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**Fluctuations in the international prices of oil, dairy products, beef and lamb between 2000 and 2008: A review of market-specific demand and supply factors<sup>†</sup>**

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**Abstract**

This paper looks at the boom period between 2000 and 2008 in the international prices of four internationally-traded commodities: oil, dairy products, beef and lamb. All are important drivers of macroeconomic dynamics in New Zealand. Our aim is to provide overviews of the demand and supply factors specific to each market and product, thus adding colour to more general analyses of the macroeconomic and financial drivers of the cycles in world commodity markets over the period. For each commodity market we examine here, we set out the structures of the markets and the major drivers of world demand and supply, and discuss the apparent relative strength of each of the drivers.

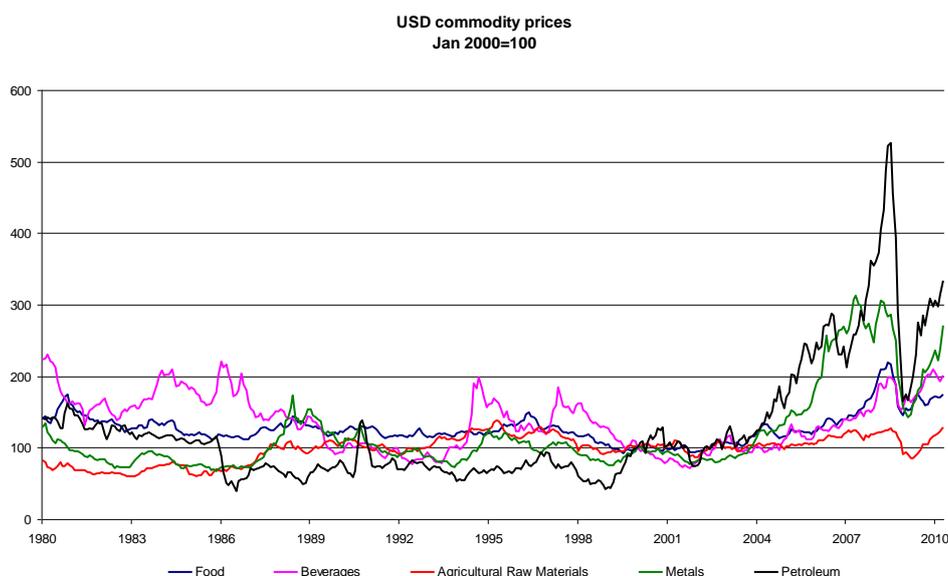
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<sup>†</sup>Reserve Bank of New Zealand Discussion Paper series is externally refereed. The views expressed in the paper are those of the authors and not necessarily those of the Reserve Bank of New Zealand. We would like to thank Özer Karagedikli and especially Patrick Conway for helpful comments on an earlier version. Reserve Bank of New Zealand, 2 The Terrace, PO Box 2498, Wellington, New Zealand. Corresponding author: Aidan Yao, email: [aidan.yao@rbnz.govt.nz](mailto:aidan.yao@rbnz.govt.nz)

## 1 Introduction

The period from 2000 to 2008 was characterised by a very large and generalised boom (and, towards the very end of the period, bust) in the prices of commodities on international markets. According to World Bank (2009), the boom phase was “the most marked of the past century in its magnitude, duration, and the number of commodity groups whose prices ... increased” (p.3).<sup>1</sup> The cycles in oil, metals and food prices in particular stand out. Between January 2000 and their peak in 2008, oil prices quintupled, metals prices tripled, and food and beverage prices doubled (figure 1).

**Figure 1**  
**International commodity prices**



Source: IMF

The boom put pressure on many countries, raising a host of issues for macroeconomic policy, social policy and international humanitarian activity (see e.g. IMF, 2008 and World Bank, 2009). Towards the latter part of 2008, however, against the backdrop of the global recession, international

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<sup>1</sup>Cashin *et al.* (2002) derive and discuss stylised facts on the magnitude and duration of commodity price cycles. For evidence against the idea that unrelated commodity prices tend to move together, see Cashin *et al.* (1999) – based on a sample that ends before the most recent cycle.

commodity prices retraced very rapidly and substantially. In many cases, they erased their gains since 2000 and imparted a further sharp shock to inflation pressure and real incomes in exposed countries. From mid-2009, a generalised recovery across commodity markets ensued. At the time of writing (June 2010), metals, beverages and agricultural raw materials had essentially regained their previous peaks.

As commodity prices surged, analysts advanced a range of macro-style explanations. IMF (2008) provides a good overview. The role of strong world growth through the period was relatively uncontroversial. Radetzki (2006) and Winters and Yusuf (2007) looked at the role of substantial growth in demand for resources from populous and rapidly-growing emerging markets such as China and India. Considerable attention was given to stimulatory financial conditions, as represented by loose monetary policy settings (Frankel 2008) and ample global liquidity (Belke *et al.* 2009). The development of financial markets, and in particular increased derivatives and speculative activity in oil markets, was examined by Wray (2008) and Conceição and Marone (2008). Caballero *et al.* (2008) argue that the sudden disappearance of liquid and safe assets in the financial crisis of 2007 served to prolong the commodity price surge. Irwin *et al.* (2009) provide a counter-argument to the idea that financial market development and activity were relevant.

Such macro influences have been relevant common factors driving all the commodity markets (Vansteenkiste 2009). In addition, commodity markets have influenced each other both on the supply side (through the production chain, especially via the price of oil) and the demand side (through income effects in commodity-exporting countries). Mitchell (2008) explored the connections between the rising price of oil, the cost of transport and fertiliser, the price of maize as a feedstock for biofuel production, and the prices of wheat and soybeans as crops competing for arable land in the face of growth in demand for maize.<sup>2</sup> Finally, policy overlays in the form of subsidies, export and import restrictions and incentives, and other local imperfections were relevant in a number of markets for food products (Trostle 2008).

This paper contributes to the macro-level accounts by looking at the specific supply, demand and inventory dynamics in markets for four internationally-

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<sup>2</sup> World Bank (2009) shows these prices to be strongly positively correlated when the price of oil exceeds about US\$50 per barrel.

traded commodities: oil, dairy products, beef and lamb over the boom period. We focus on these four products because they are of considerable importance to New Zealand macroeconomic dynamics (Buckle *et al.* 2007; Dungey and Fry 2009) and to monetary policy formulation (Bollard and Ng 2008; Bollard 2007; RBNZ 2006). According to Chen and Rogoff (2003), New Zealand (and Australia and Canada) “can plausibly be described as „commodity economies’, due to the large share of their production and exports accounted for by primary commodity products” (p.136). New Zealand’s top two goods exports by value in 2009 were dairy products (about a fifth by value) and meat (about an eighth), comprised mostly of beef and lamb. New Zealand’s real exchange rate appears to be strongly and stably influenced by shocks to commodity prices in foreign dollar terms (Chen and Rogoff 2003) and the inclusion of commodity prices in structural equations improves their ability to explain and forecast the nominal exchange rate (Chen 2003; Munro 2004).<sup>3</sup>

New Zealand is also exposed to the commodity price cycle on the import side through its importation of petrol and petroleum products, accounting for about a sixth of imports of goods by value in 2009 (it should be noted that in the late 2000s oil also became a non-trivial export for New Zealand, at about 5 percent by value in 2009). Delbrück (2005) notes that, for the size of its economy, New Zealand uses a fairly large amount of oil as transport fuel.

The heavy presence of commodities on both the imports and exports side means that the direction of impact of commodity market cycles on New Zealand’s terms of trade is hard to predict *a priori*. This underscores the value of looking at the idiosyncratic developments and drivers in the specific markets, as we do here, rather than lumping all commodities together into a single cycle (see Spatafora and Tytell 2009 for a discussion of this issue). New Zealand’s terms of trade shows considerable volatility historically (Kim *et al.* 1994), which would be consistent with the idiosyncratic variance in the commodity markets most relevant to New Zealand dominating any common cycle. We hope that the specificity of our analysis, and especially the focus on the exported commodities most relevant to New Zealand (which appear to have attracted relatively little attention in the literature), will be useful for future research.

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<sup>3</sup> Cashin *et al.* (2003) find a permanent impact of commodity price shocks on the level of the real exchange rate for a range of other, less-developed and flexible, commodity-exporting countries also.

Our analysis relies on documentary evidence and casual inspection of the data, rather than a formal quantitative one. We do not attempt a structural analysis of price fluctuations in each market. Rather, we discuss the broad demand and supply factors featuring in these markets and how they seem to have evolved over the period, as background for more formal econometric work. Partly because of the reliance on documented evidence, the focus is on the boom period through to 2008, which has been extensively analysed in the literature. That focus also reflects that the bulk of our work was undertaken around the time that commodity prices were at their peak. Although subsequent movements in commodity prices have also been quite large – and the bust at the end of 2008 and beginning of 2009 even more strikingly synchronised across markets (figure 1) – it was at the time of writing less well documented. We therefore restrict the detailed attention in the paper to the boom phase 2000-2008.

