Chapter 10

Effect of Energy Price Increase on East Asian Region's Food Industries' Interconnectedness and Integration

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CHAPTER 10

Effect of Energy Price Increase on East Asian Region's Food Industries' Interconnectedness and Integration

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The most immediate effects of energy price increase ripples in many production systems is traceable from the intermediate demand sector of an economy. In particular, the production of agriculture, manufacturing, services and several other sectors portray significant energy utilization in their inter industry relationship. We focus our study on the effect of an energy price increase on interconnectedness and integration of the East Asia (EA) region's economy with emphasis on food industries. It draws together findings from selected EA countries in three different approaches. These approaches mainly employs an input-output (I-O)-based methodology with the latest extended version to examine the effect of rising energy prices onto food and non-food sectors' energy intensity, sectoral performance as well as retail price. We find that developed EA countries had demonstrated consistent performance having lower energy intensity, higher generating capacity and resilient to price changes in times of higher energy prices. Based on these findings, the East Asian Summit is hopeful to deliberate on closing their gaps by increasing interconnectedness and integration under the framework of gradual and systematic energy market reform. This will enhance activities in stimulating energy efficiency, output generating capacity and firmer energy market to price volatility especially in developing EA countries. Regional governments can also adopt sectoral energy investment plans to bolster economic growth and consumption of more efficient and cleaner fuels.

1. Introduction

Energy has been for a long time a strategic commodity that has garnered importance over time and whose importance is only next to the national security of a nation. In addition, a voluminous body of literature had recognized that neither a nation nor a region could fully insulate itself from the effect of an oil shock. The most immediate effect of energy price increase is felt throughout an economy, even in the most basic of activities i.e. in the production of food, agriculture etc. Like all regions, the East Asia (EA) region, with emerging markets and Newly Industrialized Countries (NIC), aspires to be a fast expanding and food producing hub with wide-ranging capacities, nonetheless is vulnerable to increases in energy price, particularly to crude oil price hikes.

There exist issues that need to be dealt with by the EAS, particularly concerning competitiveness and efficiency in energy utilization. At one hand there are concerns on glaring disparity in energy and trade integration amongst EA countries particularly between developed and developing countries. On the other, there are potential measures for EA countries with diversified characteristics to undertake further integration routes that could enhance both their energy and inter-trade advantages. However, the main discussion of this paper lies on exactly how these different countries cope or vulnerable to energy price increase given their emphasis on different inter industry structure and at diverse stage of development.

Recently there has been an unsuccessful attempt towards integration in the region. Even though there are efforts to reduce trade barriers as ways to enhance economic integration as basically five stage of economic integration suggested by Balassa (1961), energy market integration (EMI) too could be enhanced by reducing barriers to interconnectedness and integration. Similarly in terms of successfulness of a common market (CM), the establishment of free trade in goods and services allows for the free mobility of capital and labor between member countries. Taking the most advanced type of economic integration such as the European Union as an example; the EAS must consider the responsibility for fiscal policy to a supra-national authority and adopt a common currency among member countries. These types of economic integration are also referred to as regionalism. Burfisher et al. (2003) describe a major transition from shallow to deeper economic integration in some regional trade areas (RTA). The old version of regionalization is based on traditional trade theory that describes trade creation versus trade diversion, as adopted from the Viner-Meade (1950, 1955) theoretical framework. The new regionalism focuses more on broader issues such as linkages between trade and productivity, rent-seeking behavior, the role of FDI and productivity growth and the integration between developed and developing countries.

Interestingly, Hamaguchi (2008) defines integration as a regional economy that is linked through interconnected networks of firms' productive activities. From business' point of view, activities may include different stages, starting with establishment of business concept, through to research and development, production and commercialization. The production process, in turn, consists of various intermediate goods (parts and components) and the final assembly. We define the term "production integration" as the production process that is physically divided into different units, but is united through systematic logistic arrangement. Such division is also called fragmentation in the literature of international trade (Jones and Kierzkowski 2000). However, distinguishing between food and non-food categories, the production system is more dynamic with food at the firm level, which is highly dependent on energy as an input of production. Developed and developing EA countries currently have different productive capacities in generating output.

Hamaguchi (2008) also posits that dividing the production process may be counter-productive because it increases administrative and logistic costs. Production integration is meaningful if the production process is composed of fractions with quite different resource intensity, because productivity of a firm should increase by allocating each fraction in the location where its most intensively used resource is abundant. The productivity gains from fragmentation are large if resource endowments are sufficiently different between countries; hence a firm can locate labour-intensive production process in an unskilled, labor abundant country and knowledge intensive process is in a country abundant in highly educated people. Therefore, this concept of integration warrants some interest in investigating chains of value added and imports shares of food and non-food production.

1.1. Terms of Reference

Our main objective focuses on the scope of EMI and examines its consequences during increases in energy prices. The study conducts an examination of the current state of the EAS energy market under the influence of increase in energy price and identifies the direct and indirect effects of such an increase, which subsequently affect energy intensity, sectoral performances and consumer food product prices.

1.2. Study Conduct

The study is undertaken in several steps:

- Initial desk studies of the food industries and energy requirement situation in selected 16 EAS countries.
- Country data and information collection by team members to setting-up profiles of food industries from the perspective of key energy policy makers and food industry personnel. This will yield insights into their priorities and concern, beyond the data and information from I-O tables and findings from the analysis. We generally succeeded in gathering key information on a few ASEAN countries, particularly Singapore, Thailand and Indonesia, with some interviews and telephone conversations for some countries. In addition, we drew upon our regional and local knowledge particularly on ASEAN countries, in particular of Malaysia, Singapore and Indonesia.
- This report combined I-O based simulations in three different models or approaches to form this final report.

1.3. Outline of Report

The report begins with an introduction to the EA food industry and its relationship with energy prices and an increase in EMI. Section 2 reviews some relevant literature on integration. Section 3 covers the methodology and framework of the study, highlighting the capability of an I-O based method. Section 4 focuses on results and findings on intensity, sectoral price effects and consumer food product prices and section 5 finally concludes with recommendations and future course of study.

2. Background of Study

2.1. EA and World's Food Share

EA countries exported 36.7 percent, imported 31.5 percent and produced 48.5 percent of global food production (FAO 2008). EA economies, especially developing countries, still endeavor to be fast growing food producers. The food sectors in the EA region have grown and integrated into a modern food-processing hub at the global level, generating income and revenue to the EA economies.

Beyond these benefits, there are issues of competitiveness and efficiency of utilizing energy resources between food and non-food industries. These issues has been exacerbate by oil price increases and it becomes critical to establish how best energy and domestic inputs are integrated and interconnected in the quest to cope with higher energy price while maintaining overall efficiency. Furthermore, food industry contributes significantly to other sectors in terms of input materials for further chains of production.

2.1.1. Rising Energy and Food Prices in EA

There are many studies that have revealed the significant correlation between an economy's performance and energy. Bernstein (1990) envisaged a recession could be triggered in the United States if oil price increased by US$40 and stayed at that level for 6 months. McKibbin (2004) predicted that a permanent double increase in oil price from the base of US$25 would cause OECD's real GDP to fall 1.6 per cent. In the EA region, Gan (1985) posits that the 1973-74 oil crises had adversely affected Malaysia which is at that time highly dependent on exports of commodities. Fong (1986) found that the oil crisis in 1974 affected OECD countries with a low GDP, widespread of inflation, and CPI as high as 13% in many OECD countries. Zakariah and Shahwahid (1994) indicated that fluctuation of export commodities during the Gulf War adversely affect the Malaysian economy especially in the 1990s. In July 2008, the CPI registered an increase of 8.2 per cent, driven by an increased oil price of US$145 per a barrel. In the same month of the subsequent year, the oil price falls with the CPI fluctuate to 5.2 per cent. A study from the Malaysian economic structure in 2000 shows that a doubling effect of oil price increase would raise competitive food markets by as much as 1.28% on particularly; Food & Non-Alcoholic Beverages items (Khalid, 2010).

