



Europe Economics

The Economic Impact of Palm Oil Imports in the EU

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Executive Summary

The European Union (EU) imported over 9 million tonnes of palm oil and palm kernel meal in 2012. Europe Economics was asked by the Malaysian Palm Oil Council to estimate the scale of the downstream economic activity in the EU and its Member States associated with those imports and the impact of any resulting increase in demand.

Palm oil is a part of a complex supply chain as it is used in the production of a wide variety of products – from biscuits to eye shadow to biodiesel. It is used by major European firms such as BASF (Germany), Ferrero (Italy), Tesco (UK) and L'Oréal (France), but also by many SMEs in a broad range of sectors.

Our key findings are that in the EU27 in 2012, palm oil imports made a substantial contribution to the EU economy, including:

- Palm oil is associated with a contribution to EU GDP of €2.7bn in downstream industries and €5.8bn including the impact of a resulting rise in demand;
- Palm oil is associated with a contribution to tax revenues of €1.2bn in downstream industries and €2.6bn including the impact of a resulting rise in demand; and
- Palm oil is associated with 67,000 jobs in downstream industries and 117,000 jobs including the impact of a resulting rise in demand.

The full results by Member State are set out in Table 0.1 on the next page.

The sectors where the contribution to GDP was the largest relate to the production of food. However there are also significant contributions to the generation of electricity and the production of chemical products including motor fuel. Other sectors involved in the production process such as retail and land transportation also see significant additional activity.

While this report does not address the question of what might happen if palm oil imports were to be restricted thanks to some policy change or other exogenous shock, it does establish the importance of the product in European industry. As an affordable and available primary input for a wide range of industries palm oil is associated with substantial downstream economic activity across Europe.

Table 0.1: Economic impact of Palm Oil, 2012

| | Value of palm oil imports, €m | Indirect change in GDP, €m | Indirect + induced change in GDP, €m | Indirect revenue impact, €m | Indirect + induced revenue impact, €m | Indirect change in employment, 000s | Indirect + induced change in employment, 000s |
|-----------------------|-------------------------------|----------------------------|--------------------------------------|-----------------------------|---------------------------------------|-------------------------------------|---|
| EU27 | 5,385 | 2,703 | 5,764 | 1,227 | 2,617 | 67.1 | 117.2 |
| <i>Including:</i> | | | | | | | |
| Austria | 37 | 15 | 24 | 7 | 12 | 0.2 | 0.4 |
| Belgium | 302 | 50 | 57 | 26 | 29 | 0.9 | 1.0 |
| Czech Republic | 37 | 14 | 19 | 6 | 8 | 0.5 | 0.5 |
| Germany | 816 | 217 | 394 | 97 | 176 | 4.5 | 7.1 |
| Denmark | 106 | 27 | 48 | 15 | 27 | 4.2 | 4.4 |
| Spain | 464 | 196 | 576 | 73 | 214 | 4.5 | 10.8 |
| Finland | 171 | 75 | 174 | 41 | 95 | 1.0 | 2.2 |
| France | 324 | 107 | 323 | 56 | 167 | 1.9 | 4.6 |
| Hungary | 16 | 6 | 6 | 3 | 3 | 0.3 | 0.3 |
| Italy | 771 | 308 | 1,063 | 147 | 507 | 5.5 | 14.6 |
| Lithuania | 9 | 2 | 2 | 0 | 1 | 0.1 | 0.2 |
| Netherlands | 1,209 | 253 | 281 | 117 | 131 | 3.2 | 3.6 |
| Poland | 189 | 39 | 73 | 15 | 28 | 5.7 | 7.1 |
| Portugal | 72 | 27 | 77 | 11 | 31 | 1.1 | 2.4 |
| Sweden | 92 | 27 | 50 | 14 | 26 | 0.4 | 0.7 |
| United Kingdom | 548 | 136 | 411 | 57 | 173 | 2.8 | 6.8 |

1 Introduction

The importance of palm oil imports to the economies in which it is produced has been the subject of considerable study. The two largest producers – Malaysia and Indonesia – exported nearly 40m tonnes of palm oil in 2013, worth over \$30bn (at the European import price).

The sector is a major employer. In Malaysia around 491,000 were estimated to work on the oil palm plantations in 2012, both Malaysians and many migrant workers.

There are a number of major firms. The largest is Sime Darby, which has been estimated to account for around 5 per cent of global crude palm oil output. There are also a large number of smallholders, around 300,000, who are estimated to account for 39 per cent of Malaysia's total production.

The economic significance of palm oil imports to the European Union – as a major importer of the commodity – is far less well understood.