As well, the discussion of demand and supply factors may provide analysts with a sense of which drivers are most likely to be durable, thus illuminating the broad outlook and empirically material determinants of the international prices of these products over the medium term.<sup>4</sup>

A common theme emerging from the analysis of New Zealand food commodity exports is that natural or policy-induced segmentation of markets (such as trade barriers) is important. Local demand and supply factors in each market appear to have materially influenced the global price. Furthermore, the effects of natural phenomena such as weather fluctuations, disease, and policy interventions in response to their incidence seem to have been material. The apparently important roles of segmentation, intensive marketing, value added by processing, and in some cases limited depth of markets suggests that the concept of homogeneous “commodity” goods produced in large volume and sold into deep and liquid world markets is not entirely appropriate for the major New Zealand agricultural exports. There

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<sup>4</sup> Modelling all the diverse influences on each market, while capturing the interconnections between markets, is a difficult exercise. The most comprehensive attempt for food products, in terms of coverage of markets and regions, is probably the International Food Policy Research Institute’s IMPACT model, documented in Rosegrant *et al.* (2002). This is a large scale model with equations for the demand and supply sides of markets for 16 food commodities in 36 countries or regions making up the world. Although it is a dynamic model in the sense that it can be used to generate projections, stockbuilding is given a very limited role, and there is little sense in which the model accommodates the asset-price view of commodity prices or the effects of the cost of capital (including the prevailing level of interest rates) on the production side.

are also many material influences specific to each market, as well as important interrelationships (such as between oil and dairy) between the markets along the lines discussed by Mitchell (2008).

The rest of the paper proceeds as follows. We begin with the oil market, as a likely causal candidate on theoretical grounds to explain at least part of the dynamics of the other three (oil is used, for example, to produce the fertiliser needed to support the production of food and then transport it around the world). We then step through dairy, beef and lamb. Taking each commodity market in turn, we look at the major fluctuations in international prices (or prices relevant to New Zealand) over the period, setting out the major drivers of world demand and supply at the time and their apparent relative strength. Because market segmentation and disease status is important for the food commodities, we bring in the relevant features of the New Zealand supply side and main export markets. We conclude the paper with a brief discussion of some of the common themes that have emerged from the analysis, and comment on directions for future research.

## **2 Oil**

The price of West Texas Intermediate oil rose from \$US33 at the end of 2003 to peak at \$US145 in July 2008. Yet by the end of 2008 it was back close to its 2003 level.

The rise in the price through to mid 2008 reflected surging demand, especially from China, and limited growth in the production of crude oil. Global production of crude oil began to level off in 2005 and actually fell slightly in 2006 and 2007. While there was continued growth in other oil products, like natural gas liquids (NGLs), only a small proportion of the world's vehicle fleet can run on these products.

The fall in oil prices from mid 2008 coincided with changes in the global economic outlook – forecasts for economic growth were revised down sharply around this time. Global production of crude oil also rose in 2008 as Saudi Arabia increased its output.

The leveling off in crude production from 2005 through to mid 2008 – at a time when prices were high – raises the question of whether crude oil production is close to peaking. US studies confirm that at some stage world oil production can be expected to peak, but the date of oil peaking is uncertain.

Data on crude oil production suggests that production in non-OPEC countries may have peaked. The situation in OPEC countries is unclear, reflecting the unreliable nature of OPEC data, especially data on oil reserves. There are concerns though that even Saudi Arabia may have reached the upper limits of what it can produce on a sustainable basis.

OPEC members decided to cut production in late 2008, as oil prices continued to fall. In the face of these cuts, and underlying concerns about peak oil, the price of oil is likely to rise again – perhaps sharply – as the global economy recovers and oil demand rises.

### **2.1 Market structure**

Oil is still the prime source of the world's liquid fuels. It is not easy to find substitutes for oil, especially with respect to its uses in transport. At the moment, oil products power nearly every aspect of transport: air transport,

shipping, goods haulage, agricultural and construction vehicles, and cars. Oil products are also used in running stationary machinery, for heating, and in the manufacturing of tar and bitumen, lubricating oils, and plastics.<sup>5</sup>

Oil is a finite resource, which can't be recycled. It is not like soft commodities, such as dairy products, where more of the commodity can be produced in future. It is unlike hard commodities, like copper, which can be recycled. As with other fuels, like coal, once it's been used, it's gone. The costs of finding and extracting oil can be expected to keep rising. Furthermore, uncertainties about future supply will be factored into the oil price.

Most of the oil currently produced in the world is „conventional' crude oil which is extracted from wells. Unconventional oil includes: tar sands, extra-heavy crude, and oil shales. Oil is produced commercially from tar sands in Canada, although the amount produced is relatively small. While the reserves of oil contained in tar sands are estimated to be large, the costs of extracting such oil are high, and the environmental impacts are significant. Most of the reserves of extra-heavy crude are in eastern Venezuela. As with tar sand, reserves of extra-heavy crude are thought to be extensive, but the costs of extraction are high, and only a limited amount of extra-heavy crude is being processed. Oil is not currently being produced commercially from oil shales.

Production of conventional oil is concentrated in a relatively small number of countries. The top 12 producing countries account for 66% of world production.<sup>6</sup> Five of the top 12 producers are members of OPEC – the Organisation of Petroleum Exporting Countries – which is a cartel made up of mainly Middle Eastern countries. In total, OPEC production currently accounts for around 45% of world production.

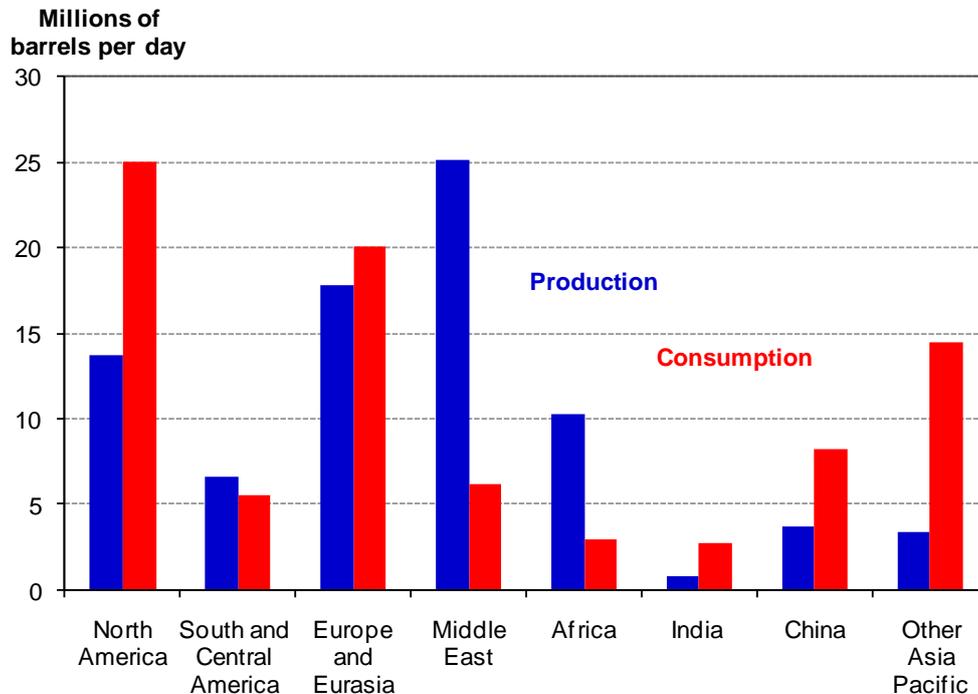
Figure 2 shows the distribution of production and consumption for world regions. Note the imbalances between production and consumption for various regions. The US, China, and Japan (which is in „Other Asia Pacific') are three of the world's largest importing countries.

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<sup>5</sup> See Samuelson (2008), pp13-17. Much of the background material in this section is taken from Samuelson.

<sup>6</sup> The top 12 producers, in order, are: Russia, Saudi Arabia, United States, Iran, China, Mexico, United Arab Emirates, Canada, Kuwait, Venezuela, Iraq, and Norway.

**Figure 2**  
**Oil production, and consumption of oil products, by region**



Source: BP (2008); the figures are averages for calendar 2007.

**Box A: Main data sources**

In some of the major oil producing countries the production of oil is undertaken by state-owned oil companies, rather than private sector companies. Hence information regarding oil production or oil reserves can be tinged by political considerations. In fact, obtaining reliable information about the world oil market is a problem.<sup>7</sup> Overall, it is fair to say that the global oil market is far from being a „full information’ market.

The major sources of data used in this report are:

1. BP’s annual review of world energy.
2. Publications by the International Energy Agency (IEA), which is an offshoot of the OECD.

<sup>7</sup> See, for example, Campbell and Laherrere (1998) regarding the accuracy of data on oil reserves.

3. Material from the website of the Energy Information Administration which is an agency that operates under the ambit of the US Department of Energy.

With respect to the data that is published, it is important to note what „oil’ covers. For example, the BP data on „oil production’ includes crude oil, shale oil, oil sands, and NGLs, while BP consumption data covers oil products like petroleum, aviation fuel, fuel ethanol, and biodiesel. All of the components of production are turned into oil-barrel equivalents and aggregated, as are the components of consumption. Differences between the production and consumption figures should reflect changes in oil stocks.<sup>8</sup> However, other factors, like the consumption of non-petroleum additives and substitute fuels, and disparities in the measurement and conversion of production and consumption components, mean that it is difficult to get an accurate picture of stock changes from the difference between production and consumption.

The IEA does attempt to balance estimates of demand and supply, with assessments of stock changes being incorporated.<sup>9</sup> In fact the IEA publishes data on oil stocks in OECD countries. However data for stock changes in other countries, including OPEC countries, is not available, and the IEA has to estimate these stock changes as a residual.