2.1.2. The ASEAN Economic Community (AEC)

The end-goal of this long-standing initiative in economic integration set out in ASEAN Vision 2020 is the establishment of a single market and production base, with a strategy for economic integration throughout ASEAN and its international economic competitiveness. Components of efforts include:

- The ASEAN Free Trade Area (AFTA), which is not yet agreed upon;
- The ASEAN Framework Agreement on Services (AFAS), which assists trade and cooperation in services;
- The ASEAN Investment Area (AIA);
- Regional integration in about a dozen nominated production areas (which does not include energy);
- A road map for financial and monetary integration, covering the development of key financial market mechanisms and liberalization;
- A trans-ASEAN transportation network including major interstate highway and rail networks, and a roadmap for integration of the air travel sector;
- The promotion of interconnectivity and interoperability in telecommunications, information and communications, and cooperation on tourism and food security; and
- The promotion of trans-ASEAN energy networks, consisting of the trans-ASEAN gas pipeline (TAGP).

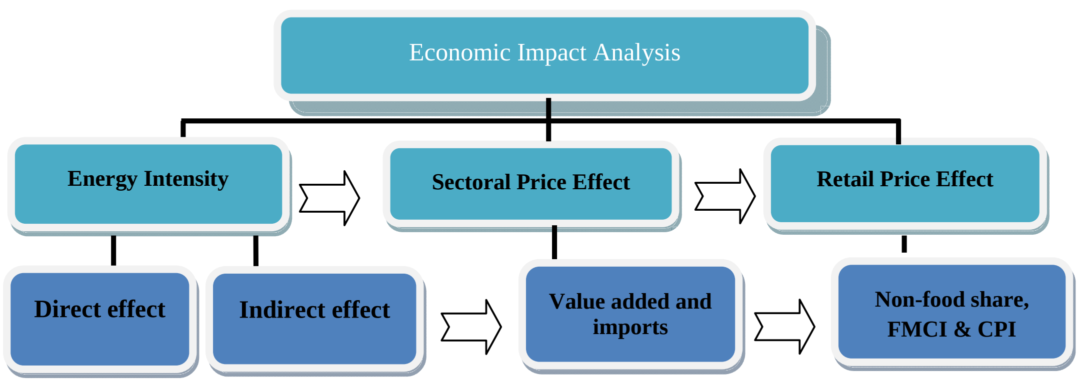
At the moment there has been little success in reaching these agreements and arrangements. An in-depth study of the above arrangements will assist efforts to enhance interconnectedness and integration and the achievement of vision 2020.

3. Methodology

3.1. Analytical Framework

The EMI has been defined in terms of developing more efficient and flexible markets to promote energy cost competitiveness, energy interconnectedness and cleaner energy. The EAS had proposed various efficiencies measures to enhance the process of integration such as *productive efficiency*[1], *allocative efficiency*[2] and *dynamic efficiency*[3]. However, our efficiency standpoint will be from the dimensions of energy intensity, sectoral inter industry capacity as well as price effects on consumer food products in times of increase in energy prices. To analyse this, we combine three different approaches represented by the following framework to present the said analysis illustrated as the following Figure 1.

Figure 1. Schematic Diagram of Analytical Framework



3.2. General Equilibrium and Market Efficiency in EA

The above three different dimensions in Figure 1 assume that there exist a general equilibrium environment in which households and firms maximize their objectives.

[1] Productive efficiency occurs when a given level of output is achieved at the lowest optimum cost

[2] Allocative efficiency occurs when relative prices of different products (e.g. different fuels) are set equal to the cost of each extra unit of production, known as marginal cost. This means that firms or individual can opt for different fuel to achieve outcome for them (energy intensity). The rising oil price had effects on allocative efficiency in terms of energy intensity

[3] Dynamic efficiency is achieved when the appropriate expenditure achieves a balanced stream of increase overtime in line with increases in energy prices. Increase in energy generally has consequences for the disposable income of households

This will result in market equilibrium, where efficient utilization of resources will give the highest returns to both sides. In this light the I-O based model has been popularly used as a general equilibrium model and widely employed to exhibit inter industry relationship. Based on many I-O studies, a general framework such as illustrated in the above Figure 1 will able us to examine energy as inputs and its relationship between food and non-food sectors. For the purpose of this report, we firstly focus on how efficiently energy is used by employing energy intensity analysis and then on relative sectoral price changes for selected EA countries. Thirdly, we will examine the vulnerability of producers and consumers to changes in retail price of food, brought about by energy price increase.

There exist many global, regional and domestic energy markets operating in the EAS region. These multi-regional markets have varying generating capacities in its production system that includes competitiveness with a well-defined market structure and the interconnectedness of energy infrastructure between the EAS countries. An efficient market will operate uninterrupted by the oil price volatility, with the capability to diversify its resources and insulates its market against the effect of oil price increase. In contrast, a susceptible country to oil price volatility will have adverse effects that accrue not only to the economy itself, but will dampen enthusiasm for measures to increase competitiveness and integration. Thus, by examining this impact, mitigation measures may be formulated by the EAS to protect the most vulnerable.

3.3. Deriving Energy Intensity

The energy intensity model is constructed in a general equilibrium model replicating Leontief's final demand approach, which is estimated using the following basic I-O system of equations:

$$X = (I - A)^{-1} Y \qquad \text{..... (1)}$$

where X represent vector of gross output, $(I - A)^{-1}$ is the Leontief's inverse matrix (with I as identity matrix and A is the coefficient matrix) and Y is the vector of net final demand. In simple term, for every unit increase in production of food output (represent by X), a certain amount of input $(I\text{-}A)^{-1}Y$ is required for its production. Using this simple analogy, we can compute the interconnected input chains for each food industry. Next, we can compare the effect of energy prices in terms of direct and indirect effects and then sort their ranks from the highest to the lowest intensity.

The above-mentioned term “direct effect” refers to the initial results that emerge from requirements or inputs in production. The sum of direct and indirect inputs is normally called the indirect effects[4] (United Nations, 1999). In these direct and indirect effects, income is accrued as a result of the initial change in final demand. Spending increased income triggers another round of economic activity. This additional round of economic activity generates output, income and employment. The economic effects resulting from re-spending of accrued income are known as induced effects.

These induced effects, or as multiplier effects, allow for determination of the full effects or total impact resulting from any change in final demand. Assuming that the national economy is subdivided into food and non-food which can be read from the column entries, the energy increase can be read from the row-wise as in Table 1.