The European Union imported nearly €5.4bn of palm oil in 2012. That palm oil was used in the production of a wide range of goods and services from food products like crisps and biscuits to household goods, such as washing powder, to health and beauty products. It was even used as a source of energy (in the production of biodiesel or in electricity generation). A wide range of firms are involved from those transporting the palm oil; to refiners and other processors; to manufacturers producing goods for consumption; to the supermarkets and other retailers who sell those final goods.

Palm oil offers two obvious qualities as a raw material for European industry: it is affordable and it is available. Global production of palm oil has increased considerably more than the production of other oils and fats. World exports almost quadrupled from 1997-98 to 2012-13, whereas exports of other major oils and fats only increased by around fifty per cent over the same period. Proponents also claim that the oil has phyto-chemical properties which make it particularly suitable for food preparation.

In order to improve the understanding of the role of palm oil in the economy of the EU and its Member States, the Malaysian Palm Oil Council asked Europe Economics to study the scale and importance of the downstream industries associated with palm oil imports. This study therefore addresses the question: what is the contribution to GDP, tax revenue and employment of other industries' use of palm oil imports? And what further contributions to GDP, tax revenue and employment might be expected to result from the factors of production in those industries spending the incomes derived from that economic activity?

It is important to note that our results are not intended to capture what might happen in the absence of palm oil or in the event that its use was restricted in some way. That would depend on the extent to which those industries were able to use other inputs and the extent to which they had to pay higher prices in order to do so, and would require further research.

Understanding the forward linkages of the industry is instead an invaluable first step in understanding the wider significance of palm oil imports. It illustrates the scale of the industrial activity at stake.

2 The Palm Oil Supply Chain

A report for the British Government's Department for Environment, Food and Rural Affairs (DEFRA) examined the palm oil supply chain in the UK. That research identified an enormous range of different sectors in which palm oil is used. A list of European firms reported to use palm oil is included in Appendix B.

There are also a number of other industries which contribute to the production of products using palm oil, though they may not physically encounter the commodity, such as financial and professional services firms supporting food manufacturers.

We treat the firms which form part of the downstream palm oil industry as broadly fitting under nine categories: refineries and processors; food manufacturers; feed manufacturers; other product manufacturers; electricity generators; biodiesel makers; freight transportation providers; retailers; and service providers.

Beyond that, a great many other firms either act as suppliers or intermediate consumers to those industries. Manufacturers produce vehicles which are used by haulage firms to move goods made with palm oil. Airlines use cleaning products produced using palm oil when preparing planes to transport passengers.

2.1 Refineries and processors

These include edible oil refineries and oleochemical plants. Those plants process crude palm oil for use by other industries. There are a relatively small number of these plants spread around the EU, but they are particularly concentrated at the Port of Rotterdam. 42 per cent of the annual throughput of edible oils, fats and oleochemicals in the Port of Rotterdam was palm oil.

2.2 Food manufacturers

The principal final use of palm oil is in food products. Around 60 per cent of EU consumption was accounted for outside the energy sector in 2012, mainly by food though also including other products. Food uses include margarine and other spreads; frying fats; food additives; bread; cakes and pastries; biscuits; snacks; confectionary; dairy and dairy replacements; and prepared foods. Unilever is the largest international consumer of palm oil identified in a recent report detailing use of palm oil.

2.3 Feed manufacturers

Palm oil is also found in food for livestock and household pets. The feed industry is estimated to account for around 5 per cent of total palm oil use in the EU. Crude palm oil is used as a fat supplement and other oil palm derivatives (such as palm kernel meal) are used to supply other nutrition.

2.4 Other product manufacturers

Other products in which palm oil is used include cleaning products, soap, personal care products and cosmetics. Cleaning products almost all include surfactants – wetting agents that lower the surface tension of a liquid and surround and trap oily materials on surfaces – and those surfactants can be produced from

petrochemical (crude oil) or oleochemical (principally palm oil) sources. For a variety of reasons, including rising fossil fuel prices and the changing location of the global industry – the share of the global market supplied by oleochemicals has been rising. Firms such as Procter and Gamble manufacture cleaning products in the European Union using imported palm oil.

2.5 Electricity generators

Under Directive 2009/28/EC, 20 per cent of energy consumption must be supplied from renewable sources by 2020. Palm oil is counted under that category – though some regulatory and reputational restrictions on its use have been imposed – alongside other sources of energy from biomass such as wood. Whilst use of palm oil for electricity generation is limited compared to food and other uses, accounting for around 10 per cent of total EU consumption, use for electricity generation has increased significantly in recent years, from 420 thousand tonnes in 2006 to 590 thousand tonnes in 2012 — a rise of some 40 per cent.

Biomass can be used either co-firing with coal in existing plants, in plants converted to burn biomass, or in purpose-built biomass plants. Crude palm oil and a wide range of other products derived from the oil palm (such as palm stearin) are used in energy generation.