Country data on crude oil production – which excludes NGLs and biofuels – can be obtained from the DoE/EIA website.<sup>10</sup> Similar data is produced by the IEA but is not in the public domain.

## 2.2 Recent trends in oil prices

Figure 3 illustrates movements in oil prices over recent years. In US dollar terms, the price of oil (West Texas Intermediate) rose from around \$33 a barrel at the end of 2003 to a peak of \$145 in July 2008. At the peak, oil prices were over 4 times what they were at the end of March 2003. Yet by mid-January 2009, just over 5 months after the peak, the oil price was down

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<sup>8</sup> Oil stocks cover oil that has been extracted and stored in some form. In contrast, oil reserves cover oil that is still in the ground.

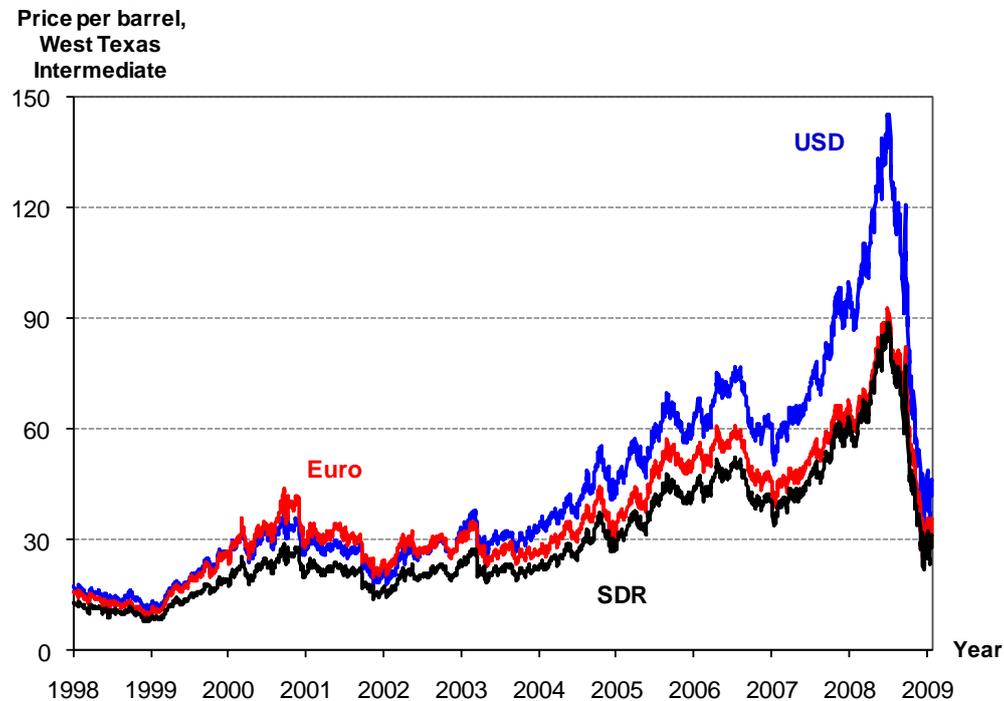
<sup>9</sup> See, for example, International Energy Agency (2009), Table 1, p49.

<sup>10</sup> Table 11.1, *Monthly Energy Review*, DoE/EIA, available from <http://www.eia.doe.gov/emeu/mer/inter.html>.

to nearly \$35 a barrel, which was very similar to the level at the end of 2003.

In terms of Euros or SDRs, price volatility was a little less. At its peak, the price of oil was around 3.5 times what it had been in late 2003. While the weakness of the US dollar in 2008 did have some impact on the USD price of oil, the rise in the Euro and SDR prices clearly show that there were other factors at work besides the weakness in the US currency.

**Figure 3**  
**Oil spot prices 1998-2009**



Source: Bloomberg

Prior to mid 2008, oil market analysts had been pointing to a number of factors that were behind the run up in oil prices. The factors that were thought to be influencing the demand for oil included:

- Growing demand for oil from emerging economies, especially China and India.
- Subsidies on fuel, especially in oil-producing countries.

- Growing domestic use of oil by oil-producing countries. This reflected, at least in part, higher incomes that were themselves the result of higher export earnings from oil (and the ability to buy subsidised fuel). It also reflected moves by some producers to use oil in energy intensive industries, such as electricity generation (Alhajji 2008).
- Expectations of further rises in the oil price. Expectations that demand growth would continue to be strong in developing countries and concerns about peak oil may have resulted in some oil buyers bringing forward their oil purchases.<sup>11</sup>
- Speculation regarding oil futures. While speculation was not widely seen as being the main driver of price rises, many analysts were of the view that it had been having some impact.

Factors that were thought to be influencing the supply of oil over the period to mid-2008 included:

- Low spare capacity regarding the production of crude oil.
- Short term disruptions to oil flows, like those arising from the civil unrest in Nigeria.
- Bottlenecks in refining capacity for some types of crude oil. Refining capacity had generally not kept up with oil demand, possibly because of low investment due to low margins and increased regulation.
- Rising costs of production (International Energy Agency 2008, p13).

In mid 2008, the situation changed markedly, especially with respect to demand. Economic growth eased, or went negative, in a range of countries, thereby reducing demand for oil products. - One of the factors behind the lower economic growth was the impact of high oil prices on consumption. Also by mid-2008 some countries had started to cut subsidies on fuel; the higher demand for oil had made the subsidies unsustainable. Demand for oil in oil-producing countries also fell, as lower oil prices affected national earnings and disposable incomes. It seems that expectations regarding future oil prices also changed, along with speculative behaviour.

The situation regarding supply also changed. OPEC production of crude oil rose in late 2007 and in 2008, reflecting higher production from Saudi Arabia. OPEC production was at a high point in mid-2008, just as demand

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<sup>11</sup> The issue of peak oil is discussed in section C.5.

began to fall. In the second half of 2008 OPEC made substantial cuts to its members' quotas in a bid to limit production and provide some support to the spot prices for oil. Overall though, the effects of lower demand dominated.

Some of the issues related to demand and supply are examined in more detail below.

### **2.3 Trends in the demand for oil**

Demand for oil, and oil production, are usually expressed in millions of barrels per day (mb/d). An oil barrel is a unit of volume, and is equal to 42 US gallons. This is just less than 159 litres.

Tertzakian (2006) pointed out that once world consumption of oil reached 86.4 million barrels a day, this would be equal to 1000 barrels a second, given that there are 86,400 seconds in a day. According to the IEA, world demand exceeded this level in December 2007.<sup>12</sup>

While oil production is expressed in millions of barrel a day, oil reserves are expressed in billions of barrels. Oil demand of 86.4 mb/d is equivalent to 31.5 billion barrels per year. Published figures for proven world reserves – which as we will see in section C.5, have to be treated very cautiously – put these at 1,240 billion barrels.<sup>13</sup> If future oil use were to average 1000 barrels a second – 31.5 billion barrels a year – the reserve figure would be equivalent to just over 39 years' worth of oil.

World consumption grew by 7.4 mb/d between 2002 and 2007, according to BP data.<sup>14</sup> This compares to growth of 4.2 mb/d in the previous 5 year period (1997-2002). The growth in the 2002-2007 period was the highest for any 5 year period since 1985.

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<sup>12</sup> Note though that these IEA figures cover not only crude oil but also other components like NGLs. As noted in the box on data sources, all of the components of production are turned into oil barrel equivalents and then summed.

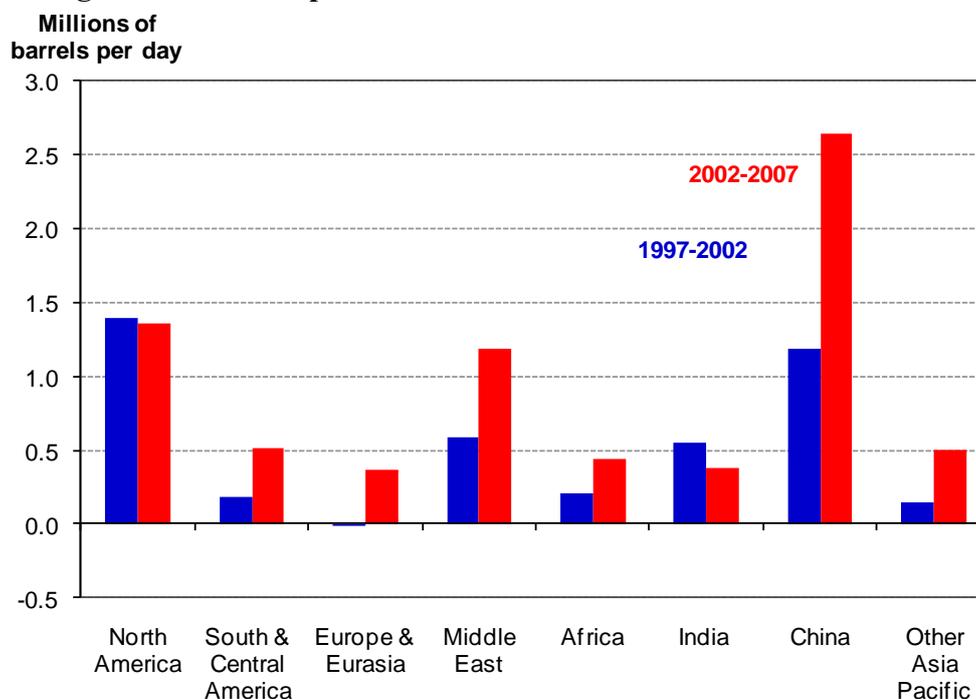
<sup>13</sup> BP (2008), p6. This figure excludes Canadian tar sands.

