Other shells	127.1	56.7	0.15	0.36
Roundscad	256.0	40.8	0.02	0.05
Shrimp	63.3	239.8	0.22	0.32
Squid	46.8	71.5	0.09	0.20
Tilapia	121.5	46.7	−0.02	−0.03
Tuna	230.5	44.7	0.20	0.40

Note: *Baseline values for variables expressed in "quantities" are in million kilograms while those expressed in "prices" are in pesos per kilo.

aquaculture Fish (−0.14%) are expected to decline. By virtue of its relatively initial large share in total output, the 0.20% expansion in the output of tuna has the biggest contribution to the expansion in the total fish output.

As input prices and technology are held constant in the experiment, the responses in the output of the fish types may be explained exclusively by changes in producer prices. Table 3 shows this as higher producer prices concurred with higher outputs. For example, the increase in the producer price of tuna coincides with the increase in its output. The same case, only in the reverse direction, can also be made for the decline in the outputs of carp, mussels & oysters, and other aquaculture Fish. This result suggests that the increases in the prices of other fish types either complement or are unable to offset the increase in the price of Tuna.[8]

The aggregate results indicate that total fish consumption declined by 0.17%. Table 4 supports this finding by showing that the decline in consumption occurs for all fish types. It registers the largest declines for processed fish (−0.35%) and shells (−0.34%). It also suggests that by virtue of their relatively large initial shares in total consumption, processed fish and other fish contribute the most to the decline in total consumption.

In identifying the link between prices and demand for fish types, it is instructive to examine the regional responses for per capita fish consumption. Table 5 shows that the consumer price of every fish type in the rural region changes by the same proportion as its counterpart in the urban region. This is explained by the assumption that marketing margins are

TABLE 4 Effects of a 1% Change in Export Prices on Fish Consumption, by Fish Type

	Baseline (in m kg)	Effect (% deviation from the base)
Total of which,	1,355.48	−0.17
Anchovy	61.17	−0.01
Milkfish	204.31	−0.02
Other fish	350.87	−0.26
Processed fish	294.28	−0.35
Roundscad	242.21	−0.03
Shells	20.01	−0.34
Shrimp	22.75	−0.31
Squid	38.42	−0.10
Tilapia	121.45	−0.02

kept constant in the experiment. Despite the similarity in the responses of consumer prices however, the responses of the demands for specific fish types differ across regions. For example, Table 5 shows that the consumer price of milkfish went down by 0.03% for both regions. However, per capita

TABLE 5 Effects of a 1% Change in Export Prices on Per Capita Fish Consumption, by Fish Type and Region

	Baseline*		Effect (% deviation from the base)	
	Quantity	Price	Quantity	Price
Rural				
Total	11.02	nc	−0.13	nc
Anchovy	0.57	49.00	0.00	−0.01
Milkfish	0.97	81.00	0.10	−0.03
Other fish	3.64	65.00	−0.16	0.04
Processed fish	2.85	59.00	−0.28	0.31
Roundscad	1.76	53.00	0.00	0.05
Shells	0.15	92.00	−0.68	0.34
Shrimp	0.09	225.00	0.00	0.32
Squid	0.24	84.00	0.00	0.16
Tilapia	0.76	110.43	0.00	−0.03
Urban				
Total	27.47	nc	−0.19	nc
Anchovy	1.14	51.00	0.00	−0.01
Milkfish	5.15	82.00	−0.04	−0.03
Other fish	5.96	76.00	−0.35	0.04
Processed fish	5.30	64.00	−0.38	0.31
Roundscad	5.21	58.00	−0.06	0.04
Shells	0.43	97.00	−0.23	0.34
Shrimp	0.60	201.00	−0.34	0.32
Squid	0.89	91.00	−0.11	0.16
Tilapia	2.80	110.43	−0.04	−0.03

Note: *Baseline values for variables expressed in "quantities" are in million kilograms while those expressed in "prices" are in pesos per kilo.

milkfish consumption rose by 0.10% in the rural region and declined by 0.04% in the urban region. The response in the rural region is consistent with the conventional theory of demand as a lower price tends to raise quantity demanded. At first glance, the same cannot be said however about consumption in the urban region. However, this does indicate a failure of conventional theory. It merely highlights the role of other factors in explaining the demand for milkfish.