2.6 Biodiesel makers

Under Directive 2009/28/EC, energy from renewable sources is required to reach 10 per cent of the total in the transport sector by 2020. While less palm oil is consumed for the purposes of producing biodiesel than for other purposes such as producing food, use for the production of biodiesel has increased sharply, by 365 per cent from 402 thousand tonnes in 2006 to 1,869 thousand tonnes in 2012, and now constitutes some 30 per cent of total palm oil use in the EU.

As an affordable vegetable oil available on world markets, palm oil has been a significant part of the increased use of biodiesel (now routinely blended into conventional motor fuel). Again regulatory and reputational restrictions have limited its role, and other alternatives such as used cooking oil are encouraged by policy in some Member States (e.g. the United Kingdom).

2.7 Freight transportation providers

The substantial volumes of palm oil imports – over six million tonnes in 2012 – means that the transport requirements are substantial. The principal entry point is the Port of Rotterdam, but that may only constitute a small proportion of the total transport requirement as refined palm oil also needs to be taken to manufacturers and final products need to be taken to retailers.

2.8 Retailers

With the substantial range of products in which palm oil is incorporated, many firms are involved in serving them to customers. This includes supermarkets – several supermarkets are major consumers of palm oil themselves for “own brand” products – but also smaller retailers and service companies such as contract caterers and cleaning firms. Public sector organisations, such as hospitals and prisons, may also supply palm oil-based products to their customers.

2.9 Legal, financial and other service providers

All of the other firms listed so far in this section will require support from a range of professional services firms, including those providing legal, financial and accountancy services.

3 Analysing the Impact of Palm Oil Imports

The challenge in analysing the importance of palm oil imports to the economy of the European Union and the economies of its Member States is that – as set out in the last section – palm oil is used in a large number of different products and a wide range of industries are involved in producing those products. At the same time, the statistics on the use of palm oil across the EU are limited. While the supply chain has been studied in detail in the UK, for example, we are not aware of any comparable study for the EU as a whole or for most other Member States.

Estimates do exist – in a GSI-IISD report using *Oil World* data – for consumption in the EU27 as a whole and for 16 Member States which account for around 97 per cent of estimated total EU palm oil use.

Table 3.1: Palm oil use by Member State and sector, 000 tonnes

| Member State | Biodiesel production | Electricity and heat generation | Other uses: mainly food but also personal care and oleochemical products | Total |
|-----------------------|----------------------|---------------------------------|--|-------|
| EU27 | 1,869 | 590 | 3,925 | 6,384 |
| <i>Including:</i> | | | | |
| Netherlands | 480 | 250 | 600 | 1,330 |
| Italy | 220 | 190 | 582 | 992 |
| Germany | 300 | 150 | 518 | 968 |
| UK | 38 | | 574 | 612 |
| Spain | 200 | | 355 | 555 |
| France | 110 | | 295 | 405 |
| Belgium | 40 | | 338 | 378 |
| Finland | 200 | | 20 | 220 |
| Poland | 60 | | 159 | 219 |
| Denmark | 9 | | 127 | 136 |
| Sweden | 21 | | 97 | 118 |
| Portugal | 50 | | 26 | 76 |
| Czech Republic | 23 | | 25 | 48 |
| Austria | 40 | | 7 | 47 |
| Hungary | 18 | | 3 | 21 |
| Lithuania | 5 | | 7 | 12 |

Our approach was to first estimate the value of the palm oil used (based on the 2012 price) and then estimate the backward linkages of that volume of primary supply, in appropriate sectors to match the uses shown above, using Input-Output (I-O) analysis. We then estimated multipliers for policy relevant variables, particularly GDP, tax revenue and employment.

In order to account for the additional use of palm kernel meal, most frequently used as animal feed, we increased the food and other uses value to reflect consumption of palm kernel meal in 2012, multiplied by the average price that year (around a fifth of the palm oil price). That increased our estimate of the total

value of palm oil imports to the EU in 2012 from around €5bn to nearly €5.4bn. It also increased our estimates significantly in a number of individual Member States.

3.1 Input-Output analysis

I-O analysis is a very simple general-equilibrium model which links various sectors in the economy through fixed linear relationships between the output of a sector and the inputs it requires from other sectors.

There are direct, indirect and induced effects. Direct effects occur in those sectors where consumption increases. Indirect effects occur as other sectors adjust to increased demand for intermediate inputs. Induced effects arise as the higher output boosts earnings for the various factors of production in the sectors affected and the additional earnings are then spent.

The main attraction of I-O analysis is that fixed linear relationships make it possible to calculate the effects of an increase in final demand for one sector on every other sector of the economy and on various macroeconomic variables – GDP, employment, tax revenue, incomes and so on. Another interesting feature is that ‘multipliers’ can easily be calculated. These multipliers indicate the percentage change in any macroeconomic quantity (GDP, tax revenue, income, employment, etc.) as a result of a unit increase in final demand for a particular sector.