Table 1. Inter industry matrix of an I-O model

Item	*Purchasing sector: Food and Non-food*	Total Intermediate	Final Demand	Total Output
Producing sector: Energy	1 x_{11} $x_{12}\ldots x_{1n}$	W_1	Y_1	X_1
	2 x_{21} $x_{22}\ldots x_{2n}$	W_2	Y_2	X_2
	3 x_{31} $x_{32}\ldots x_{3n}$	W_3	Y_3	X_3
	…	…	…	…
	N x_{n1} $x_{n2}\ldots x_{nn}$	W_n	Y_n	X_n
Total Inputs	U_1 U_2 $U_3\ldots U_n$			
Primary Inputs	V_1 V_2 $V_3\ldots V_n$	V	V	
Total Production	X_1 X_2 $X_3\ldots X_n$	Y	X	

Source: Miller and Blair (1985)

Table 1 illustrates that both the food and non-food sectors’ final demand requirement for its output generates direct and indirect effects on the economy. We can see this inter industry interaction through the purchasing sector (row-wise). In this

[4] Inputs and effects are termed differently in this context. Inputs such as direct inputs can be in a form of energy directly use such as oil, gas, coal and gas at the initial point in the production processes. Indirect inputs are inputs releases from repercussions from the direct effect into other forms such as petrol products, electricity, etc., which in turn require various production processes and in turn requires again another cycle. Whereas, direct and indirect inputs is normally classified under indirect effects since both will mostly produce energy in the form of indirect effects from chains of processes. Reference: Handbook of I-O table compilation and analysis by United Nations, New York 1999. Series F, No.74.

arrangement the initial effect is the direct effect and is followed by induced effects. Similarly, the column-wise orientation constitutes energy as inputs used for producing food and non-food output. For example, in producing a targeted amount of goods and services, we have to plan inputs in the production process that include fuels as a direct energy and non-energy goods and services. The non-energy inputs again include some fuels and goods and services in their producing processes. These processes traces inputs back to primary resources; the first round of energy inputs or is called the direct energy requirement. Subsequent round of energy inputs comprise the indirect energy requirements.

In the I-O framework, the total energy requirement is obtained through the estimation of "energy intensity" in inter industries activities employing the conventional Leontief's inversed matrix. In the recent extensions of I-O energy analysis, more and more studies are focused on energy intensity measured in physical units. In summary, the energy intensity is measured in terms of how much direct and indirect effects of using energy as inputs in the production of food output.

3.4. Sectoral Price Effects

In order to examine sectoral price effects in the midst of rising energy prices, we employ the modified Leontief's price system (MLPS). The system assumed a general equilibrium environment where internal factors are unchanged and remaining prices in the oil industry are exogenously set in the equation $P_X = A'P + v + m$. When we assume P_X to be totally exogenous we are preventing any feedbacks onto energy use. In many EA countries, energy use would particularly be crude oil, natural gas and coal. Prices for these products are established in world markets (dominated by OPEC in the case of oil and Japan in the case of coal). To copy this exogeneity, we drop the P_X equation from the price system and thus, we partition the price of oil, P_X , into exogenous and endogenous divisions as follows:

$$\begin{pmatrix} P_X \\ P_E \end{pmatrix} = \begin{pmatrix} a_{xx} & \boldsymbol{A'_{EX}} \\ \boldsymbol{A'_{XE}} & \boldsymbol{A'_{EE}} \end{pmatrix} \times \begin{pmatrix} P_X \\ \boldsymbol{P_E} \end{pmatrix} + \begin{pmatrix} v_X \\ \boldsymbol{v_E} \end{pmatrix} + \begin{pmatrix} m_X \\ \boldsymbol{m_E} \end{pmatrix} \quad \text{... (2)}$$

where;

P_X = *price index for energy as an exogenous variable*;

$\mathbf{P_E}$ = (*n-1*) x *1* column vector of basic prices in the endogenous sectors;
a_{xx} = *input requirement of the energy sector from its own output*;
A'_{EX} = *1* x (*n-1*) row vector of the input requirement from *n-1* endogenous sector for the production of one unit of energy;
$\mathbf{A'_{XE}}$ = (*n-1*) x *1* column vector of input requirements from energy products sector for the production of one unit of output in each *n-1* endogenous sector;
$\mathbf{A'_{EE}}$ = (*n-1*) x (*n-1*) "square matrix" of the Leontief's domestic direct coefficients of the *n -1* endogenous sector;
v_X = *ratio of value added to the output in the energy sector*;
$\mathbf{v_E}$ = (*n-1*) x *1* column vector of value added ratio to output in the endogenous sector;
m_X = *ratio of imported inputs to output in the energy sector*;
$\mathbf{m_E}$ = (*n-1*) x *1* column vector of imported inputs ratio to output in the endogenous sectors; and
n = number of sectors i.e. 40 in our aggregation scheme.
Note: Italics to term for exogenous effect, non-italics for endogenous effect.

Next, we run equation (2) endogenously:

$$P_E = (I-A'_{EE})^{-1} A'_{XE} P_X + (I-A'_{EE})^{-1} (v_E+m_E) \qquad \text{….. (3)}$$

We use suitably aggregated sectors of the 2005 I-O table to simulate the impact of oil price rises by employing the MLPS. For simplicity, we use the 2005 OECD I-O tables with 48 sectors in selected EA countries. These tables provide the most specific sector decomposition that relates to oil classification, i.e. "energy". Thus in terms of specificity, MLPS analysis refers to the Mining and quarrying (energy) sector. These sectors represent crude oil or petroleum. This is suitable for our purpose since we need an exogenous sector that affects both the food and non-food sectors, although they generally do not use crude oil directly as inputs in their production.

3.4.1. Simulating Sectoral Price Effects

The MLPS works column-wise if we read from the I-O tables. Some caution should be taken with some basic I-O assumptions i.e. homogeneity of output, particularly on types of food, zero rates of substitutions between energy inputs, fixed proportions between input and output, absence of economies of scale and linearity of coefficient and final demand component. However, if the single input structure is violated, then the general rule is that choices made must to preserve the basis of the single input structure. The degree of aggregation adopted depends on many factors such as the purpose of study, availability of data, time and resources available. Detailed information is highly aggregated but, in general, the greater the degree of detail, the greater is the likelihood of substitution between sectors. However, the most desirable aggregation uses a commodity classification, which has a single input structure.

An example of how a price mechanism works can be shown by O'Connor and Henry (1975), who offer a simplified equation to portray price effects using the original Leontief's price equation, $P = [(I\text{-}A)^{-1}]' \,(\pi b)$. Although the MLPS is very much similar to this equation, the system is more varied as it provides endogenous and exogenous effects as the above-mentioned equation (3):

From the I-O tables we can the derive price of energy, P_E if we run equation (3) based on the following illustration diagram of *n-1* columns:

$$\underset{(nx1)}{PE} = \underset{(n\,xn)}{(I\text{-}A'_{EE})^{-1}} \; \underset{(n\,x1)(1x1)}{A'_{XE}\,P_X} + \underset{(nxn)}{(I\text{-}A'_{EE})^{-1}} \; \underset{(nx1)}{(v_E+m_E)}$$

$$\underset{(40x1)}{\begin{pmatrix} P_{E1} \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} = \underset{(40x40)}{\begin{pmatrix} a'ee_1 \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} \text{x} \underset{(40x1)}{\begin{pmatrix} a'xe_1 \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} \underset{(1x1)}{\begin{pmatrix} 1 \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} + \underset{(40x40)}{\begin{pmatrix} a'ee_1 \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} \text{x} \underset{(40x1)}{\begin{pmatrix} ve_1 \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} + \underset{(40x1)}{\begin{pmatrix} me_1 \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}} \quad ...(4)$$

To endogenize the price system, we take out the Mining & quarrying (energy) sector, representing the exogenous energy sector, leaving the non-energy or endogenous sectors. The next step is to run the inverse on *(I-A'EE)* matrix and A'_{XE} multiply by P_x. This product will then be added to the multiplication of (*I-A'EE)* and (v_E + m_E) resulting with unity representing a balanced matrix. *P*x is then multiplied by two to simulate a double increase in energy price. The MLPS shows results of direct and indirect impact for both 2000 and 2005 with results on both value added and import share of output. We expect to gain some insight on EA countries' sectoral price effects and output generating capacity in this exercise.