<sup>14</sup> This data is for oil barrel equivalents.

Growth in world consumption averaged 1.8% per annum over the 2002-2007 period, compared to 1.1% for the 1997-2002 period. Growth has averaged 1.6% per annum since 1983, when the second oil shock ended.

Figure 4 shows changes in oil consumption by world region. It shows that between 2002 and 2007 China had the largest increase in average daily consumption. In comparison the increase for India was relatively small. While China's increase was large in the earlier 5 year period, 1997-2002, it was not as large as that of North America. The increase in average daily consumption in the Middle East was relatively large in both periods.

**Figure 4**  
**Changes in oil consumption**

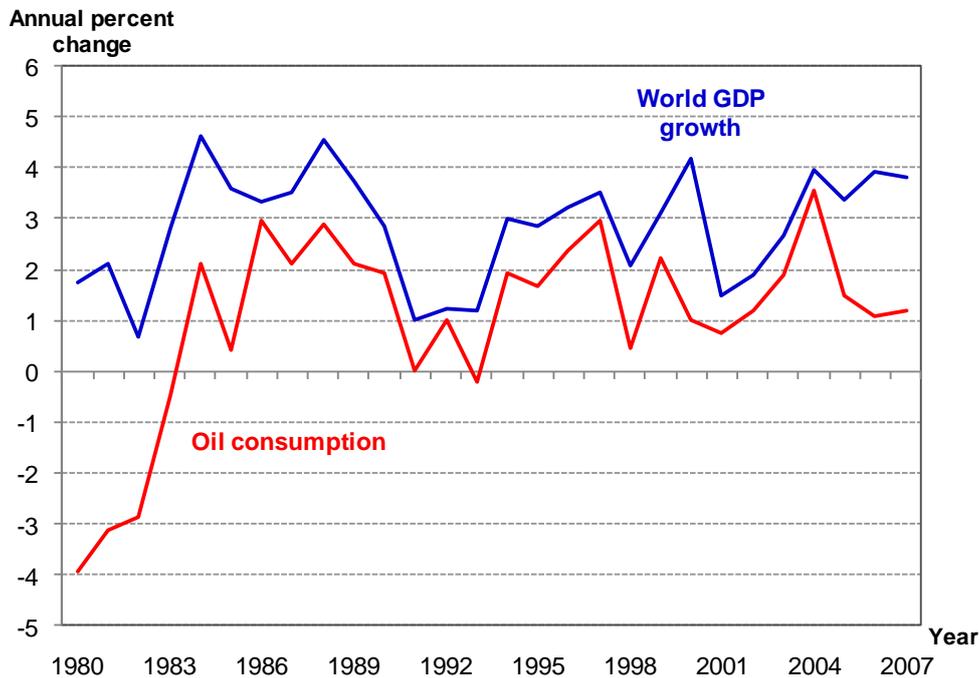


Source: BP Statistical Review of World Energy June 2008

Figure 5 shows annual growth in global oil consumption, and also annual growth in world real GDP. Clearly growth in oil consumption was high in 2004, with annual growth reaching 3.6%. This was the highest annual growth rate since 1978.

As the chart shows there is also a relationship between changes in demand for oil and world GDP growth. Economic growth averaged 2.9% per annum over 1997-2002 and 3.6% over 2002-2007. In the second period, economic growth peaked in 2004, coinciding with the spike in growth in oil consumption.

**Figure 5**  
**World growth in real GDP and oil consumption**



Sources: IMF World Economic Outlook database, BP Statistical Review of World Energy June 2008.

GDP growth was also high in the mid 1990s, yet this didn't produce a spike in growth in oil consumption like that of 2004. One possibility is that in 2004 the rise in real GDP per capita in China got to a point that triggered very strong growth in oil consumption. Brown, Virmani and Alm (2008) include a chart which shows that oil consumption per capita rises as real GDP per capita rises, but in a non-linear fashion. For a country which initially has a low level of GDP per capita, a rise in GDP per capita can result in a relatively sharp rise in oil consumption per capita.

It seems that the strong economic growth that occurred in 2004 was enough to push oil demand to a level where supply constraints began to have an impact on the price. The tailing off of consumption growth after 2004, while economic growth stayed high, would also be consistent with there being significant constraints on extra oil production in the post 2004 period. We will come back to this issue later.

In the second half of 2008 the demand situation changed dramatically, as the financial crisis unfolded in the US and there were dramatic changes to the economic outlook there. The September 2008 issue of Consensus Forecasts showed that, on average, forecasters expected real US GDP to be flat in the last quarter of 2008 but to show positive growth in the first quarter of 2009.<sup>15</sup> Furthermore, annual growth in US GDP in 2009 was expected to be 2.1%. However, by December 2008, quarterly growth in late 2008 and early 2009 was expected to be strongly negative, and the forecast for growth in 2009 had been revised to -1.3%.

The outlook for *global* economic growth also changed substantially over the period. In January 2009 the IEA's forecast for global oil demand was revised down sharply for calendar 2009, following a reassessment of global economic prospects based on Consensus Forecasts (International Energy Agency 2009).

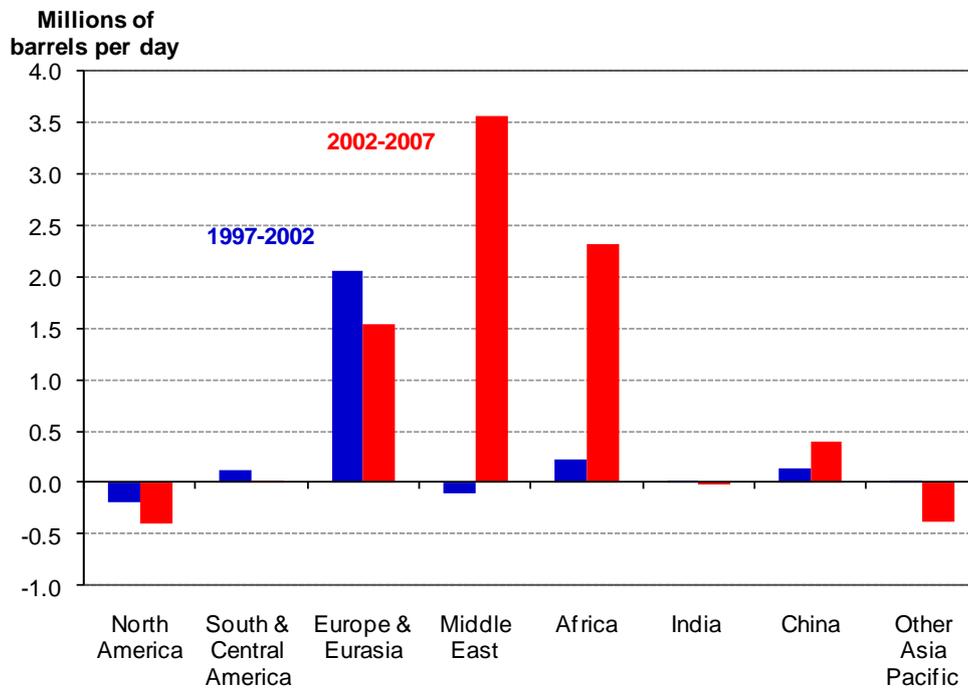
## **2.4 Trends in the supply of oil**

Figure 6 shows changes in oil production by world region. As can be seen, the Middle East made the largest contribution in the 2002-07 period, followed by Africa. Europe/Eurasia had provided most of the growth in the previous 5 year period with this being due to the rise in production in Russia and Kazakhstan.

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<sup>15</sup> Consensus Forecasts presents averages of forecasts made by leading economic agencies. Analysis suggests that average forecasts tend to be more accurate than the forecasts of an individual agency.