There are two main well-rehearsed drawbacks of I-O analysis.

- The reliance on fixed linear relationships assumes no change in production technologies. Consequently, I-O is not accurate when analysing long-run effects. The results of I-O analyses should always be viewed as rough approximations to true short-run effects.
- I-O analysis only produces close approximations when economies are not close to full employment. Close to full employment, the additional resources required to produce extra output would simply not be available.

In the current case, however, those drawbacks are of limited importance as we are not seeking to establish the impact of a certain exogenous change in demand, but instead to determine the linkages of an industry and the scale of the downstream economic activity.

3.2 Application to palm oil

There were three challenges in applying I-O analysis in order to understand the forward linkages of the palm oil industry:

- Our exogenous variable is a volume of primary supply – the quantity of palm oil imported for various uses – rather than a change in final demand.
- There is no “palm oil” sector in the I-O tables. We therefore need to assign the palm oil use under the four categories above to appropriate sectors in the I-O tables.
- Palm oil is imported, and therefore the direct economic activity does not occur within the EU. Our task was therefore to estimate only the indirect and induced effects.

3.2.1 Supply-driven Input-Output analysis

In order to model the downstream activities associated with a source of basic supply, we essentially had to reverse the normal process by which I-O analysis is conducted. Instead of calculating fixed input coefficients between different industries and using those to estimate the overall impact of a new vector for final demand, we calculated fixed output coefficients and then applied those to a volume of output from certain primary input sectors.

A concern about this approach might be that supply-driven I-O analysis of shocks lacks sound theoretical foundations and is not recommended as a tool for understanding the impact of policy changes or other exogenous shocks. However, in this case we are not attempting to estimate how much the economy might grow or shrink in response to a supply shock. Rather, we are trying to estimate the scale of given linked activities that are assumed stable. The theoretical foundation for such linkages can be seen as residing in the I-O demand linkages, not supply linkages. Our use of supply linkages is not reflective of an assumed causal mechanism (of doubtful validity). Instead, it can be seen as purely a calculation device to “reverse out” the impact of the demand linkages that theory does supply.

Thus, the findings reported here show the scale of the current economic activity associated with the use of palm oil as a primary input. They should not be taken as an estimate of the extent to which economic activity might contract in the absence of palm oil. That would depend on the availability of other means of supplying final demand and how any resulting increases in price might be passed on.

More detail on the technical process by which the estimates were produced is set out in Appendix A.

3.2.2 Input-Output categories

Eurostat releases I-O tables for use in analysis of this kind, for the EU as a whole and for the individual Member States. Those tables set out the flows of goods and services between different sectors, and the value added by each sector, in the process of producing goods for final consumption. Most Member States now use the NACE 2 classification of economic activity, which breaks the economy down into 65 sectors. Some Member States – for the purposes of this study: Denmark, Poland and Spain – still use the NACE 1 classification, which breaks the economy down into 59 sectors.

Palm oil could be thought to fit under a single category, probably as a product of agriculture. However, in our judgement it is more appropriate, for the current purpose, to assign the use of palm oil to appropriate primary input sectors based on the extent to which the output of those sectors was used in a similar manner to that set out in Table 3.1. That allowed us to reflect the different economic effects that could arise from palm oil being used in different ways. The results are set out in Table 3.2.

Table 3.2: Mapping scheme for palm oil use to NACE 2 and NACE 1 industrial sectors

| Use | Appropriate input sector | | Major consuming sector for input sector | |
|--|-----------------------------|--|---|---|
| | NACE 2 | NACE 1 | NACE 2 | NACE 1 |
| Biodiesel production | CPA_B: Mining and quarrying | II: Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying | CPA_C19: Coke and refined petroleum products | 23: Manufacture of coke, refined petroleum products and nuclear fuels |
| Electricity and heat generation | CPA_B: Mining and quarrying | II: Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying | CPA_D35: Electricity, gas, steam and air-conditioning | 40: Electricity, gas, steam and hot water supply |

| Use | Appropriate input sector | | Major consuming sector for input sector | |
|---|--|---|---|--|
| Other uses: mainly food but also personal care and oleochemical products | CPA_A01: Products of agriculture, hunting and related services | 01: Agriculture, hunting and related service activities | CPA_C10-12: Food products, beverages and tobacco products | 15: Manufacture of food products and beverages |
| Palm kernel meal: mostly used in animal feed | CPA_A01: Products of agriculture, hunting and related services | 01: Agriculture, hunting and related service activities | CPA_C10-12: Food products, beverages and tobacco products | 15: Manufacture of food products and beverages |

Essentially we have modelled the impact of palm oil used for food and other uses as equivalent to agricultural output, and palm oil used for biodiesel production or electricity generation as equivalent to conventional energy output. We think that is an appropriate reflection of the economic role that palm oil is playing when put to those uses.