3.5. Retail Price of Food

Unlike the above two models discussed in the earlier sections, the price-spread model is a short-run model which classifies 10-food-industries to estimate the impact of changes of input prices onto consumer food product prices. As a short-run model, it is assume that consumers do not respond to retail price changes, whilst food producers do not alter input proportions despite changes in relative input prices. Furthermore, output of each industry serves only as a final consumer of food products[5]. In our price-spread model, we compute 10 components of food industries in each EA country as categorized in their respective CPI to estimate price changes on retail price. Each firm of the respective 10 final food industries produces a single product by combining a farm commodity with a set of non-farm inputs in fixed proportions. In this model, consumer demand is fixed for all levels of retail price. These simplifying assumptions reduce the computation of a food price estimate to an evaluation of an accounting-type formula. This formula states that the percentage change in the retail price is a weighted sum of the percentage changes in input prices, with cost shares (e.g. from the Malaysian I-O tables, 2005) serving as weights:

$$P_R^* = P_F^* s_F + P_x^* s_x \qquad \ldots\ldots (5)$$

where s_F *and* s_x represent the cost shares of the food and non-food inputs, respectively, and where P_R^*, P_F^*, P_x^* denote the percentage changes in the retail, the food price, and the aggregate non-food price, respectively. The variable P_x is the food marketing cost index (FMCI), or the average price of the aggregate non-food input. The above formula asserts that a 1-percent increase in the FMCI leads to a s_x-percent increase in the retail price.

Energy is one of several non-food inputs used to produce food, and the price of energy is approximately about one-twelfth of non-food input prices used to construct the FMCI (i.e. P_x). Suppose that food is produced using a single food input and a single aggregate or representative non-food input, with a price equal to the FMCI. If this

[5] This assumption simplifies that each industry's output serves only at that respective final consumer of food product. Thus, we can examine each of the 10 components of food industry's retail price changes from increase in energy price.

single non-food input is produced from individual non-food inputs in fixed proportions, the retail price formula given by equation (5) above can be extended directly to:

$$P_R* = P_F*s_F + P_x*s_x = P_F*s_F + \mathbf{(P_E*s_E + \sum_{i=3} P_i*s_i)\, s_x} \quad \text{……. (6)}$$

where s_E and s_i are the non-food cost shares of energy and the *i*th non-food input, and P_E^* and P^*_i are the percentage changes in energy and the other non-farm input prices, respectively. The sum in the parentheses of equation (6) represents the percentage change in the FMCI (i.e., P_x^*), and the shares of each term serve as weights on the individual input prices[6]. Equation (6) states that the percentage increase in the consumer price of food is the weighted sum of the percentage change in the price of the food ingredient, the energy price, and the other non-food input prices comprising the FMCI. At this point, it is convenient to describe the main difference between the price-spread and intensity models. The term, P_E*s_E in equation (6) is referred to as the direct effect because it denotes the energy cost increase incurred by producers of the aggregate marketing input[7].

$$\mathbf{\Sigma c P_i * s_i}, \quad (7)$$

The second term is referred to as the indirect effect because it measures the effect of a rising energy price on the costs of other inputs used in producing the marketing input. For example, because energy is used to produce food packaging, the cost of packaging will rise with higher energy prices. In a typical price-spread model simulation, the indirect effects would be zero since the price of energy does not affect the price of other marketing inputs. In a typical I-O model simulation, a change in the price of crude oil could affect the price of all other inputs used in the production of food.

Since we wish to impose the same exogenous change on the two models, we include the indirect effects of energy increase in both model simulations. In particular, we used the I-O model's prediction of the percentage change in energy intensity whilst also using the FMCI in the price-spread model to estimate the effect of a doubling of the crude oil price. The price-spread model simulation suggests that a doubling of the price

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[6] The weights are the derived from averaging the inverse matrix of two main energy-related sectors'.
[7] $S_x\, P_F*S_F$ is the direct effect of the energy price increase on the average cost of producing the food product.

of crude oil leads to a 1.483 percent increase in the FMCI in 2000. This predicted increase in the FMCI is used in the price-spread model simulations, whereas, the intensity analysis uses at least three energy sectors in its total impact.

3.6. Construction of Models

Table 1 is constructed by employing I-O analysis using selected EA data and information from the OECD I-O table 2005. The data from the I-O table is classified and aggregated according to the product lists in the EA's CPI. Using the inverse matrix table, we calculate intensity of each food industry using Crude oil, petrol & coal products and Electricity & gas by their input proportion. This estimate is used as a proxy for the total multiplier of energy for the whole economy. Next, the I-O table is used to produce the cost share of non-food and the average of energy price, or the FMCI. We take 10 food industries[8] from the I-O tables using the CPI classification and insert these figures into equation (6).

Table 2 summarizes the steps involved in using the price-spread model to compute an estimate of the effect of a 100 percent increase in the price of crude oil on the CPI for food at home. The non-food cost share is reported in column (1), and the 1.483 percent figure reported in column (2) is taken from the I-O model simulation from two energy sectors, mainly Petroleum products & coal and Electricity & gas, which serve as the total impact of energy multiplier in our model. Column (4) is the product of the three columns (1), (2) and (3), which individually represents the percentage change in the retail price of each industry. Column (3) reports the Department of Statistics (DOS) expenditure weight associated with each Food and Beverages industry.

3.7. Data and Measurement

This study uses secondary data, which is mostly sourced from OECD and various selected EA countries' statistical agencies, for example the Department of Statistics (DOS) in Malaysia and Singapore. The I-O based model primarily employs the Malaysian I-O tables 2005 published by the Department of Statistics in 2010. We also employ other data from statistics agencies to put up patterns on demand and

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[8] Out of 11 food products in the CPI, we managed to classify 10 food industries, which were aggregated from the 120 by 120 sectors of the Malaysian I-O table, 2005.

consumption of petroleum products. Oil is classified under classification number 11100-01 includes crude oil, natural gas and coal in the Malaysian Classification of Products by Activity (MCPA) 2005 which is compliance to other international standards of classification. In line with the purpose of this paper we use Petroleum product & coal and Electricity & gas to proxy for energy prices. For 2005, since there are changes in classification, we use the transport sector's total effect to portray the nearest output multiplier of energy input price in terms of average and incorporate this as FMCI. The data and measurements used are tested for stability to ensure the robustness and validity of the analysis.

4. Results and Findings

4.1. Energy Intensity

The I-O analysis provides as a useful means to trace the footprints of energy use and related energy activities. It assists in determining direct and indirect energy utilization in the production chains of goods and services. Thus, the production target of goods and services can be met by combination of inputs, including fuels as one component, that produce direct energy and non-energy goods and services as another component. The non-energy inputs again include some fuels and goods as well as services for production processes. These effects ripple in the economic system forming total effects originating from an initial increase in the final demand. The initial effect or similarly called direct effect for the selected EA countries is as shown in the following Table 2.

