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An Extension of the World Import/Export Land Model

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This is a guest post by Mark B, who has a B.S. in Physics and is presently in graduate school in an area of Applied Physics/Engineering.

Disclaimer: While I certainly think I'm qualified to perform quantitative analysis, I'm no expert on the oil industry. I welcome and expect the constructive criticism of the many knowledgeable editors and commenters.

There are many people on either side of the Export Land Model issue: those who think the internal consumption of an exporter will continue to increase at the detriment of exports and those who think there will be enough pressure, be it economic or otherwise, to stifle internal consumption so that net exports don't suffer. I see no reason we won't see both of these situations occurring depending on the specific details of a given exporter. The question, I think, is which effect will be dominant in the aggregate and to what degree? If, after the peak in world oil production, either effect is dominant in the extreme then "bad things" happen. If internal consumption continues to grow, importers will have to drastically decrease consumption. If exporters force their populace to decrease consumption for the sake of exports, my guess is this would initiate or fan unrest and increase instability in the exporting countries - possibly resulting in production loss (i.e. Nigeria) and hence a decline in net exports.

What I've set out to do in this post is to construct a World Import/Export Land Model (extending the work of westexas and Khebab, the most recent of which can be found here) followed by an investigation into one of the possible extreme situations above: the pre-peak rate of change in internal consumption of Export Land continues post-peak.

This model is constructed using IEA all liquids data. As Dave Cohen pointed out after I first posted this model, this excludes the international trade of finished petroleum products. The best model would certainly include this trade, however, I haven't found the required data anywhere. While I don't have the numbers in front of me, what I think we would see is the international trade in finished products is much smaller than the international oil trade. The addition of that trade in the model below would then result in a perturbation of the results without changing them drastically (Hand-waving over).

The Model:

Import Land is defined as the OECD countries minus Canada, Mexico, and Norway plus Asian countries. **Export Land** is defined as the Non-OECD countries plus Canada, Mexico, and Norway minus Asian countries. "Asian countries" is China plus the countries that are contained within the IEA's "Other Asia" category. The data for each country or group of countries is from

the IEA all liquids data.

Data Source Files:

IEA 12 June 2007 Report (PDF)
IEA 13 Dec 2005 Report (PDF)
IEA 10 Dec 2004 Report (PDF)
IEA 10 Dec 2003 Report (PDF)
EIA page on Norway to estimate Norway's consumption. Only piece of data not in the IEA PDFs.

Data was taken from the most recent PDF (of the four) it was present in. Net exports for Export Land is calculated as production minus consumption. Net imports for Import Land is calculated as consumption minus production plus total change in stocks. If the "total stock change" is not added to the net imports calculation, then net exports and net imports between the two lands don't match as they should (See Figures 2 and 3). The aggreement shown in Figure 2 justifies associating the entire IEA "Total Stock Change" category with Import Land. Figure 1 shows the World Import/Export Model for 2002 through 2007.

Import/Export Land Oil Balance 2002-2007:

Figure 1: Import/Export Land All Liquids Oil Balance 2002-2007. Source: IEA, EIA (see above for specifics).

Figure 2: Export Land Net Exports vs. Import Land Net Imports. Source: IEA, EIA (see above for specifics).

Figure 3: IEA Total Stock Change and Misc. Source: IEA (see above for specifics).

Observations:

Export Land and Import Land exhibit a substantial trade imbalance with regards to oil: Export Land produces nearly 3x the amount of oil it consumes, while Import Land consumes nearly 4x the amount it produces. Furthermore, it appears Import Land has peaked and is exhibiting a gradual decline in production. Export Land shows a production plateau over the last few years, but it is far from certain it's peaking. Both lands show increasing consumption.