The different responses across regions can be explained by two factors. First, estimated price elasticities in the demand for fish are different across regions. Second, differences in the parameters for Stages 1 and 2 of the demand side suggest potential differences in the response of real fish expenditure.

In the experiment, per capita fish expenditure declined at different rates for the urban (−0.11%) and rural (−0.02%) regions. This demonstrates the second point made in the previous paragraph. In addition, the increase in aggregate fish prices suggests that per capita real fish expenditure has fallen by more than the values reported here. Based on the estimated elasticities in the demand side of the model, this exerts downward pressure on the demand for all fish types.

Going back to the case of milkfish, the decline in real fish expenditure creates pressure for a decline in per capita consumption of fish. This is contrary to the upward pressure created by the decline in the consumer price of milkfish. Ignoring cross price effects, the results suggest that the impact of the declining expenditure is stronger than the impact of the declining consumer price in the milkfish consumption of urban households.[9]

The differences in demand responses across regions make it necessary to explain the results in the aggregate. In the case of milkfish, the aggregate results show that its total consumption went down by 0.02%. This suggests that the impact of the decline in the per capita consumption of fish in the urban region dominates that of the increase in the rural region. Why?

In the case of milkfish, per capita fish consumption in the urban region is about 5.15 kilograms (see Table 5). This is more than five times larger than the per capita consumption in the rural region (0.97 kilograms). Multiplying per capita consumption by the population, the urban region consumes about 160.55 million kilograms of fish. This is close to four times larger than the rural region (43.75 million kilograms). Hence, the 0.04% decline in urban per capita consumption is likely to have a relatively large impact on the total.

Table 6 shows the detailed effects on trade of fishery products. It indicates an across the board increase in the quantity of fish exports. Among the different fish types, exports of milkfish (1.56%), other fish (1.25%), and roundscad (1.41%) expanded the most. However, the most influential fish type in explaining the expansion in total exports is

TABLE 6 Effects of a 1% Increase in Export Prices on Trade, by Fish Type

	Baseline (in m kg)		Effects (% deviation from the base)			
	Exports	Imports	Exports	Imports	RPM*	RPX*
Total	131.60	154.27	0.61	−0.19	nc	nc
Carp	0.00	0.00	0.00	0.00	0.22	1.22
Catfish	0.00	na	0.00	na	0.25	1.25
Grouper	6.64	na	0.87	na	−0.19	0.55
Milkfish	0.09	0.00	1.56	0.00	0.03	1.03
Mussels & oysters	0.00	0.05	0.00	−0.20	0.09	1.10
Other shells	5.30	0.02	0.61	0.00	−0.35	0.31
Other fish	5.38	100.78	1.25	−0.24	0.00	0.83
Processed fish	53.91	1.31	0.68	−0.01	−0.31	0.43
Roundscad	4.55	0.00	1.41	0.00	−0.05	0.92
Shrimp	12.06	0.01	0.71	0.00	−0.32	0.33
Squid	1.60	17.62	1.07	0.08	−0.16	0.65
Tilapia	0.00	0.00	0.00	0.00	0.03	1.03
Tuna	42.07	34.48	0.26	−0.20	−0.08	0.04

Note: *RPM represents is the relative price of imports. It is the ratio of the import price (pm) to the composite price (parm). On the other hand, RPX is the relative price of exports. It is the ratio of the export price (px) to the composite price (parx).

processed fish. This is so because of the sizeable amount of its initial exports relative to the total.