Table 2 shows that energy use in terms of coefficient of direct energy effects that arises from an increase in final demand for selected EA countries in 2005. Take Japan for example, for every $1.00 increase in final demand for the output of food sectors, 2.4 cents worth of energy is required. An average of 4 cents is needed by Japan to produce non-food output. Thus, by ranking these direct energy use amongst EA countries, the highest energy use is found for Thailand in production of food and likewise for

Indonesia in non-food production. However, Indonesia has the lowest direct energy effect in food production with Malaysia has the lowest direct energy effect for non-food.

Table 2. Direct Energy in food and non-Food Production for Selected EA Countries, 2005 (by rank)

Direct energy in food and non-food production			
Country	**Food**	**Country**	**Non-food**
Thailand	0.0591	Indonesia	0.0768
China	0.0382	Thailand	0.0677
Taiwan	0.0359	China	0.0638
Korea	0.0313	Taiwan	0.0503
Australia	0.0277	Korea	0.0471
Malaysia	0.0264	New Zealand	0.0408
Japan	0.0243	Japan	0.0375
New Zealand	0.0145	Australia	0.0274
Indonesia	0.0112	Malaysia	0.0055

Table 3. Thailand's Total Energy Used in Producing Food for a $1 Increase in Final Demand in 2005

Energy input	Sector 4-Food products, beverages & tobacco	Sector 32-Hotels & Restaurants
2 Mining and quarrying (energy)	6.04	29.45
8 Coke, refined petroleum products and nuclear fuel	6.10	39.32
26 Production, collection and distribution of electricity	4.25	9.00
27 Manufacture of gas; distribution of gaseous fuels through mains	1.12	2.43
Average	4.38	20.05

We use selected energy sectors[9] as found in the 2005 OECD's I-O tables representing energy[10] in selected EA economies. The following total effect of energy intensity in Thailand is exhibited in Table 3. Holding other factors as constant, for every $1 of food output in the final demand, Thailand needs 6.04 cents of inputs from

[9] Specifically, sectors 2, 8, 26, 27

[10] Energy used varies between developed and developing EA countries with former used more secondary energy than latter which utilizes more primary energy like crude oil and natural gas. Thus, energy intensity in terms of primary energy for developed countries is maintained at low intensity. Nevertheless, one can aggregate this different energy level from the I-O table to obtain better results.

Mining & quarrying (energy), 6.1 cents from Coke, refined petroleum products and nuclear fuel, 4.25 cents from production, collection and distribution of Electricity, as well as 1.12 cents from Manufacture of gas and distribution of gaseous fuels through mains. Similarly, in order to produce non-food industry's output, Thailand need a higher amount of energy, on average 5 times greater than the requirement to produce food. Therefore, energy inputs are less intensively used in Thai food productions.

Table 4. Total Energy Intensity in Food and Non-food Production for Selected EA Countries, 2005

Country	Food	Country	Non-food
Taiwan	0.2677	China	0.3163
Thailand	0.2104	Taiwan	0.3138
China	0.1980	Thailand	0.2592
Korea	0.1613	Korea	0.2240
Indonesia	0.1488	Indonesia	0.2060
Malaysia	0.1048	Malaysia	0.1270
Australia	0.0960	Japan	0.1222
Japan	0.0844	Australia	0.0970
New Zealand	0.0815	New Zealand	0.0896

Table 4 shows that for every dollar increase in the final demand for food products will result in direct and indirect output of energy to increase by 26.8 cents in Taiwan. Taiwan has the highest average total energy impact in food production amongst the selected EA countries. New Zealand ranked lowest effect from energy increase of only 8 cents in production of food. Non-food production in China (31.6 cents) ranked the highest whereas New Zealand again had the lowest effect (9 cents) with energy increase.

These processes trace inputs back to primary resources. The first round of energy inputs, which is the direct energy requirement and the subsequent round of energy inputs comprise of indirect energy requirements. In the I-O framework, computing the total energy requirement is called measuring the "energy intensity" of industries which is analogous to computing the total energy requirement or Leontief's inverse of the traditional I-O model. In energy, I-O analysis more often are concerned with energy measured in physical units.

Table 5. Average Grand Total of Energy Intensity in Food and Non-food Production for Selected EA Countries, 2005

Selected EA countries	Average grand total for food and non-food
New Zealand	0.1132
Australia	0.1241
Malaysia	0.1319
Japan	0.1342
Indonesia	0.2214
Korea	0.2319
Thailand	0.2982
China	0.3082
Taiwan	0.3339

Assuming other things are fixed, Table 5 shows that on average New Zealand has the overall lowest energy intensity amongst the selected EA countries. It uses only 11 cents on average for both energy input costs in producing food and non-food amongst the EA countries. At 33.4 cents, Taiwan pays the most for its energy inputs amongst the selected EA countries and exhibits the most intense energy input utilization for each unit of output produced.

In summary, for every unit of food output there are variations of unit of energy inputs used by the EA countries' food industries in producing food and non-food output. This study reveals that selected EA countries like New Zealand used lower unit of total energy inputs in producing food compared to countries like Taiwan.

4.2. Sectoral Price Effects

In line with our second objective in examining the effects of energy price increases on sectoral performance, we focus our attention on how an exogenous increase in energy prices affects prices in other sectors. An exogenous increase in energy price directly and indirectly pushes up cost of production of food and non-food. The cost of production will be affected in terms of value-added and imported inputs. Based on the selected EA countries, we obtain interesting findings with regards to different value-added and imported input content per unit of output, which will finally affect their sectoral performance.

4.2.1. Case Study 1: Malaysia and Singapore

Malaysia and Singapore are very close proximity neighbours despite of their differences in economic structures and distribution networks. While Malaysia is endowed with arable land, labour and resources, Singapore at the other end comprise of a small island, lacking of labour and natural resources factors. Nevertheless, Singapore has built considerable human and physical capital-base to generate its economy's output. Although Malaysia is an oil-exporting country and Singapore mostly imports its energy need, similarly both were vulnerable to the increase in crude oil price. The following Table 6 illustrates this point.

Table 6. Total Effects of Increase in Oil Price for Malaysia and Singapore, 2005

Malaysia				**Singapore**			
Total effects	VA'* (I-A)	M'* (I-A)	M/ VA	Total effects	VA'* (I-A)-1	M'* (I-A)-1	M/V A
Food Crops	0.829	0.162	0.195	Food preparations	0.402	0.595	1.478
Vegetables	0.715	0.274	0.383	Bread, biscuits & confectionery	0.559	0.439	0.784
Fruits	0.828	0.161	0.195	Sugar, chocolate & related products	0.300	0.699	2.332
Poultry Farming	0.754	0.232	0.307	Oils & fats	0.240	0.759	3.155
Other Livestock	0.804	0.186	0.231	Dairy products	0.447	0.552	1.234
Fishing	0.747	0.224	0.300	Coffee & tea	0.408	0.590	1.444
Meat and Meat Production	0.721	0.257	0.356	Other food products	0.423	0.575	1.359
Preservation of Seafood	0.674	0.292	0.434	Soft drinks	0.484	0.513	1.061
Preservation of Fruits and Vegetables	0.652	0.324	0.497	Alcoholic drinks & tobacco products	0.568	0.426	0.751
Dairy Production	0.518	0.455	0.878	Food & beverage services	0.718	0.279	0.388
Oils and Fats	0.730	0.236	0.323				
Grain Mills	0.530	0.442	0.834				
Bakery Products	0.606	0.358	0.591				
Confectionery	0.453	0.528	1.165				
Other Food Processing	0.566	0.394	0.695				
Wine and Spirit	0.495	0.340	0.688				
Soft Drink	0.496	0.468	0.944				

Source: DOS, I-O Table 2005 and OECD
Notes: Highlighted M/VA is impact more than 1.0 index

The direct effect of value added and imports for both countries varies differently for each economy correspondingly. Malaysia, which is more resource-based economy compared to Singapore, exhibits a different magnitude of total effect across sectors, particularly in terms of effects having measures of coefficient which is greater than one (i.e. confectionery as highlighted). Singapore has seven food sectors scoring more than one and, including Oil & fats which is 3.16. More detailed information regarding direct and indirect effects can be found in Table 11, in Appendix 1.

