UNIVERSITI PUTRA MALAYSIA

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By

SHRI DEWI A/P APPLANAIDU

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IMPACT OF BIODIESEL DEMAND ON THE MALAYSIAN PALM OIL MARKET

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SHRI DEWI A/P APPLANAIDU

November 2010

Chairman: Professor Fatimah Mohamed Arshad, PhD

Faculty: Economics and Management

One of the new elements in the palm oil market is the growing demand for this commodity as a feedstock to biodiesel production. This new development is affecting the dynamics of the market, in particular, the supply and demand sectors of this commodity. The general objective of the study is to investigate the impact of biodiesel demand on the Malaysian palm oil market. The specific objectives are: (i) to develop an econometric model of the Malaysian palm oil market, (ii) to examine the relationship between crude oil and palm oil and eventually to examine the impact of world crude oil prices on Malaysian palm oil market, (iii) to examine the impact of biodiesel demand on Malaysian palm oil market (supply, demand and price) and (iv) to recommend some policy options to ensure the competitiveness of Malaysian biodiesel industry.

The study uses econometric modelling involving simultaneous system of nine structural equations and four identities. The estimators of the structural parameters were derived with the two stage least squares (2SLS) method using annual data for the period 1976-2009. The structural relationships were validated with Theil's inequality coefficients (U-Theil), the root mean squares percentage errors (RMSPE) and turning points. The 2SLS model was used for simulation of counterfactual and scenario analysis. The econometric simulation consists of two parts. The first part consists of *counterfactual analysis*. A 'shock' was injected into the system by indicating two levels of crude oil prices (i.e., 20 percent increase and decrease in crude oil prices; 30 and 60 percent increase in biodiesel demand). The impact of these change on endogenous variables were then estimated. The second part was the *ex-ante* simulation scenario analysis. The forecast was carried out for the years 2010 to 2015 before the *ex-ante* simulation exercise.

The results of the regression analyses show that relative price between palm oil and natural rubber, interest rate, government development expenditure on agriculture and time trend are important factors affecting palm oil production. The domestic consumption is significantly affected by palm oil price, income, price of soybean oil and lagged domestic consumption. All the variables in the export demand of palm oil for biodiesel equation including palm oil world price, exchange rate, rapeseed oil price, biodiesel importing countries GDP and price of crude oil are statistically significant. Meanwhile, the export of palm oil for non-biodiesel purpose is significantly affected by palm oil world price, exchange rate, soybean oil price, world income and presence of a lagged dependent variable. The palm oil stock, palm oil world price, biodiesel demand and lagged domestic price are the main important variables influencing the domestic

price of palm oil. Meanwhile, the world price is affected by soybean price, world income and lagged world price. The coefficient of the world stock variable is negative and it follows the expected sign. This coefficient, however, is not statistically significant.

A *counterfactual analysis* of a sustained 20 percent increase in crude oil prices predicts a direct effect of a 22.94 percent increase in export of palm oil for biodiesel. The indirect effects through the export of palm oil for biodiesel transmission channels are: 11.43 percent decrease in stock, 25.03 percent increase in Malaysian domestic palm oil price, 0.18 percent increase in crude palm oil production, 0.72 percent decrease in domestic consumption and there is also 26.33 percent increase in world price. Meanwhile an ex-ante simulation suggests that the directions are consistent with the theory and *counterfactual analysis* but the magnitude of changes are smaller.

A sustained 30 percent increase in biodiesel demand of *counterfactual analysis* predicted a direct effect of a 27.94 percent increase in Malaysian domestic palm oil price. The domestic price acted as a transmission channel which results in a 1.18 percent increase in crude palm oil production, 0.45 percent decrease in domestic consumption, 0.43 percent increase in stock, 20.77 percent decrease in world price, 2.52 percent increase in export of palm oil for biodiesel and a 12.95 percent increase in imports. An *ex-ante* simulation suggests that the directions are consistent with the theory and *counterfactual analysis* but the magnitude of changes are smaller.

The econometric simulations suggest that the biodiesel demand does bring positive economic impact on selected sub-sectors of the palm oil industry such as it encourages export, increase

domestic price and hence to some extent production. Since the study suggest that production of palm oil as a feedstock to biodiesel in Malaysia increase in response to the biodiesel demand future expansion may be hindered because of land constraint. As an option, Malaysia can invest offshores such as in Indonesia, Papua New Guniea and selected African countries.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

IMPAK PERMINTAAN BIODIESEL KE ATAS INDUSTRI KELAPA SAWIT DI MALAYSIA

Oleh

SHRI DEWI A/P APPLANAIDU

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Salah satu elemen baru dalam pasaran minyak sawit Malaysia ialah pertumbuhan dalam permintaan minyak sawit mentah (MSM) sebagai input untuk pengeluaran biodiesel. Pertumbuhan baru ini mempengaruhi dinamik pasaran MSM khususnya penawaran dan permintaan. Objektif umum kajian ini adalah untuk mengkaji impak perubahan permintaan biodiesel ke atas pemboleh ubah endogen utama industri kelapa sawit Malaysia. Objektif khusus merangkumi: (i) membentuk model ekonometrik bagi pasaran minyak sawit Malaysia; (ii) melihat hubungan diantara minyak mentah dan MSM yang seterusnya mengkaji impak perubahan harga minyak mentah ke atas pasaran minyak sawit Malaysia; (iii) mengkaji impak perubahan permintaan biodiesel ke atas pemboleh ubah endogen utama industri kelapa sawit

Malaysia (khususnya penawaran, permintaan dan harga) dan (iv) mengesyorkan beberapa polisi untuk memastikan pembangunan industri biodiesel adalah kompetatif.