In all cases, the expansion in exports is strongly influenced by the higher relative price of exports (*RPM*). The increase in *RPM* suggests that the price received from selling in foreign markets has increased relative to selling the good in the domestic market. It therefore offers a greater incentive to export.

The direction of change in imports across fish types is mixed, with quantities rising for some and falling for others. However, total imports are lower because the top two fish types that are imported (other fish and tuna) experienced relatively large contractions.

Relative prices also play a big role in explaining the pattern of change in imports. Other things held constant, an increase in the relative price of imports encourages substitution in favor of domestically produced or harvested fish. As such, imports are likely to decline. This assertion holds in majority of the fish types. For example, the higher relative price of imports for mussels & oysters explains the decline in its imports. There are however a few notable exceptions.

Take the case of processed fish. For this fish type, the relative price and quantity of imports fell by 0.31% and 0.01%, respectively. This result is inconsistent with the previous assertion that relative prices are inversely related to the quantity of imports. However, it does not mean that the relationship is invalid. It only suggests that there is another factor that dominates the impact of the change in the relative price. On closer inspection, it is the decrease in the total consumption demand for Processed fish (shown to be -0.35% in Table 4) that explains the behavior of its imports. The logic behind this argument is that lower consumption, ignoring changes in relative prices, tends to reduce the demand for fish that is sourced locally and overseas. Hence, it exerts downward pressure on the demand for imports. What the decline in the imports of processed fish therefore implies is that the downward pressure caused by the decline in total consumption is stronger than the upward pressure created by the decline in the relative price of imports.

CONCLUDING REMARKS

This paper examined the effects of higher fish export prices on the fisheries sector using the Philippine version of the AsiaFish model. The simulation results show that such a change is beneficial as a whole to fishers and fish farmers by way of higher production and revenues. Moreover, higher export prices also benefit the entire country in terms of foreign exchange earnings. This is reflected by the expansion of fish exports vis-à-vis imports.

While the simulation results suggest that higher export prices are as whole beneficial to the sector and the country, such changes are not free of costs. One such cost is the decline in the output and revenues of certain fish types, notably other aquaculture fish, carp, and catfish. Another potential cost is the decline in consumer welfare that is associated with lower fish consumption. Finally, the expansion in the output of capture fisheries also raises environmental concerns. This stems from well documented findings of overfishing in Philippine waters (see Israel & Roque, 1999; Costales & Garcia, 2002).

Being a small player in the global markets, the Philippines has very little control over the international prices of the fish that it exports. Despite this, the simulation results in this paper have important policy implications for the Philippine fishery authorities. First, its potential to hurt certain stakeholders in the fisheries sectors (i.e., producers of the contracting fish types and consumers) suggests that the fishery authorities may have to institute safety nets in order to ease the burden of higher export prices. Second, to the extent that the export prices incorporate trade distorting policies of the markets for Philippine fish products, the results in this paper suggest that local authorities should strengthen their resolve for the reduction, if not the removal, of such barriers. A possible venue for such actions might be the multilateral trade negotiations that take place in the World Trade Organization.

In concluding this paper, it is important to note two shortcomings of the analysis. First, the model used in the analysis is confined to the fisheries sector only. It therefore ignores how the changes in the sector, particularly in fish prices, affect other sectors of the economy. As a consequence, it also fails to account for the feedback effects of the responses of other sectors. Second, the model assumes that household incomes are exogenously determined. As such, it does not incorporate how the higher revenues of fishers and fish farmers as a whole lead to higher household income. Given that demand for fish as a whole is positively related to income, this implies that the effects on fish consumption in the model tend to be underestimated.