In addition to Table 6, the subsequent Table 7 shows differences in the components of food industries from food crops to soft drinks for Malaysia, which were mainly focus on producing resource-based commodities like vegetables and fruits. Each food commodity is evaluated using direct and indirect effects with each owns a share of value-added, imports and relative imports over value added showing how it performed relatively in these two variables. In Malaysia, these ranked food commodities, particularly the resource-based food industry, has the highest rank followed by process-based commodities.

Table 7. Malaysia: Direct Effect of Value Added Share by Rank, 2005

Food Sector	Value-Added
Food Crops	0.608
Vegetables	0.570
Fruits	0.557
Other Livestock	0.528
Fishing	0.502
Poultry Farming	0.483
Wine and Spirit	0.277
Preservation of Fruits and Vegetables	0.255
Confectionery	0.236
Preservation of Seafood	0.231
Bakery Products	0.202
Soft Drink	0.202
Other Food Processing	0.194
Meat and Meat Production	0.182
Dairy Production	0.162
Grain Mills	0.143
Oils and Fats	0.120

Source: Calculated from I-O Table 2005, DOS Malaysia

The resource-based orientation in food products are more widely spread in Malaysia, be it in supermarkets, flea markets and small stalls. The alternative, mechanization and food manufacturing, constitutes only a small portion of domestic output. Usually these manufacturing-based food processes contain inputs of high imported portion as shown by the highest contribution in the import column and high relative imports to value added, as in the third column of Table 6.

In terms of indirect effects, the Oils & fats industry and Meat & meat production sectors are mostly influenced by a double increase in oil price. This means that energy price shows substantial influence in the production of these food commodities. Surprisingly, Confectionery scores more than one and the highest total effects in the relative measure. This may be possibly brought about by greater spending on imported inputs.

There are 10 types of food commodities illustrated in the Singapore 2005 I-O Table. Food & beverages ranked the highest for the direct effect in value-added followed by Bread, biscuits & confectionery. Whilst, in terms of imports, Oils & fats ranked the highest followed by Sugar, the relative measure of import share over value-added shows that almost all commodities scored more than one, except for Alcoholic, Food & beverages and Bread. The indirect effect depicted that only Oils & fats have a relative measure greater than one. We also find that almost all of the total effects scored more than one, showing a high influence of inputs sourced from foreign or external markets.

Analysis: Interconnection and Integration between Malaysia and Singapore

As EA countries become more developed, the share of food inputs imported for food production increases. Thus, less developed countries have low import content but a more developed country such as Singapore has higher import content in its direct food production. In general, in terms of total effects, the share of inputs differs according to whether a country is more developed or less, having similar results to those found in UNIDO[11].

The direct and indirect effects have different magnitudes in the food industry. For Singapore, the attention has always been more on manufacturing-based products whilst Malaysia is still largely concentrating on resource-based products. As gaps between direct and indirect effects become widened, an efficient economy will aspire to higher end product development and value chains, leading to higher efficiency and integration.

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[11] *Source*: UNIDO Working paper 19/2009
Notes: UNIDO figures based on IDE I-O tables, 2009

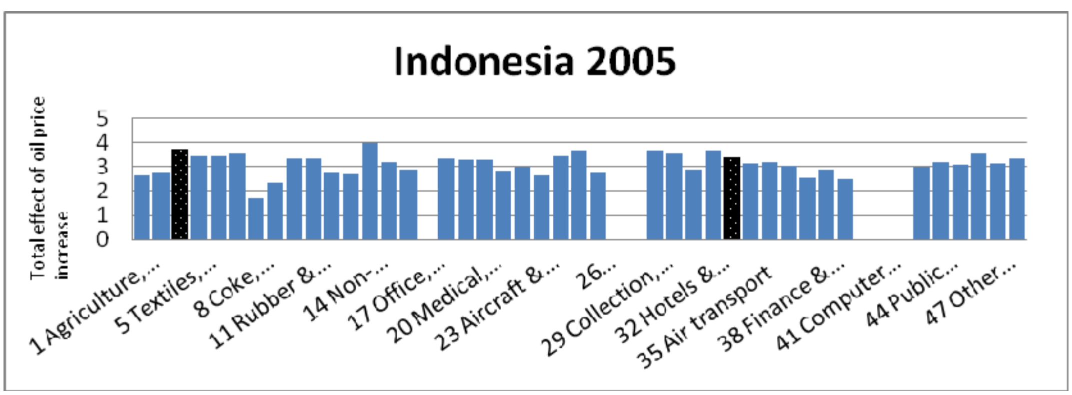
4.2.2. Case study 2: Indonesia, China and Japan

Analysis on performances of Indonesia, China and Japan in generating food and non-food products can be deduced by employing MLPS on their respective I-O Tables 2005. By 48 sectors into two dimensions: food products and non-food products, with beverages & Tobacco and Hotels & restaurant as food sectors and others as non-food sectors from the I-O tables. Next, we simulate interaction in endogenous price effects by making the energy sector i.e. sector 2 exogenous. Assuming other things fixed, for every increase in energy price, Japan generated a total effect of 4.898 for food and 3.61 for transport as shown in Figure 2 exhibiting a higher effect from increase in oil price.

Analysis: Performance of Indonesia, China and Japan

Figure 2 shows the total effect of energy increase in Indonesian food industry sectors. In sum, the total effect on food sector in Indonesia is bigger than China and Japan. This is also substantiated by the fact that for every unit increase of energy price; Indonesia generated a total effect of 3.73 for food and 3.71 for transportation which were higher than the average national effect of 2.72. Thus, again we found that energy used in food industries in developing EA countries is very sensitive to the increase in energy price.

Figure 2. Total effect of oil price increase on food and non-food for Indonesia, 2005



Source: Estimated from OECD I-O Table 2005

On average, total effect from a double increase in oil price has effects which are greater than average for developing countries, as shown in Table 8. Indonesia has effects in both food sectors of approximately 1.4 from its weighted average compared to only 1.0 and 0.7 for Japan. Thus, in contrast, these demonstrate that a double increase in energy price has less effect on energy resilient country like Japan.