Satu model ekonometrik struktur industri minyak sawit telah dibentuk. Data tahunan bagi tempoh 1976-2009 digunakan dalam penganggaran. Kaedah penganggaran Kuasa Dua Terkecil Dua Peringkat (2SLS) tak linear digunakan. Untuk menentukan kesahihan model ini, ketaksamaan koefisien Theil (U-Theil) dan kesalahan punca kuasa dua peratusan purata (RMSPE) dikira. Nilai keanjalan daripada penganggaran 2SLS digunakan untuk analisis *counterfactual* dan senario. Simulasi ekonometrik dalam kajian ini terbahagi kepada dua. Bahagian pertama adalah analisis *counterfactual*. Satu 'kejutan' telah disuntik ke dalam sistem dengan dua tahap harga minyak mentah (peningkatan dan penurunan 20 peratus harga minyak mentah; peningkatan sebanyak 30 and 60 peratus dalam permintaan biodiesel). Impak perubahan ini keatas pembolehubah endogen utama dianggarkan. Bahagian kedua adalah analisis senario. Ramalan *ex-ante* dijalankan bagi tahun 2010-15 sebelum menjalankan simulasi *ex-ante*.

Keputusan kajian menunjukkan harga relatif diantara MSM dan getah asli, kadar faedah, perbelanjaan pembangunan kerajaan ke atas pertanian dan tren masa adalah faktor penting yang mempengaruhi pengeluaran MSM. Penggunaan domestik dipengaruhi oleh harga minyak sawit, pendapatan, harga minyak soya dan penggunaan domestik tertangguh secara signifikan. Kesemua pemboleh ubah dalam persamaan permintaan eksport minyak sawit untuk biodiesel termasuklah harga dunia minyak sawit, kadar pertukaran asing, harga minyak biji sesawi, Keluaran Dalam Negara Kasar (KDNK) negara pengimport biodiesel dan harga minyak mentah dunia adalah signifikan. Seterusnya, eksport minyak sawit untuk kegunaan selain daripada biodiesel secara signifikannya di pengaruhi oleh harga minyak sawit dunia, kadar pertukaran

asing, harga minyak kacang soya, pendapatan dunia dan pemboleh ubah endogen tertangguh. Stok minyak sawit, harga minyak sawit dunia, permintaan biodiesel dan harga domestik tertangguh adalah faktor penting yang mempengaruhi harga domestik minyak sawit Malaysia. Seterusnya harga dunia dipengaruhi oleh harga kacang soya, pendapatan dunia dan harga minyak sawit dunia tertangguh. Walaupun koefisyen stok dunia tidak signifikan namun ia adalah negatif dan mengikut tanda yang dijangka.

Analisis *counterfactual* dengan 20 peratus peningkatan dalam harga minyak mentah menganggarkan kesan langsung peningkatan sebanyak 22.94 peratus dalam eksport minyak sawit untuk kegunaan biodiesel. Kesan tidak langsung melalui transmisi eksport minyak sawit untuk kegunaan biodiesel adalah: 11.43 peratus penurunan dalam stok minyak sawit, 25.03 peratus peningkatan dalam harga domestik minyak sawit, 0.18 peratus peningkatan dalam pengeluaran, 0.72 peratus penurunan dalam penggunaan domestik dan peningkatan sebanyak 26.33 peratus dalam harga minyak sawit dunia. Seterusnya simulasi *ex-ante* mencadangkan bahawa arah perubahan adalah konsisten dengan teori dan analisis *counterfactual*.

Seterusnya peningkatan 30 peratus dalam permintaan biodiesel dalam analisis *counterfactual* menganggarkan kesan langsung sebanyak 27.94 peratus peningkatan dalam harga minyak sawit domestik. Kesan tidak langsung melalui transmisi harga domestik adalah: 1.18 peratus peningkatan dalam pengeluaran minyak sawit, 0.45 peratus penurunan dalam penggunaan domestik, 0.43 peratus peningkatan dalam stok, 20.77 peratus penurunan dalam harga minyak sawit dunia, 2.52 peratus peningkatan dalam eksport minyak sawit untuk kegunaan biodiesel dan domestik dan peningkatan sebanyak 12.95 peratus dalam import. Seterusnya simulasi ex-ante

mencadangkan bahawa arah perubahan adalah konsisten dengan teori dan analisis *counterfactual*.

Simulasi ekonometrik mencadangkan bahawa permintaan biodiesel mampu memberi impak ekonomi positif ke atas sub-sektor terpilih dalam industri minyak sawit khususnya meningkatkan eksport, harga domestik minyak sawit dan juga pengeluaran minyak sawit. Oleh kerana analisis ini juga mencadangkan peningkatan dalam pengeluaran minyak sawit sebagai input untuk pengeluaran biodiesel di Malaysia akibat daripada peningkatan dalam permintaan biodiesel namun begitu pertambahan dalam pengeluaran mungkin terjejas akibat kekangan tanah untuk kelapa sawit. Sebagai pilihan, Malaysia boleh melabur di Indonesia, Papua New Guniea dan beberapa negara Afrika terpilih.

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I certify that an Examination Committee met on November 11, 2010 to conduct the final examination of Shri Dewi a/p Applanaidu on her Doctor of Philosophy thesis entitled "Impact of Biodiesel Demand on the Malaysian Palm Oil Market" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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DECLARATION

I declare that this thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously and is not concurrently submitted for any other degree at Universiti Putra Malaysia or any other institutions.

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SHRI DEWI A/P APPLANAIDU

Date: 11 November 2010

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