**Figure 6**  
**Changes in oil production**



Source: BP Statistical Review of World Energy, June 2008

Oil production comes from a number of components:

- crude oil
- condensate (a liquid similar to a light crude oil that is obtained from natural gas)
- other natural gas liquids (NGLs) such as propane and butane<sup>16</sup>
- biofuels, which are generally blended into gasoline.<sup>17</sup>

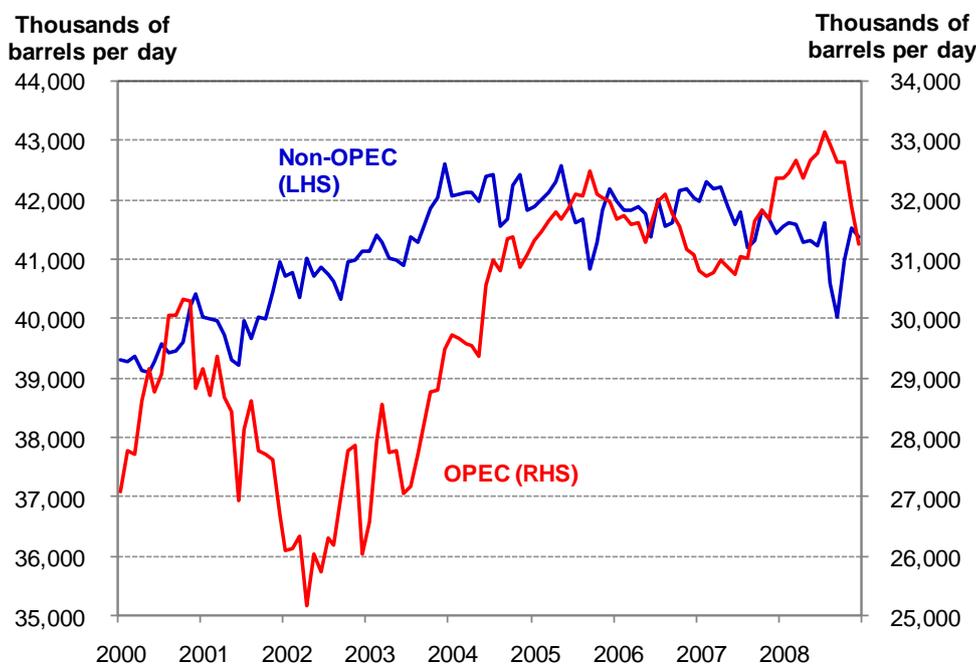
Crude oil is the major component and we will take a closer look at this. Figure 7 shows production of crude by OPEC and non-OPEC countries.<sup>18</sup>

<sup>16</sup> Condensate is also an NGL.

<sup>17</sup> Blended biofuels are included in IEA's supply figures. Given that the IEA produces a balanced account, it seems that these biofuels are also included in IEA's demand figures for oil. Biofuels are not included in BP's production figures, although biodiesel is included in BP's consumption figures.

<sup>18</sup> This chart is similar to one in Goldman Sachs (2008), although that chart was based on IEA data while Figure 6 uses DoE/EIA data.

**Figure 7**  
**Production of crude oil**



Source: US Department of Energy/Energy Information Administration

As Figure 7 shows, non-OPEC production levelled off in 2004. As can be seen from Figure 8, production from Russia levelled off around this time. And while China's production has continued to grow since 2004, this growth was more than offset by continuing declines in the UK, Norway and the US.

Growth in OPEC production of crude oil was very strong in 2003 but growth began to ease in late 2004. Production reached a peak in mid 2005, and eased back through to mid 2006. It then moved up sharply, reaching another peak in mid-2008. Movements in OPEC production tend to reflect movements in Saudi Arabia's production as the dominant producer (figure 9). The rise in 2008 also reflected increased production from Angola and Iraq.<sup>19</sup>

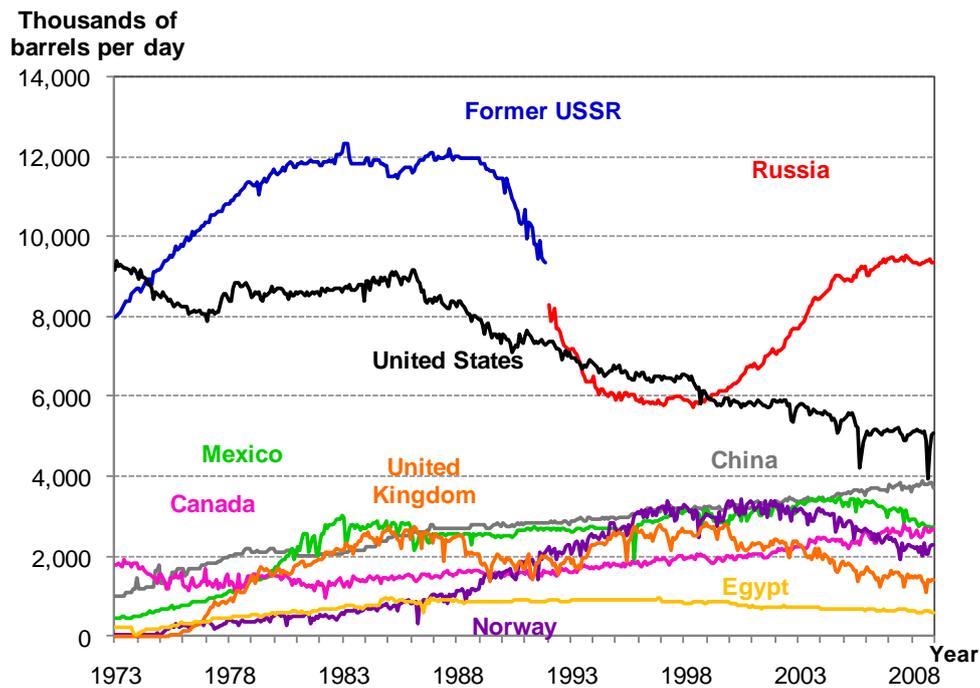
The rise in production in Saudi Arabia in 2008 may have taken Saudi production close to capacity. When oil prices were high in early 2008, Saudi

<sup>19</sup> Iraq is currently not an active member of OPEC.

Arabia agreed to lift its production to a level of 9.7 million barrels a day, which would have been a rise of around half a million barrels a day (Penketh 2008). However, it seemed that lifting production above this level would require additional investment; Saudi Arabian officials raised the possibility of investing \$US80 billion in order to lift output to 12.5 million barrels a day (Cronin 2008).

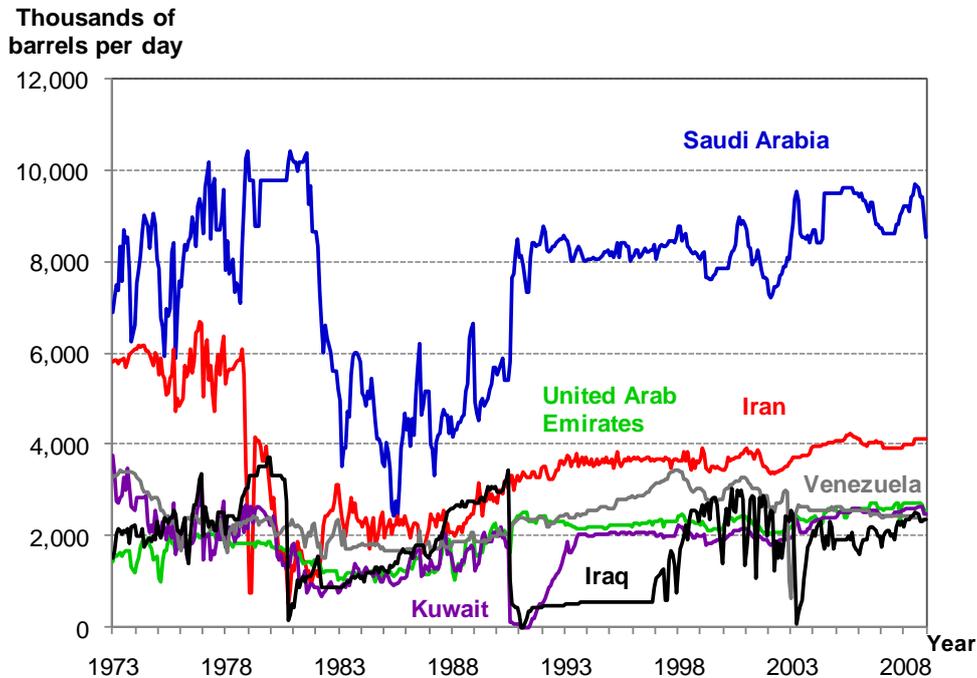
On an annual basis, OPEC crude production fell in both 2006 and 2007. World crude production also fell in these years. However, OPEC crude production rose in 2008 (figure 7, above). This rise meant that world crude production also rose in 2008, despite a continuing decline in non-Opec production.

**Figure 8**  
**Production of crude oil, major non-OPEC producers**



Source: US Department of Energy/Energy Information Administration

**Figure 9**  
**Production of crude oil, major OPEC suppliers**



Source: US Department of Energy/Energy Information Administration

Despite the fall in crude production in 2006 and 2007, data from the IEA indicates that total oil supply increased in both of these years.<sup>20</sup> However, it seems that this rise was the result of the contribution from „other oil’, including NGLs and biofuels. Overall, it seems that it was variations in the supply of crude oil which were having a major impact on the price of oil. In comparison, „other oil’ probably had only a minor impact. As yet, biofuels account for only a small part of supply, and NGLs – which account for a large part of „other oil’ – cannot generally be used directly in vehicles. For example, only a small proportion of the world’s vehicle fleet can use LPG, which is an NGL.<sup>21</sup>

It seems that falls in crude oil production in 2006 and 2007 were a major factor behind the rise in oil prices in those years. These were years of high demand for oil products. In contrast, crude oil production increased in 2008,

<sup>20</sup> See International Energy Agency (2009), Table 1, p49.

<sup>21</sup> BP’s figures for oil production, which cover NGLs but not biofuel, show a rise in production in 2006, but a decline in 2007.

at a time when demand was going into sharp decline. The result was a large fall in the oil price.

The fact that supply was so slow in responding to high levels of demand in 2006 and 2007 may reflect the high costs and long lead times involved in increasing the supply of oil. However, the muted response also raises a question as to whether supply can rise much further in the future. In fact, it raises the question of whether oil production is nearing its peak. We take a brief look at this issue in the next section.