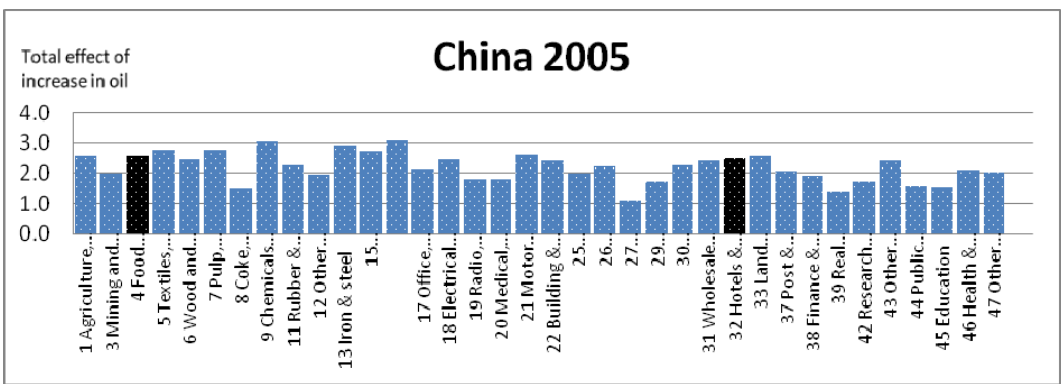
Table 8. Total Effect of Double Increase in Energy Price

Country	Sector 4 (1)	Sector 32 (2)	Weighted average (3)	Distance from average (4)	Distance from average (5)	Total (6)
Indonesia	3.73	3.71	2.72	1.4	1.4	1.0
China	2.57	2.52	2.22	1.2	1.1	1.0
Japan	4.90	3.61	4.88	1.0	0.7	1.0

Source: Estimated from OECD I-O Table 2005

This comparison between total effects of energy increase on food sectors are represented by sector 4 and 32 as shown in column (1) and (2) in Table 8. We measure vulnerability by the distance of total effect from the average. Thus, amongst the three selected countries, Japan showed the least distance from average portraying the least vulnerability from energy price changes.

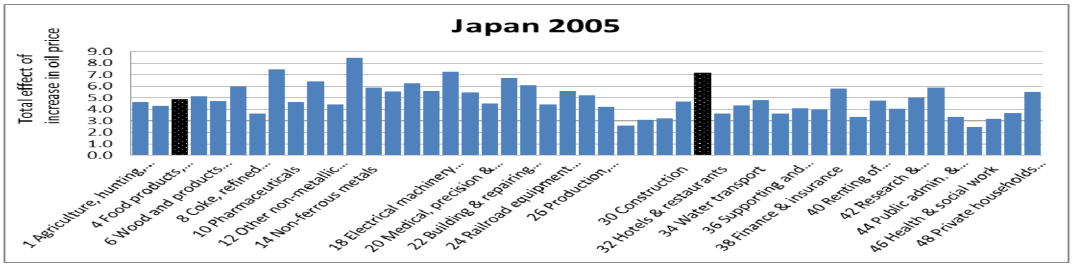
Figure 3. Total Effect of Oil Price Increase on Food and Non-food for China 2005



Source: Estimated from OECD I-O Table 2005

This is complemented by Figure 3, which exhibits the response of a doubling of oil price on food and non-food. Here, the Mining & quarrying (energy) sector is taken out as proxy to oil and we simulate an increase in food and non-food prices from its initial price endogenously. Food and non-food shares are implicitly determined by value added and imported an input, which varies amongst economies. Resilient economies have consistent performance in terms of value added creation and imported inputs during periods of energy price increase.

Figure 4. Total Effect of Oil Price Increase on Food and non-Food for Japan 2005



Source: Estimated from OECD I-O Table 2005

The total effect of energy increase is also positive in Japan. However, food sector 32, i.e. Hotels and restaurants, has a higher impact than food products and beverages of sector 4, showing imported inputs plays important role during oil price increase. In comparison with Indonesia and China, Japan has a higher impact in this sector showing there are considerable effects from increases in energy price.

4.3. Retail Price of Food Products

In this simulation, the retail price is determined by food and non-food cost share, FMCI and CPI weights using the price-spread model. By employing 10-food sectors from the Malaysian I-O tables of 2000 and 2005, we observed the following patterns:

i. The increase in the share of non-food, owing to the higher change in FMCI and CPI weight, resulted in an increased retail price, from 28% in 2000 rising to 36% in 2005.

ii. In 2005, the highest ranking food item is Food-away-from-home, which comprised of Restaurants and hotels. The change was approximately 12%, followed by Fish and seafood, 7%.

iii. Malaysia exhibits lower interconnectedness of energy use in marketing of food (as FMCI is higher) if FMCI is represented by Transport sector 2005 (1.49) than in 2000 (1.48). Thus, as transport has a higher index, it means that some marketing costs had increased in the midst of increasing oil prices.

Table 9. Retail Price of Food Products in Malaysia, 2000

Food Products	Share of non-food	FMCI	Change in PR	CPI Weight	CPI %	Retail Price
Rice, Bread, other cereals	0.378	1.4828	0.560431	4.6	0.046	0.026
Meat & meat products	0.733	1.4828	1.087133	2.9	0.029	0.032
Fish & seafood	0.961	1.4828	1.424701	4.5	0.045	0.064
Milk, cheese, & eggs	0.454	1.4828	0.673735	1.8	0.018	0.012
Oils and fats	0.313	1.4828	0.464125	0.6	0.006	0.003
Fruits & vegetables	0.588	1.4828	0.871543	3.7	0.037	0.032
Sugar, jam, honey, chocolate, & confectionery	0.356	1.4828	0.527323	0.7	0.007	0.004
Food products n.e.c	0.685	1.4828	1.015118	0.8	0.008	0.008
Food away from home	0.549	1.4828	0.814687	10.4	0.104	0.085
Coffee, tea, cocoa, & Non-Alcoholic Beverages	0.644	1.4828	0.954705	1.4	0.014	0.013
Sum/Total average				31.4		0.278

Table 9 shows that FMCI for Malaysia is lower in 2000 (1.48) than in 2005 (1.49) with both the petrol product and electricity and gas as weight. This may mean that a little increase will change marketing costs in the midst of increasing oil prices. Retail prices increased from 28 % in 2000 to 36% in 2005 illustrating that the country had experienced an increase in vulnerability as energy price affects through costs of production inputs, as in Table 10.

Table 10. Retail Price of Food Products in Malaysia, 2005

Food products	Share of non-food	FMCI *	Change in PR	Wt. CPI	CPI%	Retail Price
Rice, Bread, other cereals	0.761	1.49	1.13	4.40	0.044	0.050
Meat & meat products	0.845	1.49	1.26	2.90	0.029	0.036
Fish & seafood	0.963	1.49	1.44	4.50	0.045	0.065
Milk, cheese, & eggs	0.775	1.49	1.15	1.80	0.018	0.021
Oils and fats	0.623	1.49	0.93	0.60	0.006	0.006
Fruits & vegetables	0.742	1.49	1.11	3.30	0.033	0.036
Sugar, jam, honey, chocolate, & confectionery	0.855	1.49	1.27	0.60	0.006	0.008
Food products n.e.c	0.678	1.49	1.01	0.80	0.008	0.008
Food away from home	0.779	1.49	1.16	10.00	0.100	0.116
Coffee, tea, cocoa, & Non-Alcoholic Beverages	0.763	1.49	1.14	1.40	0.014	0.016
Sum/Total average				30.30		0.361

Source: Calculated from I-O Table 2005, DOS Malaysia

Amongst food items, food-away-from-home (0.116) shown at the last column of Table 10 has the highest percentage increase in response to an oil price doubling. This industry comprises of hotels and restaurants, which requires high oil inputs indirectly for transportation, food preparation, packaging, and other direct and indirect activities. Since oil price increases comprises a significant share of their production chains, the rise in oil price will certainly be felt by these industries and the price of products will increase if there are no change in composition of input.