3.2.3 Imports

In order to account for the fact that we are studying imported palm oil, rather than domestic production, we have subtracted the direct effects (those which arise most straightforwardly where a product is produced) from our estimates of the impact on production. The resulting production estimates give the indirect effects or indirect plus induced effects, from which we can obtain appropriate results using multipliers for the policy relevant variables GDP, employment and tax revenue.

4 Results

The results from our analysis show the significant downstream economic activity associated with palm oil imports. In 2012, the around €5.4 billion of palm oil imports to the EU27 were associated with:

- an indirect contribution to GDP of €2.7bn or an indirect and induced contribution to GDP of €5.8 billion;
- an indirect contribution of €1.2bn in tax revenue or an indirect and induced contribution of €2.6bn in tax revenue; and
- an indirect contribution to employment of 67,000 jobs or an indirect and induced contribution to employment of 117,000 jobs.

A full breakdown of the headline results for each Member State where data on palm oil use in 2012 was available can be found in Table 0.1 in the Executive Summary of this report.

The largest volume of palm oil imports was to the Netherlands – at over €1.2bn – but the largest indirect and induced contributions to GDP are estimated to occur in the larger Member States: Italy, Spain, Germany, France and the United Kingdom.

In Italy, the substantial indirect and induced effects result from:

- The large volume of palm oil imports. Italy imported the second largest quantity of palm oil in 2012, at 992,000 tonnes.
- The substantial Italian food manufacturing sector, which contributed around 11 per cent of the total gross value added in the sector across the EU in 2010.
- Relatively low import penetration at 29 per cent of GDP, compared to the average of 43 per cent across the EU28, which increases the induced effect as money spent in Italy is relatively likely to be spent on Italian products.

In Spain, the substantial indirect and induced effects result from:

- A substantial volume of palm oil imports, it imported the fifth largest quantity of palm oil in 2012, behind the Netherlands, Italy, Germany and the United Kingdom.
- The substantial food manufacturing sector, which contributed around 10 per cent of the total gross value added in the sector across the EU in 2010.
- Relatively low import penetration at 32 per cent of GDP in 2012, again compared to the average of 43 per cent across the EU28.

The importance of Germany, France and the United Kingdom to the palm oil supply chain is to be expected as they are the largest economies of the EU Member States. The broad range of uses to which palm oil is put mean that – all else equal – palm oil-related economic activity is likely to match the distribution of economic activity more broadly.

Larger economies will also generally capture more of the economic activity associated with palm oil. It is possible that leakages between Member States not captured in this modelling exercise might add to the contribution in each individual Member State. Furthermore, cross-leakages (leakages of one kind of activity away from one Member State to another whilst at the same time there are leakages of other kinds of activity in to that first Member State from the second) can be very significant within the EU, particularly because of the ways the Single Market facilitates intra-industry trade. The EU27 estimates are therefore the best guide to the overall contribution.

The extent of downstream economic activity in the Netherlands might appear relatively modest, given that it is the largest importer of palm oil and the location for substantial refining capacity. However the analysis reflects the fact that – in a relatively small and open economy like the Netherlands – palm oil will often be imported or imported and then refined in the Netherlands but most of the value added will then be contributed in other Member States, where refined palm oil is used to produce goods and services and those goods are then distributed to retailers and consumers.

In terms of the different sectors affected, selected sectors are shown in Table 4.1, the sectors where the indirect contribution to GDP associated with palm oil is the largest (the induced impact is not associated with any particular sector or sectors) are those associated with the production of food and chemical products (particularly motor fuel). That reflects our understanding of how palm oil is used in practice. However there are also significant contributions in other sectors such as land transportation and retail trade services, which may be associated with distributing intermediate or finished products, and other sectors which might produce complementary raw materials, such as agriculture.

The fact that no one sector represents more than around a fifth of the indirect contribution to GDP demonstrates the diffuse nature of the palm oil sector in the EU. There are a wide range of industries included, to varying extents, in the downstream palm oil supply chain. That can also be seen in how the top ten companies by palm oil consumption (listed in Appendix B) accounted for only around a third of EU palm oil consumption in 2013 (and that may include some overlap with palm oil processed by one company – e.g. BASF – and then used by another in final products). The rest of the market will be accounted for by smaller firms, in many cases small and medium-sized enterprises.