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NOTES

1. The need for explicit export demand and import supply equations is eliminated by the assumption that each country is a small open economy.
2. A detailed listing of the data sources is available from the authors upon request.
3. Owing to the special nature of *Processed Fish*, *Shells* and *Others*, the detailed balance sheets for these fish types are shown in Appendix 1.
4. The additional process of recomputing the parameters again recognizes the differences between the sample data used in estimation and the aggregate data used in the model.
5. For a discussion of the estimation procedure, see Garcia et al. (2004).
6. The papers consulted for this exercise are Kumar (2004), Delgado et al. (2003), Alam et al. (2002), Estrada & Bantilan (2001), Dey (2000), and Squires (1987).
7. See the models of Clarete & Warr (1991), Cororaton (2000), Horridge et al. (2002), Inocencio et al. (2001), Cororaton & Cuenca (2000), and Bautista (1997).
8. Recall that the output of a particular fish type depends on its own price, prices of other fish and socioeconomic factors.
9. In the case of *Milkfish*, the *cross price effects* strengthen or weaken the effect of the decline in fish expenditure vis-à-vis the decline in its consumer price. The strength of its influence is not discussed here because it does not appear to seriously alter the theme of the discussion. However, it does not rule out the possibility that the *cross-price effects* are the dominant factors in explaining the results for the other fish types.

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APPENDICES

APPENDIX 1: BALANCE SHEETS FOR PROCESSED FISH AND DEMAND COMPOSITES

	Value (m Php)			Quantity (m kg)		
Item	Processed fish	Shells	Others	Processed fish	Shells	Others
Production						
Processed fish	11,943.9			346.9		
Aquaculture						
Mussels & oysters		212.1			31.2	
Other shells		305.3			4.9	
Other aquaculture			224.6			2.0
Carp			280.3			10.7
Catfish			54.8			0.9
Municipal fisheries						
Other shells		7415.3			120.7	
Other capture			10,977.6			557.1
Carp			132.0			5.0
Catfish			128.9			2.2
Grouper			1,499.5			10.9
Tuna			4,959.2			104.7
Commercial fisheries						
Other shells		88.6			1.4	
Other capture			10,439.1			529.8
Grouper			226.8			1.6
Tuna			5,960.4			125.8
Imports						
Processed fish	77.0			1.3		
Mussels & oysters		3.2			0.1	
Other shells		3.9			0.0	
Other capture			1,167.7			100.8
Other aquaculture			0.0			0.0
Carp			0.0			0.0
Catfish			0.0			0.0
Grouper			0.0			0.0
Tuna			698.9			34.5
Export						
Processed fish	4,557.2			53.9		
Mussels & oysters		0.0			0.0	
Other shells		908.3			5.3	
Other capture			777.1			5.4
Other aquaculture			0.0			0.0
Carp			0.1			0.0
Catfish			0.1			0.0
Grouper			549.0			6.6
Tuna			2,494.3			42.1
Consumption demand						
Urban	4,184.1	297.9	3,829.8	165.0	6.7	185.8
Rural	3,279.5	591.2	3,402.8	129.3	13.3	165.1
Intermediate demand						
Mussels & oysters		178.2			26.2	
Other shells		6,052.8			106.8	
Other capture			16,791.6			879.9
Other aquaculture			179.7			1.6
Carp			329.9			12.6
Catfish			147.0			2.5
Grouper			0.0			0.0
Tuna			8,248.4			184.5
Balance	0.0	0.0	0.0	0.0	0.0	0.0

APPENDIX 2: SUPPLY AND DEMAND PARAMETERS OF THE MODEL

A. DEMAND-SIDE PARAMETERS

A1. Estimating Equations

Stage 1:

$$\begin{aligned}\ln\ \mathrm{FDEX_i} &= \beta_0 + \beta_1 \cdot \ln\ \mathrm{PFD_i} + \beta_2 \cdot \ln\ \mathrm{PFDN_i} + \beta_3 \cdot \ln\ \mathrm{Y_i} + \beta_4 \cdot (\ln\ \mathrm{Y_i})^2 \\ &\quad + \beta_5 \cdot \mathrm{HS_i} + \beta_6 \cdot \mathrm{Children_i} + \mathrm{e_i}\end{aligned}$$

where: *FDEX* = food expenditure, *PFD* = price of food, *PFDN* = expenditures on nonfood commodities, *Y* = income, *HS* = household side, *Children* = number of children in the household