## **2.5 The issue of “peak oil”**

### *The general idea*

Those subscribing to the idea of „peak oil’ generally hold the view that the production of oil – oil flows – will peak around the time that half of the world’s oil has been extracted. Some are of the view that we will be at peak oil very soon, or that it may have occurred already.<sup>22</sup>

The idea of peak oil rests on the normal behaviour of an oil well, or an oil field. In many wells, oil is in an underground reservoir along with natural gas and water. The gas, being less dense than oil, is above the oil, while the water, being denser than oil, is below the oil.

Recovery of oil generally falls into three phases. In the primary phase, the oil can be extracted from the well relatively easily, because of the pressure from the gas in the reservoir. In the secondary phase, the pressure from the gas has dissipated. Therefore, in order to get the oil out of the well, additional water is pumped down into the layer of water below the oil. This produces enough pressure to keep the oil flowing up the well. When this approach begins to fail, the third recovery phase begins. This involves pumping solvents or gas – steam, chemicals, or carbon dioxide – down into the well in order to loosen up the oil and allow it to be brought to the surface (Samuelson 2008). When this process fails, the well is normally shut down, although a significant proportion of the original oil – usually over a third – will remain in the reservoir.

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<sup>22</sup> See for example Deffeyes (2005).

Overall therefore oil flows from a particular field will tend to build up as wells are brought into production. At some point though, production will peak, and then fall, as extracting the oil becomes more difficult.

US geologist, M King Hubbert, argued in the 1960s that a nation's oil flow would show a similar pattern. Oil production would build up to a peak, then decline. He fitted a logistic curve to US oil data and predicted that US oil would peak around 1970. It did in fact peak at this time.

A logistic curve is a symmetrical bell-shaped curve, which means that the peak occurs at the point where half of the oil has been used. People took to fitting a „Hubbert curve' to world oil data, and some were of the view that the Hubbert peak would occur around 2010, or even earlier.<sup>23</sup>

Two problems for the peak oil view are:

- More oil is likely to be discovered in future
- Reserves of oil are large; the oil can simply be extracted quicker.

Regarding oil discoveries, a logistic curve can be fitted to „amount of oil discovered' in a similar way to which a curve is fitted to oil production. The „discovery curve' appears to have peaked globally in around 1970. Around this time, there were discoveries of very large oils field in Alaska, the North Sea, and Siberia. Since then, the number – and size – of discoveries has generally declined. The largest discoveries in recent years have been Brazil's off-shore fields. However, these fields are not large compared to those found around 1970 (Tertzakian 2007).

Regarding reserves, those who argue that oil will peak say that reserves are simply overstated. Reserves are classified under three categories: proven, probable, and possible. Proven reserves, in theory, include reserves that have been clearly shown to exist – via geological and engineering reports – and which are capable of being extracted under current conditions. Reserves can change over time. For example they can move from probable to proven as engineering difficulties are overcome, or if it becomes economically viable to extract them. Proven reserves – which are the type most often published and quoted – should understate the amount of oil that is available.

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<sup>23</sup> See Deffeyes (2005). Chapter 3 outlines the basis of the logistic curve. The curve is sometimes used to estimate the increase and decline of a biological population, where the food source for this population is fixed.

However, this appears not to be the case. Campbell and Laherrere (1998) noted that in practice, companies and countries are often vague about the likelihood of the reserves they report. Furthermore national companies which have exclusive oil rights in their own countries do not need to release, and do not release, detailed statistics on each field that could be used to verify the country's total reserves. In general they do not face the same scrutiny as smaller private sector companies that have to produce reports for, for example, their bankers. In some sense then, some oil reserves might be seen as being political estimates.

During the late 1980s, 6 of the 11 OPEC nations increased their reserve figures by very large amounts. As Campbell and Laherrere note, the suspicion is that they did this only to boost their export quotas. Campbell and Laherrere also note that total world oil reserves, not just the OPEC component, have tended to move steadily upward over time. This was an illusion, they said. Oil companies tended not to adjust reserve figures to account for the oil that had been extracted since the original estimate of reserves was made. The only revisions companies did seem to make was when reserves were found to be larger than the original estimate.

Campbell and Laherrere backdated what they saw as justified revisions to oil reserves, taking them back to the date at which the initial discoveries were found. They then adjusted these figures to account for the oil that had been extracted. They got a different picture from the general rise in reserves shown by official figures – the adjusted figures show reserves declining from around the mid-1980s (Campbell and Laherrere 1998).

### *The case of Saudi Arabia*

As noted earlier, published figures show „proven’ world reserves, excluding Canadian tar sands, as being around 1,240 billion barrels. The country that has the largest reserves figure is Saudi Arabia, which has 264 billion barrels, or 21% of the world's total oil. Saudi Arabia is also one of the world's two largest producers. The other large producer is Russia. However, the published reserves figure for Russia is „only’ 79 billion barrels. Saudi Arabia seems to hold a special place in the oil world – the future of world oil could to a large extent depend on the future of Saudi oil.

Saudi oil is owned by Saudi Aramco, which in turn is owned by the Saudi Arabian government. Saudi Aramco publishes very little information about

its operations; even reserve figures have tended to be adjusted on an irregular basis.

Simmons (2005) questions whether the situation is as rosy as it seems regarding Saudi Arabia's productive capacity, and claimed proven reserves. His study is based on an examination of around 200 technical papers about Saudi Arabia's production operations. These papers were written by engineers and scientists familiar with the major Saudi oil fields and were published by the Society of Petroleum Engineers (SPE).

The bulk of Saudi Arabia's oil production comes from four fields: Ghawar, Safaniya, Abqaiq and Berri. According to Simmons, these fields have for many years – decades, in fact – produced 80 to 90 percent of the country's production. Another four fields account for most of the rest. While Simmons does not dismiss the chance that oil could still be found in areas of Saudi Arabia where no drilling has yet occurred, he is not optimistic that another large field – similar to one of the big four – will be found.

Simmons produces an assessment of 12 Saudi fields, including the four largest. He catalogues problems that engineers have had with these fields, most of which seem to relate to the water which has been pumped into wells in order to maintain underground pressures. It seems that an increasing proportion of the liquids being raised from the wells is water.

Even the Shaybah field, a field that is in the isolated 'empty quarter' of Saudi Arabia and which was developed only in the 1990s, has had its difficulties, according to Simmons. The presence of a very large gas cap has required a complex and costly approach to drilling into the oil.

Regarding the level of Saudi Arabia's proven reserves, Simmons is as sceptical as Campbell and Laherrere. He draws attention to the apparently ad hoc upwards adjustments to the figures that have been made in various years.

Simmons concludes:

*Assuming that the Saudi-authored SPE papers present an accurate description of the problems affecting the kingdom's oilfields...it*

*would seem safe to conclude that Saudi Arabia's oil output is unlikely to grow in coming years and could soon begin to decline.*<sup>24</sup>

In recent statements Simmons has been sceptical of the ability of Saudi Arabia to lift its production and to produce 12.5 mb/d on a sustainable basis.

As Figure 8 showed, the profile for crude production by Saudi Arabia is strange, presumably because of the oil embargo in the early 1980s. It is worth noting though that even with the rise in production in recent years, the level of production is still lower than it was in the late 1970s. Simmons is of the view that peak production from Ghawar and Safaniya occurred in 1981, and even earlier for Abquiq and Berri. If so, current production levels must be being made up from newer fields, like Shaybah, where extraction is more complicated and more expensive.

Regarding the debate between proponents and critics of „peak oil‘, Simmons agreed in a recent interview that the debate boils down to an argument about timing (The Economist 2008).

### ***US government studies on peak oil***

In 2005 a small team led by Robert Hirsch produced a report for the US Department of Energy on the peaking of world oil production (Hirsch, Bezdek and Wendling 2005). A summary version of the report was published in 2005 in the bulletin of the Atlantic Council (Hirsch 2005). The conclusions, assembled from both reports, include the following:

- The peaking of world oil production presents an unprecedented risk management problem.
- As peaking is approached, liquid fuel prices and price volatility will increase dramatically.
- The exact date of oil peaking is not known. Estimates vary from soon, to a decade or more away.
- Geological fundamentals mean that at some point higher prices will have only a limited impact on the amount of oil that is supplied.
- Improved technology is unlikely to yield dramatically higher conventional oil production.
- Oil peaking represents a liquid fuels problem, and effective mitigation will be required.

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<sup>24</sup> Simmons (2005), p283.

- If mitigation is too late, world supply/demand balance will have to be achieved through massive demand destruction.

Hirsch produced another paper for the US Department of Energy in 2007 in which he updated his review of studies which contained estimated dates for peak oil. He found that half of the new studies picked a date up to and including 2010, while the other half picked a date after 2010.<sup>25</sup>

## **2.6 Medium-term outlook for demand and supply**

The impact of slower world economic growth has had a major impact on the demand for oil since mid-2008. The effects of the global slowdown may be felt for some time yet, keeping oil prices relatively low.

However, the level of oil supply is likely to emerge again as a major issue. In such a situation, the price of oil would again rise, although the rise may be constrained to some extent by the increased use of alternative fuels. Possible long-term substitutes for oil-based fuels include electricity, and biofuels derived from non-food sources.