Table 4.1: Indirect contribution to EU27 GDP associated with palm oil, 2012, sectors where contribution is over €50m

| Sector | Indirect contribution to GDP associated with palm oil, €m |
|---|--|
| Food products, beverages and tobacco products | 610 |
| Products of agriculture, hunting and related services | 254 |
| Electricity, gas, steam and air-conditioning | 205 |
| Accommodation and food services | 189 |
| Constructions and construction works | 170 |
| Wholesale trade services, except of motor vehicles and motorcycles | 130 |
| Retail trade services, except of motor vehicles and motorcycles | 65 |
| Other non-metallic mineral products | 61 |
| Public administration and defence services; compulsory social security services | 60 |
| Human health services | 60 |
| Chemicals and chemical products | 59 |
| Coke and refined petroleum products | 58 |
| Mining and quarrying | 57 |
| Land transport services and transport services via pipelines | 51 |

5 Conclusions

To put the contribution to economic activity in the EU27 in context, the indirect and induced contribution to employment associated with palm oil in 2012 was similar to the number directly employed in the extraction of crude petroleum and natural gas, or around twice the number directly employed in the mining of metal ores.

In Malaysia around 491,000 workers were involved in producing 19 million tonnes of palm oil in 2012. In other words, around twenty six workers were employed for every thousand tonnes of palm oil produced that year.

In Europe, our estimates suggest that nearly 67,000 jobs were associated with around 9 million tonnes of palm oil and palm kernel meal imports in 2012, or nearly 117,000 jobs once the wider increase in demand resulting from that economic activity is taken into account. That implies – despite the generally higher labour productivity in European economies, particularly in this case with a contribution to GDP of around €40,000 per worker – more than seven workers were employed in the downstream supply chain for every thousand tonnes imported, or around thirteen workers including the resulting increased demand.

That leads to a simple intuitive result: imports of palm oil are important, on an at least somewhat similar scale, to the importer as well as the exporter. While the importance of palm oil exports to the Malaysian economy is obvious, it is much easier for the importance of palm oil imports to the European economy, diffused across all the Member States; a wide range of industrial sectors; and both large firms and a multitude of SMEs, to be ignored. This report hopefully constitutes a valuable first step in correcting that imbalance.



Appendices



Europe Economics

Appendix A: Input-Output Analysis

Background

Most Input-Output analysis is based upon the static input-output system developed by Wassily Leontief in the 1930s. Leontief's model is based upon fixed, linear production functions and sets out the output needed from each industry in order to satisfy a given vector of final demand:

For illustrative purposes, assume that the economy has three sectors: agriculture, industry and services. There are two factor inputs: labour and capital. The end uses for the products of each sector are summarised in one quantity vector called final demand (in a more complicated model, this would be broken down into household consumption expenditure, government consumption expenditure, gross fixed capital formation and net exports).

In this simplistic model, the production of any sector can be looked at by use – the produce is used as inputs by any or all of the three sectors, and is sold to final demand. The entire economy may be summarised in the following three equations.

$$\begin{aligned} X_{AA} + X_{AI} + X_{AS} + X_{AD} &= X_A \\ X_{IA} + X_{II} + X_{IS} + X_{ID} &= X_I \\ X_{SA} + X_{SI} + X_{SS} + X_{SD} &= X_S \end{aligned}$$

Here:

- Sectors are represented by the following subscripts: A = agriculture, I = industry, S = services;
- X_{ij} is the intermediate demand for the produce of sector i by sector j , where $i, j \in \{A, I, S\}$;
- X_{iD} is the final demand for the produce of sector i ;
- X_i is the total production of sector i ; and
- all units are in money terms.

The assumption of fixed coefficients is interpreted in the following way. Take the industry sector. It needs to use X_{AI} of the produce of the agriculture sector to produce X_I of final produce. Consequently, it needs $\frac{X_{AI}}{X_I}$ worth of the agricultural produce to produce product worth one unit of currency. The assumption is that a_{AI} is the fixed technical coefficient of intermediate consumption that provides one link between the industry and agriculture sectors – regardless of the amount that the industry sector produces this proportion would remain constant. Similar intermediate consumption coefficients may be calculated for links between each pair of sectors.

$$a_{ij} = \frac{X_{ij}}{X_j} \text{ for } i, j = A, I, S$$

The system of equations can then be represented in terms of the fixed technical coefficients, the total production of each sector and the final demand facing each sector as follows.

$$\begin{aligned} a_{AA}X_A + a_{AI}X_I + a_{AS}X_S + X_{AD} &= X_A \\ a_{IA}X_A + a_{II}X_I + a_{IS}X_S + X_{ID} &= X_I \\ a_{SA}X_A + a_{SI}X_I + a_{SS}X_S + X_{SD} &= X_S \end{aligned}$$

Using matrix notation, this may be re-written as follows.