Stage 2:

$$\begin{aligned}\ln \mathrm{FEX_i} &= \theta_0 + \theta_1 \cdot \ln\ \mathrm{PF_i} + \sum\nolimits_j \theta_{2j} \cdot \ln\ \mathrm{PFN_{ij}} + \theta_3 \cdot \ln\ \mathrm{FDEX_i} \\ &\quad + \theta_4 \cdot (\ln\ \mathrm{FDEX_i})^2 + \theta_5 \cdot \mathrm{HS} + \theta_6 \cdot \mathrm{Children} + \mathrm{e_i}\end{aligned}$$

where: *FEX* = fish expenditure, *PF* = price of fish, *PFN* = price of non-fish food commodities, *j* = {meat, cereal, fruits & vegetables, beverages, other food}

Stage 3:

$$\mathrm{SH_i} = \gamma 0_i + \sum\nolimits_k \gamma_{ik} * \ln\ \mathrm{PC_{ij}} + \gamma 1_i * (\ln \mathrm{FEX_j}) + \gamma 2_i * (\ln\ \mathrm{FEX_j} - \mathrm{STONE_j})^2$$

where: *SH* = share in fish expenditure, *PC* = consumer price of fish, *FEX* = fish expenditure, *STONE* = Stone price index of fish (in logs), *j* = {anchovy, milkfish, roundscad, tilapia, shrimp, shells, other fish, processed fish}

TABLE A.2 Parameter Estimates of Stages 1 and 2 for the Rural and Urban Regions

Coefficient	Rural	Urban
Stage 1		
β_0	−8.890	−1.410
β_1	−0.750	−0.870
β_2	−0.200	−0.190
β_3	3.780	2.300
β_4	−0.150	−0.070
β_5	−0.020	−0.030
β_6	0.000	0.090
Stage 2		
θ_0	2.590	−6.920
θ_1	0.030	−0.380
θ_2		
Meat	−0.540	−0.550
Cereal	−0.100	0.120
Fruits & vegetables	0.120	0.080
Beverage	−0.300	−0.120
Other food	0.120	0.090
θ_3	1.120	3.130
θ_4	−0.020	−0.130
θ_5	−0.030	−0.030
θ_6	−0.210	−0.110

TABLE A.3 Parameter Estimates of Stage 3 for the Rural Region

		γ_{ik}										
Coefficient	$\gamma 0_{ij}$	Anchovy	Milkfish	Roundscad	Tilapia	Shrimp	Squid	Shells	Others	Processed	$\gamma 1$	$\gamma 2$
Anchovy	0.1310	−0.0302	0.0283	−0.0346	0.0182	−0.0088	−0.0157	0.0076	−0.0194	0.0547	−0.0081	−0.0003
Milkfish	0.3236	0.0283	−0.0142	0.0072	0.0387	0.0016	−0.0200	0.0114	0.0075	−0.0606	−0.0286	−0.0011
Roundscad	0.3554	−0.0346	0.0072	−0.0989	0.0332	0.0093	−0.0046	−0.0135	0.0163	0.0855	−0.0377	−0.0015
Tilapia	0.3510	0.0182	0.0387	0.0332	−0.0427	−0.0002	0.0337	−0.0009	−0.0147	−0.0654	−0.0392	−0.0016
Shrimp	0.0767	−0.0088	0.0016	0.0093	−0.0002	0.0000	0.0078	0.0102	0.0033	−0.0232	0.0067	0.0003
Squid	0.0956	−0.0157	−0.0200	−0.0046	0.0337	0.0078	−0.0117	0.0101	−0.0121	0.0125	0.0054	0.0002
Shells	−0.4421	0.0076	0.0114	−0.0135	−0.0009	0.0102	0.0101	0.0027	0.0102	−0.0377	0.0061	0.0002
Others	−0.4900	−0.0194	0.0075	0.0163	−0.0147	0.0033	−0.0121	0.0102	−0.0072	0.0160	0.1409	0.0056
Processed	0.5988	0.0547	−0.0606	0.0855	−0.0654	−0.0232	0.0125	−0.0377	0.0160	0.0182	−0.0455	−0.0018