Figure 7 suggests that the supply of crude oil in non-OPEC countries levelled off in 2005 and has begun to decline. While the IEA's 2008 medium term outlook indicated that total supply from non-OPEC countries would continue to increase through to 2013, this increase would come from NGLs, non-conventional oil, and biofuels. The supply of crude oil from non-OPEC countries would continue to decline (International Energy Agency 2008). While some increases in supply could be expected from countries such as Canada, the US (the Gulf of Mexico area), Brazil, and Kazakhstan, this growth would be more than offset by ongoing declines in Norway, the UK and Mexico.

It is not possible to say definitively that non-OPEC oil has peaked. However, even if a massive oil field were to be found now, it would probably take close to 10 years to bring it into full production. Also, the past example of the US, where the development of the huge Alaskan field did

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<sup>25</sup> In February 2007 a report on peak oil was prepared by GAO for the Science and Technology Committee of the US House of Representatives. GAO is the US Government Accountability Office and is similar to New Zealand's Audit Office. The report covered similar issues to those considered in Hirsch's reports.

not prevent a long term decline in US oil production, does not provide a lot of comfort.

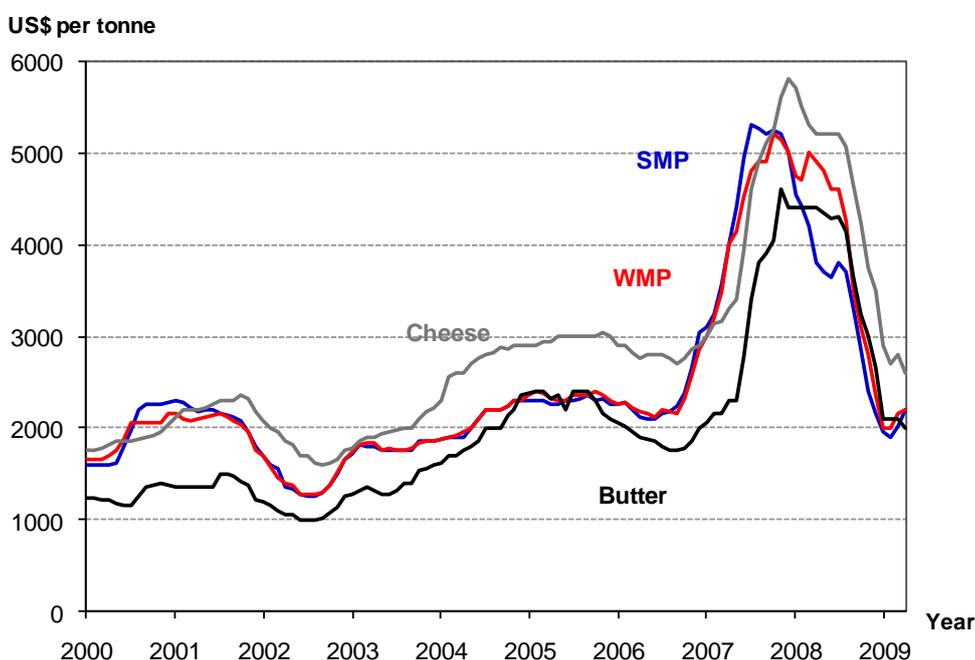
OPEC supply will certainly be lower for the next few years, reflecting the organisation's response in the wake of the financial crisis. OPEC members decided to cut production in September 2008, as oil began to sink below \$US100 a barrel. They agreed to further cuts in December 2008, when the price had sunk to around \$NZ44 a barrel (Hoyos 2008a). There have been indications that Saudi Arabia wants the oil price to be no lower than \$US75. Saudi Arabia sees such a price as being needed in order to stimulate the investment in oil and alternative fuels necessary to meet the world's future energy needs (Hoyos 2008b). There are indications that Saudi Arabia is prepared to cut its production to levels that are even lower than its OPEC quota in order to lift the oil price (Hoyos, Carola and Blas, Javier 2008).

In the face of such production cuts, the price of oil is likely to rise – perhaps sharply – as the global economy recovers and oil demand rises. If oil supply has indeed peaked in non-OPEC countries, then the price level will depend on how much OPEC is prepared or able to supply. It is possible too that the supply of crude oil from OPEC may never again exceed the peak that it reached in 2008. If this were to be the case, the age of alternative fuels would have definitely arrived.

### 3 Dairy Products

In 2007 global dairy prices spiked dramatically with skim milk and whole milk powder (SMP, WMP) prices more than doubling over the year to August 2007 in USD terms (figure 10). By December the prices of butter and cheese had followed suit.

**Figure 10:**  
**Wholesale Dairy Prices**



Source: USDA f.o.b Oceania

We find that:

- Growing dairy demand, combined with reduced supply from traditional exporters (particularly Australia and the European Union) from 2003 to 2006 led to a run-down in global inventories, removing any buffer to supply shortfalls.
- Adverse weather in Australia, Argentina and Uruguay then further reduced dairy exports in 2007.
- Higher costs of production, with rising cattle feed costs and fertiliser prices, may have discouraged production in some areas (for example in Europe where milk price increases were slow to pass through to

producers). However in the case of the US milk price increases were such that farmers had an increased incentive to produce over the 2007 dairy price spike. A more critical factor appears to be time delays in ramping up production with the bulk of the US export response to favourable returns not seen until 2008. Similarly, in NZ, record payouts in 2007 triggered farm conversions with 330 new farms (165,000 head) added, but these did not come on line until late 2008.

- Rising dairy consumption across developing economies in South East Asia, the Middle East and North Africa likely contributed to supply shortfalls in 2007. However the fastest growing economies, India and China, saw offsetting increases in domestic production by 2007.

During 2008, global dairy prices eased considerably from their peak. Increased supply was forthcoming primarily from the European Union and the US among traditional exporters (despite high returns New Zealand production fell by 3% in the 2008 season as a result of drought), but also from non-traditional exporters such as Brazil. Demand also fell away in response to high retail dairy prices (despite attempts by many governments to keep prices down through reductions to import tariffs and price subsidies) and then later in 2008 as the global financial crisis unfurled.

### **3.1 Market Structure**

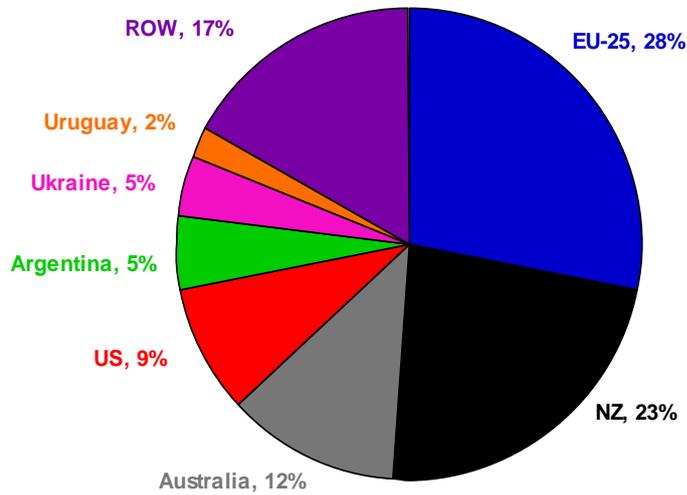
Only a very small fraction of global dairy production is exported, and this by only a few major suppliers. Indeed the European Union, US, New Zealand and Australia, followed by Argentina, the Ukraine and Uruguay, account for over 80% of global dairy exports (figure 11). By contrast the range of importers is diverse. Most product is exported as either non-fat dry milk/skim milk powder<sup>26</sup>, whole milk powder, butter or cheese.

Global dairy markets are relatively open (in contrast to the meat markets discussed in Sections E and F). However there are major distortions introduced by government import tariffs, export subsidies and intervention policies (Beghin 2006). These can have a significant effect on the global market. For example changing government policy in the European Union played an important role in the 2007 dairy price spike (discussed further later). Another critical aspect is the ability to store dairy products, typically in powder or butter form, which can affect market dynamics.

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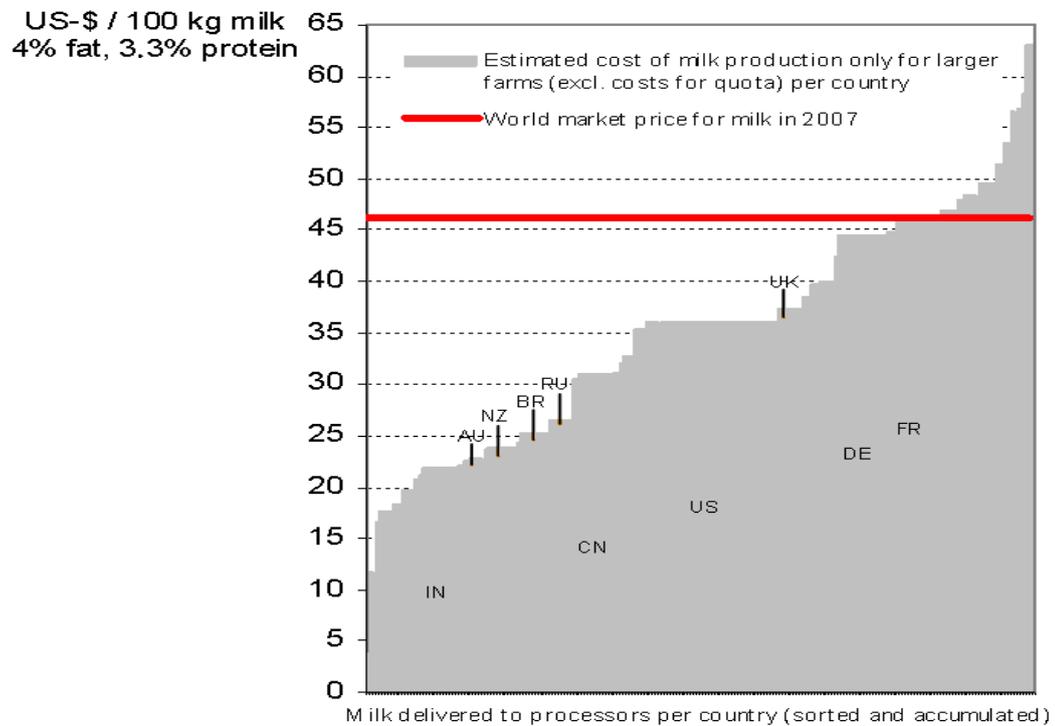
<sup>26</sup> Skim milk powder (SMP) has a minimum milk protein content of 34% whereas non-fat dry milk (NFM) has no standardised protein level (definition from US Dairy Export Council).