$$\begin{bmatrix} a_{AA} & a_{AI} & a_{AS} \\ a_{IA} & a_{II} & a_{IS} \\ a_{SA} & a_{SI} & a_{SS} \end{bmatrix} \begin{bmatrix} X_A \\ X_I \\ X_S \end{bmatrix} + \begin{bmatrix} X_{AD} \\ X_{ID} \\ X_{SD} \end{bmatrix} = \begin{bmatrix} X_A \\ X_I \\ X_S \end{bmatrix} \Rightarrow \mathbf{A} \cdot \mathbf{X} + \mathbf{X}_D = \mathbf{X}$$

Change in final demand

With this set up, it now becomes possible to analyse the effects on the economy when the final demand changes for the produce of a certain sector. The problem is straightforward – we have a new set of final demands X_{iD} (contained in the vector X_D) and a set of technical coefficients a_{ij} (which are contained in the matrix A) that are known. We need to know what the total produce of each sector should now be, i.e. we need to find the X_i s (contained in the vector X). In terms of the three-equation set up, the problem is simple – there are three equations with three unknown variables to solve for. Simple algebraic manipulation leads us to the new final outputs.

For computational reasons, it is easier to work with matrices, as in actual models the number of sectors is much higher than three, and algebraic manipulation becomes harder. Thus, in matrix terms, the solution is given by manipulation of the basic set-up equation.

$$X = (I - A)^{-1} \cdot X_D$$

Here

- I is an identity matrix with 1 along the diagonal and 0 elsewhere; and
- $(I - A)^{-1}$ is the inverse of the matrix $(I - A)$

There are a number of reservations over that approach, in particular:

- The assumption of a fixed, linear production function excludes the possibility that firms can substitute other inputs or that there are increasing or decreasing returns to scale.
- The assumption that inputs can respond freely to final demand (the only exogenous variable) in the model is only plausible if none of those inputs are scarce and the economy is therefore not close to full employment.

However, demand-driven I-O analysis does provide an understanding of the backward linkages between industries and, in the short-term, the demand-driven input-output approach also gives an understanding of the likely effects of policies such as Keynesian stimulus programmes.

Change in supply

In the case of Palm Oil imports, we are not studying the effects of final demand, or changes in final demand, but changes in supply from certain sectors. The supply-driven application of I-O analysis demands some differences in approach and has a different set of limitations to demand-driven analysis.

There is a corresponding supply-driven quantity model analogous to the demand-driven model set out above. The model uses output coefficients, which are distribution parameters products reflecting market shares, rather than the input coefficients described above and used in demand-driven I-O analysis, which reflect production functions or cost structures of activities. Those output coefficients are calculated by dividing each entry of the input-output table by the corresponding row total.

An output coefficient model then takes the following form:

$$\begin{aligned} B' \cdot X + Z_S &= X \\ (I - B') \cdot X &= Z_S \\ X &= (I - B')^{-1} \cdot Z_S \end{aligned}$$

Here

- B' is a transposed matrix of output coefficients for intermediates;
- I is an identity matrix with 1 along the diagonal and 0 elsewhere; and
- Z_S is a new set of primary inputs or value added for intermediate sectors.

There are further limitations on the use of supply-driven I-O models though as they are often thought to “lack a proper microeconomic foundation”. However that shortcoming mainly relates to studies of the

impacts of policy shocks, where a “straightforward use of the model” is seen as inappropriate. Even critical analysis suggests that “using the supply-driven model as a descriptive device to indicate the strength of forward linkages is justified”.

That is how we need to understand the results obtained in this study: as an indication of the forward linkages of Palm Oil imports in European Member State economies; the scale of the economic activity associated with Palm Oil imports as an input. Further research would be needed in order to understand the impact of discrete policy changes; how the economic activity associated with Palm Oil imports might be diminished by any attempts to restrict those imports.

Direct, indirect and induced effects

In I-O analysis, changes in macro variables are the result of three kinds of effect:

- **Direct effect:** If a sector produces more output, either in response to final demand in a demand-driven model or as an exogenous input in a supply-driven model. It results in additions to GDP, employment, income, taxes, and other policy relevant variables, but we have subtracted that component in our analysis as the direct effects of increase Palm Oil production will take place in the exporting countries, not in the EU Member States which import the Palm Oil.
- **Indirect effect:** These are caused by all sectors adjusting outputs to allow for an increase in demand for intermediate inputs that would accompany any increase in output by any sector. The model described above captures indirect effects and, as Palm Oil is best understood as a primary input, we are particularly studying the forward linkages of the sector.
- **Induced effect:** Increases in production mean increased incomes for those providing the factors of production (investors providing capital; workers providing labour). As they spend those higher incomes, that creates an increase in final demand and therefore a further increase in production. Induced effects cannot be calculated using I-O tables because the household sector is regarded as extraneous.

We have calculated these effects indirectly using data on income multipliers. To do this, we first estimated income multipliers based on savings and import rates. We then multiplied the GDP effects (excluding induced effects) by the income multipliers to arrive at the total effects (including induced effects). It should be noted that this analysis was conducted only at the Member State and EU levels, not at the sector level.