TABLE A.4 Parameter Estimates of Stage 3 for the Urban Region

		γ_{ik}										
Coefficient	$\gamma 0_{ij}$	Anchovy	Milkfish	Roundscad	Tilapia	Shrimp	Squid	Shells	Others	Processed	$\gamma 1$	$\gamma 2$
Anchovy	0.1257	−0.0096	0.0277	−0.0197	0.0223	−0.0176	−0.0144	0.0006	−0.0238	0.0346	−0.0078	−0.0003
Milkfish	0.5073	0.0277	−0.0850	0.0268	−0.0230	−0.0265	−0.0331	−0.0082	0.1051	0.0162	−0.0421	−0.0013
Roundscad	0.3405	−0.0197	0.0268	−0.0819	0.0670	0.0311	0.0181	−0.0175	−0.0391	0.0152	−0.0427	−0.0014
Tilapia	0.4202	0.0223	−0.0230	0.0670	−0.0798	−0.0179	0.0088	−0.0112	0.0534	−0.0197	−0.0414	−0.0013
Shrimp	0.0029	−0.0176	−0.0265	0.0311	−0.0179	0.0020	0.0026	0.0084	0.0155	0.0025	0.0169	0.0005
Squid	0.0549	−0.0144	−0.0331	0.0181	0.0088	0.0026	−0.0083	−0.0013	0.0093	0.0184	0.0092	0.0003
Shells	−0.2412	0.0006	−0.0082	−0.0175	−0.0112	0.0084	−0.0013	0.0009	0.0275	0.0008	0.0060	0.0002
Others	−0.5691	−0.0238	0.1051	−0.0391	0.0534	0.0155	0.0093	0.0275	−0.0988	−0.0491	0.1343	0.0043
Processed	0.3587	0.0346	0.0162	0.0152	−0.0197	0.0025	0.0184	0.0008	−0.0491	−0.0190	−0.0323	−0.0010

TABLE A.5 Demand Elasticities for the Rural Region

	Own and cross price elasticities								Fish expenditure elasticities
	Anchovy	Milkfish	Roundscad	Tilapia	Shrimp	Squid	Others	Processed fish	
Anchovy	−1.25	0.78	−0.49	0.64	−0.47	−0.38	−0.55	1.00	0.70
Milkfish	0.29	−1.76	0.34	−0.16	−0.24	−0.31	1.19	0.28	0.43
Roundscad	−0.13	0.24	−1.53	0.53	0.23	0.14	−0.15	0.20	0.57
Tilapia	0.22	−0.15	0.68	−1.66	−0.15	0.09	0.64	−0.06	0.48
Shrimp	−0.67	−1.05	1.01	−0.74	−0.95	0.07	0.29	−0.10	1.85
Squid	−0.57	−1.31	0.62	0.28	0.09	−1.33	0.20	0.59	1.49
Others	−0.10	0.27	−0.21	0.10	0.03	0.01	−1.50	−0.29	1.60
Processed fish	0.16	0.09	0.10	−0.07	0.02	0.09	−0.16	−1.04	0.80