So, what can be concluded from the data of the last six years? The Export Land plot in Figure 1 shows that although production has stagnated, internal consumption increased just as it has been. The result is a decline in exports, consistent with the Westexas interpretation of the Export Land Model. However, can we say anything as to why production has stagnated? If Figure 3 can be taken to be Import Land's input into oil stocks (and at least through 2006 it definitely looks that way from Figure 2) then it appears sometime around 2003 Import Land started building stocks and then Export land production began to level off. This is consistent with Export Land voluntarily slowing production because Import Land was well supplied. That said, the data from 2007 is showing a net draw from Import Land stocks - a condition that can't continue for long without a need for Export Land to increase production.

A few possible Import/Export Land Model scenarios:

The following does not represent an attempt to accurately predict oil production. Rather, I'm

trying to explore the Export Land Model by extrapolating real data. In all of the following plots it is assumed Export Land peaks in 2007 and then sees an exponential decline in its production. The two cases assume a 2% and 5% decline rate for Export Land respectively. In all cases, it is assumed Import Land sees a 2% decline rate in production. Given the real data showing a gradual decline, a rate more than 2% seems unwarranted. As a control, each decline rate scenario was projected both by assuming the internal consumption of Export Land continues to grow at the same rate it has been and also for constant internal consumption.

The extrapolated curves were calculated in the following way. The internal consumption of Export Land was estimated with a linear fit to the data and then as a constant. Export Land exports were calculated as production minus consumption and were taken to be equal to the imports of Import Land. Import land's consumption was then calculated as production plus imports. The results are below in Figures 4 through 7. In all cases Import Land's consumption shows a greater rate of decline than the rate exhibited by the production in Export Land as it is squeezed by Export Land's declining production, constant to increasing internal consumption, and Import Land's own decline in production.

Figure 4: Import/Export Land All Liquids Oil Balance Scenario: 2% decline, increasing internal consumption. Source: IEA, EIA (see above for specifics).

Figure 5: Import/Export Land All Liquids Oil Balance Scenario: 2% decline, constant internal consumption. Source: IEA, EIA (see above for specifics).

I think most people would agree the decline rates assumed in Figures 4 and 5 are the most realistic. However, even with such decline rates Import Land's consumption sees quite a hit. With an overall decline rate of 2% in production and with increasing internal consumption in Export Land, Import Land's consumption declines at 5% and by 2020 is half its 2007 value. Figure 5 shows what happens if Export Land's internal consumption maintains its present value: roughly a 3% decline in Import Land's consumption ensues with a 33% decline by 2020. So, for internal consumption of Export Land ranging from flat to a maximum growth rate of that shown in the past six years and with an overall production decline rate of 2% we see a decline in Import Land's consumption ranging from 3% to 5% with a total decline in 2020 from 33% to 50%. I have a hard time buying that exporters *in the aggregate* will get away with forcing their populations to actually decrease their overall consumption so that importers can continue something akin to business as usual. I therefore view the above results as a reasonable range of outcomes we might see in a bit more than a decade post-peak.

Figure 6: Import/Export Land All Liquids Oil Balance Scenario:
5% decline in Export Land Production, 2% decline in Import Land Production, increasing internal consumption.
Source: IEA, EIA (see above for specifics).

Figure 7: Import/Export Land All Liquids Oil Balance Scenario:
5% decline in Export Land Production, 2% decline in Import Land Production, constant internal consumption.
Source: IEA, EIA (see above for specifics).

A 5% decline rate seen in Export Land production with increasing internal consumption translates

into about a 10% decline rate in Import Land's consumption. Consumption would drop 75% by 2020. Assuming a constant internal consumption translates into a 7% decline rate for Import Land consumption which would be a drop of about 60% by 2020. So, for internal consumption of Export Land ranging from flat to a maximum growth rate of that shown in the past six years with Export Land production declining at 5% and Import Land production declining at 2% we see a decline rate for Import Land's consumption ranging from 7% to 10% with a total decline in 2020 from 60% to 75%. I think it's probable that we would see less than optimal events occurring should a 5% decline rate be attained and the model presented would end up being wildly incorrect by 2020.