Estimating policy relevant multipliers

Once the new total outputs have been calculated, the effects on several macro variables may be obtained:

- **GDP effects:** As GDP is simply the sum total of all goods and services produced in the economy, the new GDP is obtained by adding up all new total production figures for all sectors in the economy. We first calculated the proportion of output of each sector that represents value creation. We then used the same proportions to estimate the value added consistent with the increased outputs as a result of the increased production expected.
- **Employment effects:** To calculate these, one needs to multiply the change in output in each sector with the number of employees it takes to produce one currency unit worth of produce. This is also a fixed coefficient, and can be calculated using initial production and initial employment. Initial employment was available from Eurostat based on the same NACE categories as the I-O tables. The induced effect was estimated by multiplying the induced effect on GDP by the ratio of employment to GDP in each Member State.
- **Tax effects:** For the purposes of this report, we have simply multiplied the increase in GDP by the share of taxes in GDP in the wider economy. This method is consistent with the assumption that the additional GDP (direct, indirect and induced) has the same composition in terms of tax liability as pre-existing GDP. This assumption is unlikely to be entirely accurate because the direct and indirect GDP increases have a different sectoral composition when compared to pre-existing GDP, which in turn may

not have the same tax liability as each other. Therefore, estimates obtained using this method should be regarded as an approximation.

Appendix B: List of firms using Palm Oil

The following data is drawn from the *WWF Palm Oil Buyers Scorecard 2013*.

| Company Name | Country | Palm oil use, 2013, tonnes |
|------------------------------------|----------------|-----------------------------------|
| Unilever | Netherlands | 1,523,605 |
| BASF | Germany | 200,000 |
| Ferrero Trading | Italy | 150,000 |
| CSM | Netherlands | 107,449 |
| Reckitt Benckiser | UK | 106,895 |
| Henkel | Germany | 71,608 |
| L'Oréal | France | 61,850 |
| Vandemoortele | Belgium | 57,306 |
| United Biscuits | UK | 54,137 |
| Aldi | Germany | 53,100 |
| Associated British Foods | UK | 45,831 |
| Barilla | Italy | 39,250 |
| IKEA | Sweden | 34,000 |
| Tesco | UK | 33,811 |
| Aviko | Netherlands | 20,509 |
| Farm Frites | Netherlands | 18,917 |
| Lidl | Germany | 17,530 |
| Premier | UK | 16,358 |
| Nutreco International | Netherlands | 15,000 |
| August Storck | Germany | 14,403 |
| Arla Foods | Denmark | 14,025 |
| ASDA | UK | 12,421 |
| Smilde Foods - Royal Smilde | Netherlands | 12,100 |
| Sainbury's | UK | 11,212 |
| EDEKA | Germany | 11,175 |
| REWE Group | Germany | 10,100 |
| Lotus | Belgium | 8,700 |
| Scamark | France | 8,364 |
| Remia | Netherlands | 8,300 |
| Royal Ahold | Netherlands | 8,000 |
| Lantmännen | Sweden | 7,546 |
| Groupe Lactalis | France | 7,400 |
| Bongrain | France | 7,000 |
| Carrefour | France | 7,000 |
| Les Mousquetaires | France | 6,537 |
| Dansk Supermarket | Denmark | 5,889 |
| Oriflame | Sweden | 5,801 |
| Morrisons | UK | 5,778 |
| Karl | Finland | 5,636 |
| Yves Rocher | France | 5,125 |

| Company Name | Country | Palm oil use, 2013, tonnes |
|--------------------------------|----------------|-----------------------------------|
| Cémoi | France | 5,100 |
| Magasins | France | 4,174 |
| Co-operative | UK | 3,890 |
| Kaufland | Germany | 3,674 |
| HARIBO | Germany | 3,350 |
| Marks & Spencer | UK | 3,064 |
| Sodexo | France | 2,939 |
| Waitrose | UK | 2,728 |
| Brioche | France | 2,585 |
| Delhaize | Belgium | 2,500 |
| Casino | France | 2,376 |
| ICA | Sweden | 2,200 |
| Jumbo | Netherlands | 2,000 |
| Harry's | France | 1,800 |
| Axfood | Sweden | 1,690 |
| Reitan/REMA | Denmark | 1,463 |
| Laboratoire L'Occitane) | France | 1,287 |
| Warburtons | UK | 1,180 |
| SOK | Finland | 1,145 |
| Dcoop Sweden | Sweden | 949 |
| Raisio Oyj | Finland | 841 |
| Kesko Food | Finland | 800 |
| Ecover | Belgium | 775 |
| Boots | UK | 367 |
| R&R Ice cream | UK | 211 |