TABLE A.6 Demand Elasticities for the Urban Region

	Own and cross price elasticities								Fish expenditure elasticities
	Anchovy	Milkfish	Roundscad	Tilapia	Shrimp	Squid	Others	Processed fish	
Anchovy	−1.34	1.11	−0.67	0.88	−0.63	−0.52	−0.79	1.34	0.59
Milkfish	0.15	−1.37	0.18	−0.07	−0.12	−0.16	0.60	0.13	0.70
Roundscad	−0.12	0.27	−1.50	0.52	0.24	0.14	−0.18	0.17	0.58
Tilapia	0.17	−0.08	0.52	−1.49	−0.10	0.08	0.46	−0.07	0.59
Shrimp	−0.33	−0.56	0.49	−0.38	−0.99	0.03	0.19	−0.02	1.43
Squid	−0.39	−0.94	0.43	0.18	0.05	−1.23	0.17	0.43	1.35
Others	−0.14	0.32	−0.32	0.12	0.02	0.01	−1.66	−0.37	1.90
Processed fish	0.23	0.16	0.14	−0.08	0.03	0.13	−0.25	−1.07	0.71

B. SUPPLY SIDE ELASTICITIES

TABLE B.1 Supply-side Elasticities for Commercial Fisheries

	Fish prices								Input prices	
	Grouper	Tuna	Anchovy	Roundscad	Other shells	Squid	Shrimp	Other capture	Fuel	Labor
Grouper	0.60	−0.01	0.00	−0.01	0.00	0.00	0.00	0.01	−0.03	−0.03
Tuna		0.60	0.00	−0.01	0.00	0.00	0.00	0.01	−0.03	−0.03
Anchovy			0.60	0.00	0.00	0.00	0.00	0.00	−0.03	−0.03
Roundscad				0.60	0.00	0.00	0.00	0.01	−0.03	−0.03
Other shells					0.60	0.00	0.00	0.00	−0.03	−0.03
Squid						0.60	0.00	0.00	−0.03	−0.03
Shrimp							0.60	0.00	−0.03	−0.03
Other capture								0.60	−0.03	−0.03
Fuel									0.03	0.03
Labor										0.10

TABLE B.2 Supply-side Elasticities for Aquaculture

	Fish prices								Input prices	
	Mussels/ oysters	Carp	Catfish	Milkfish	Tilapia	Shrimp	Other aquaculture	Other shells	Fertilizer	Labor
Mussels/oysters	0.80	0.00	0.00	0.00	0.00	0.00	0.00	−0.01	−0.04	−0.04
Carp		0.80	−0.01	0.00	−0.01	0.00	−0.01	0.00	−0.04	−0.04
Catfish			0.80	0.00	−0.01	0.00	−0.01	0.00	−0.04	−0.04
Milkfish				0.80	0.00	0.00	−0.01	0.00	−0.04	−0.04
Tilapia					0.80	0.00	0.00	0.00	−0.04	−0.04
Shrimp						0.80	0.00	0.00	−0.04	−0.04
Other aquaculture							0.80	0.00	−0.04	−0.04
Other shells								0.80	−0.04	−0.04
Fertilizer									0.04	0.04
Labor										0.10

TABLE B.3 Supply-side Elasticities for Municipal Fisheries

	Fish prices												Input prices	
	Tuna	Grouper	Anchovy	Roundscad	Squid	Other shells	Shrimp	Milkfish	Tilapia	Carp	Catfish	Other capture	Fuel	Labor
Tuna	0.40	−0.01	0.00	−0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Grouper		0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Anchovy			0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Roundscad				0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Squid					0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Other shells						0.40	0.00	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Shrimp							0.40	0.00	0.00	0.00	0.00	0.01	−0.02	−0.02
Milkfish								0.40	0.00	0.00	0.00	0.01	−0.02	−0.02
Tilapia									0.40	−0.01	−0.01	0.01	−0.02	−0.02
Carp										0.40	−0.01	0.01	−0.02	−0.02
Catfish											0.40	0.01	−0.02	−0.02
Other capture												0.40	−0.02	−0.02
Fuel													0.02	0.02
Labor														0.10