Since the price-spread model requires multiple and detailed data for food and non-food share, FMCI and CPI, we could not complete simulations for other EA countries. We hope this subsequent exercise is able to be extended in the near future.

4.4. Summary of Findings on Energy Intensity:

a. Energy intensity varies amongst EA countries. An increase in energy price has direct and indirect effects on energy inputs used in food and non-food production. The more intense energy is utilized, the higher the risks of coping with higher energy price. This ultimately relates to measures enacted by EA countries to cope with energy price increases that escalate production costs in the course of producing food and non-food output;
b. Low energy intensity economies as found in developed countries use less energy as inputs in the production of food and non-food as they are more efficient and diversified in energy types. Over and above this, their production sectors also have higher output generating capacity; and
c. Energy intensity analysis can be a basis for investigating policies related to efficiency, planning alternative energy inputs and expanding output capacity.

Sectoral Price Effects:

a. Relative prices across sectors of the EA economy performed differently. Increased in the energy price generates more costs in terms of generating value added and importing input in producing food and non-food output. This has consequences on policies concerning interconnectedness of energy inputs along food and non-food corridors.

b. Food productions in developed EA countries are lower than average total effect, nevertheless, these sectors generate greater value added. Thus, they are more resilient to energy price increases;
c. In contrast, developing EA countries' food productions are higher than total effect, however, generate less value added; and
d. Agricultural-based countries with low technology have low value-added. Thus, local value added has limits in using new techniques.

Retail price:

a. A rise in energy prices has direct and indirect effects on EA economies. The lower an economy's energy inputs, the lower the effect from energy price increases. Additionally, such economy's have greater potential in nurturing efficiency and diversification with lower food intake and thus exhibit smaller effects in retail prices;
b. The price-spread effects in terms of energy use, non-food costs share and CPI differ across food items; and
c. The higher the effect of an increase in the oil price, the greater the retail price. This occurs through channels of food marketing such as transportation, packaging and so on.

5. Conclusions and Recommendations

Productive integration transpires if the production process is composed of fractions with different resource use intensities, since the productivity of a firm will increase in allocating each fraction in locations where its most intensively used resource is abundant. The productivity gains from fragmentation are large if resource endowments are sufficiently different in both countries; hence a firm can optimize their energy intensive production process using non-intensive energy techniques of production of a developed country.

Energy interconnection can act as catalyst towards higher productivity even during an increase in energy prices as found in the case of Malaysia and Singapore. The case study showed that there is huge potential to interconnect activities that enhance competitiveness and comparative advantage on food and non-food industries. In the case study of Indonesia, China and Japan, we found that as countries with different input intensity and output generating capacity, can interconnect their activities by closing their gaps in lowering their trade barriers such. Although a less developed country will be at a disadvantage, however if integration is more widespread they will become more efficient and diversified by sharing new technologies.

In this light it is recommended to deepen EMI activities that could maintain output and productivity even in the wake of oil price increase by:

- Emulating consistent energy policies in mitigating energy efficiency gains with energy diversification in line with intensities of energy utilization in EA countries;
- Obtaining productivity gains from fragmentation/clusters, as measured by interconnectedness. These are large if resource endowments, especially energy, are sufficiently different and can be integrate between countries. Hence, a firm can locate a less energy intensive plant in an energy resources abundant country, which will allow more efficient food production; and
- On investment plans, an unbalanced growth strategy should be embark amongst EA countries by selecting the main player and highest value added producer of food industries with highest efficiency to lead investment plans in bolstering for higher energy growth and at the same time encouraging for consumption of more efficient and cleaner fuels.

In a dynamic and changing food and non-food industry of the EA economy; energy intensity, capacity and value chains of production measures how efficient, interconnected and integrated a country to a region. This assists in driving efficiency and expanding output, especially in times of energy price increase. In this continuous effort of building capacity, interconnectedness amongst chains of production is critical in crystalizing integration.

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Appendix A. Energy intensity results for selected EA countries

Table 11. Direct and Indirect Effects of Oil Price Increase for Malaysia and Singapore, 2005

Malaysia

Direct effects	VA	M	M/VA
Food Crops	0.608	0.092	0.151
Vegetables	0.570	0.197	0.346
Fruits	0.557	0.074	0.133
Poultry Farming	0.483	0.041	0.085
Other Livestock	0.528	0.040	0.076
Fishing	0.502	0.107	0.213
Meat and Meat Production	0.182	0.068	0.373
Preservation of Seafood	0.231	0.104	0.448
Preservation of Fruits and Vegetables	0.255	0.159	0.623
Dairy Production	0.162	0.266	1.649
Oils and Fats	0.120	0.061	0.512
Grain Mills	0.143	0.332	2.324
Bakery Products	0.202	0.147	0.724
Confectionery	0.236	0.416	1.760
Other Food Processing	0.194	0.188	0.969
Wine and Spirit	0.277	0.198	0.717
Soft Drink	0.202	0.260	1.288

Singapore

Direct effects	VA	M	M/VA
Food preparations	0.228	0.463	2.029
Bread, biscuits & confectionery	0.323	0.251	0.775
Sugar, chocolate & related products	0.180	0.608	3.385
Oils & fats	0.129	0.611	4.725
Dairy products	0.246	0.361	1.468
Coffee & tea	0.207	0.420	2.032
Other food products	0.219	0.401	1.829
Soft drinks	0.260	0.311	1.198
Alcoholic drinks & tobacco products	0.256	0.227	0.888
Food & beverage services	0.411	0.150	0.365

Malaysia

Indirect effects	VA	M	M/VA
Food Crops	0.221	0.070	0.3148
Vegetables	0.145	0.077	0.5284
Fruits	0.271	0.087	0.3230
Poultry Farming	0.271	0.190	0.7028
Other Livestock	0.276	0.146	0.5272
Fishing	0.245	0.117	0.4781
Meat and Meat Production	0.540	0.189	0.3509
Preservation of Seafood	0.443	0.189	0.4261
Preservation of Fruits and Vegetables	0.397	0.165	0.4169
Dairy Production	0.356	0.188	0.5290
Oils and Fats	0.610	0.174	0.2858
Grain Mills	0.387	0.110	0.2854
Bakery Products	0.404	0.212	0.5247
Confectionery	0.217	0.113	0.5185
Other Food Processing	0.372	0.206	0.5524
Wine and Spirit	0.218	0.142	0.6510
Soft Drink	0.294	0.208	0.7083

Singapore

Indirect effects	VA'*(I-A)-VA	M'*(I-A)-M	M/VA
Food preparations	0.174	0.131	0.754
Bread, biscuits & confectionery	0.236	0.188	0.797
Sugar, chocolate & related products	0.120	0.091	0.758
Oils & fats	0.111	0.148	1.332
Dairy products	0.201	0.191	0.949
Coffee & tea	0.201	0.169	0.840
Other food products	0.204	0.174	0.854
Soft drinks	0.224	0.202	0.902
Alcoholic drinks & tobacco products	0.312	0.199	0.639
Food & beverage services	0.307	0.129	0.419

Source: DOS, I-O Table 2005 and OECD
Notes: Highlighted results constitutes M/VA coefficients of more than 1.0