**Figure 11**  
**Dairy export**



Source: Rabobank (2007)

**Figure 12**  
**Global Dairy Supply Curve (2007)**



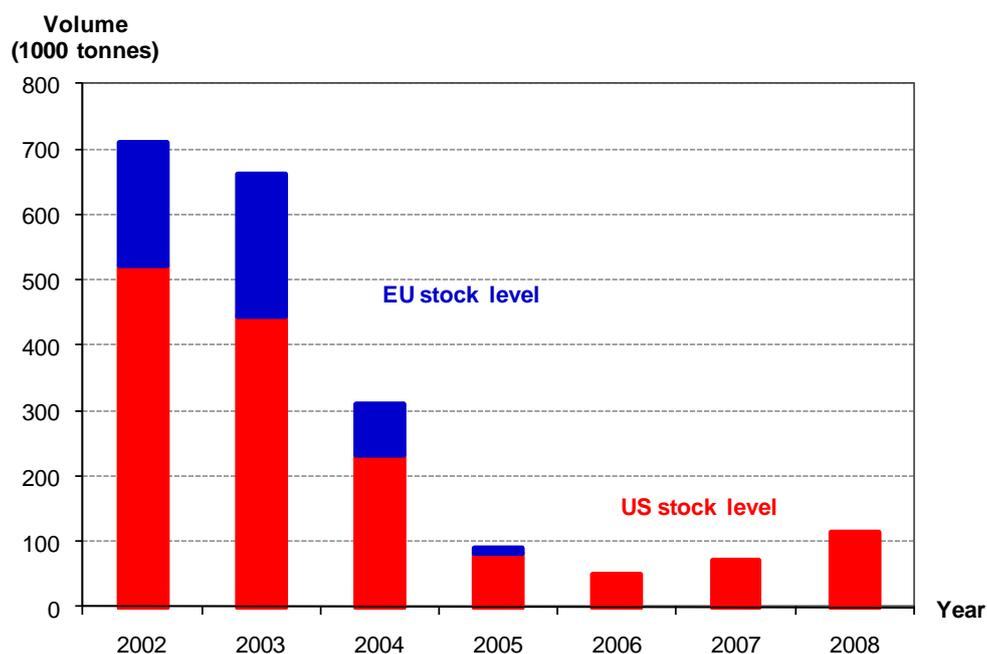
Source: IFCN Dairy Report 2008

### 3.2 Setting the Scene: a massive Inventory Rundown from 2003 to 2006

The foundations for the 2007 dairy price spike were laid down during the preceding four years, with global inventories being depleted at a rapid rate as global demand ran ahead of global production.

In the early 2000s both the EU and the US had large official inventories of NDM and butter, under their respective official government intervention schemes. Indeed in 2003 combined EU and US NDM intervention stocks stood at just under 700 million tonnes (about 7 months of global NDM trade). By 2006 the combined official NDM stockpile had reduced to a mere 49 million tonnes (figure 13). Butter intervention stocks in the EU had also declined markedly.

**Figure 13:**  
**NDM Intervention Stock Levels**



Source: USDA

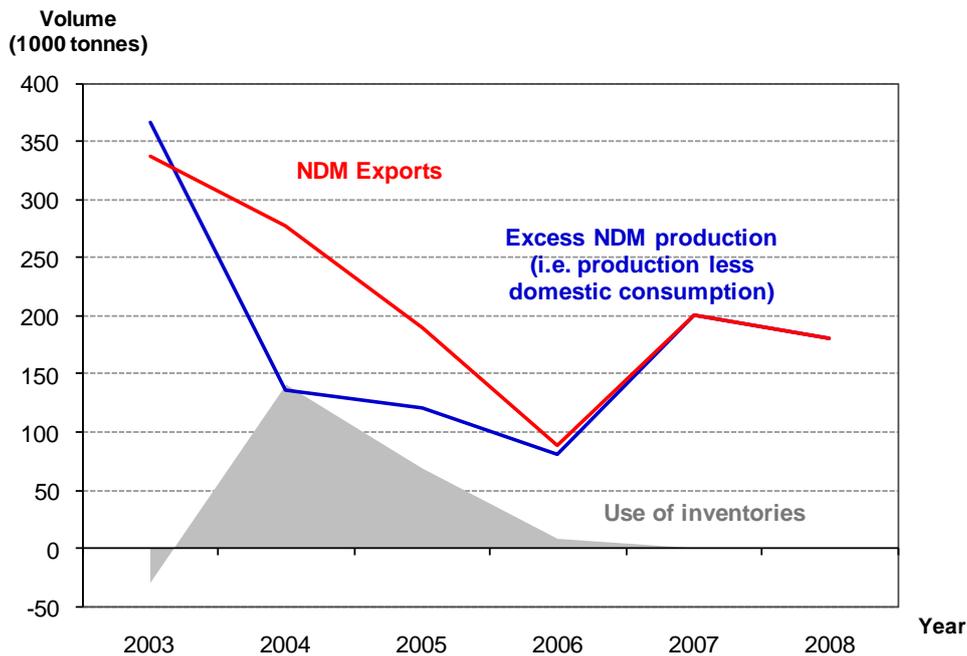
Over the pre-spike period (2003-2006) supply to global dairy markets from some of the biggest traditional exporters was shrinking, as in the case of the EU following a reform to their Common Agricultural Policy (see Box 1)

and in Australia (in response to severe drought, see Box C). Meanwhile global trends of rising incomes, urbanisation, Westernisation of culture, and government schemes to promote dairy consumption on nutritional grounds in many developing economies were supporting rising demand for dairy, which was only partially met by domestic production.

The divergence in supply and demand trends was able to persist as EU and US intervention stockpiles poured into the global market place - meeting, and to some extent masking, real production shortfalls (figures 14 and 15). Indeed, in 2003, perhaps a quarter of global NDM exports were sourced directly out of inventory.

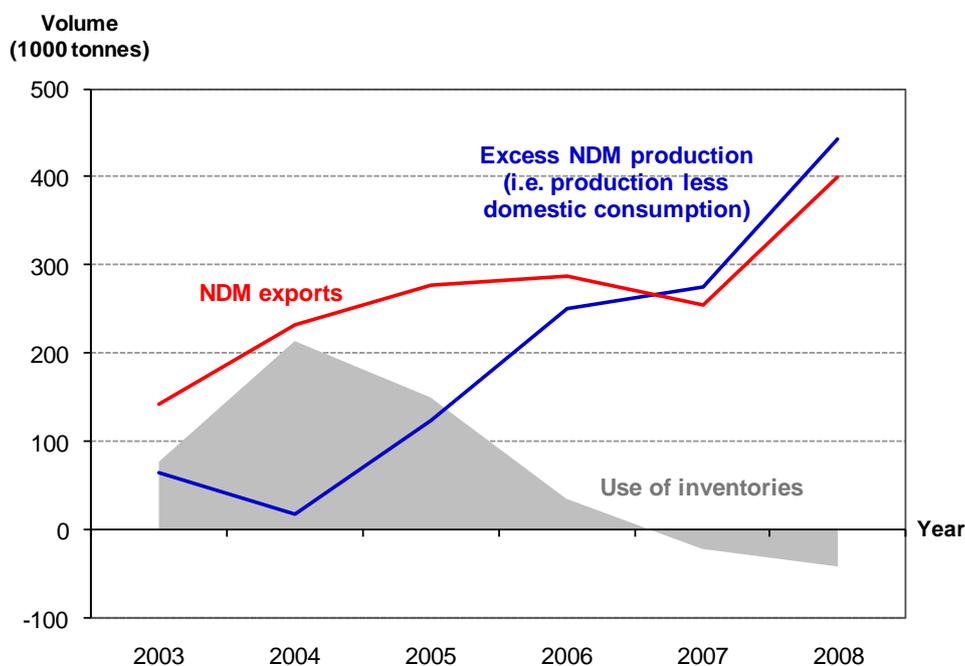
The elimination of global inventories would provide a crucial backdrop to the 2007 dairy price spike, forcing market clearance to be achieved by an unprecedented explosion in price.

**Figure 14:**  
**Use of NDM intervention stocks in EU**



Source: USDA

**Figure 15:**  
**Use of NDM intervention stocks in US**



Source: USDA

**Box B: The importance of the EU CAP reform in 2003**

A significant drag on global dairy exports in the build up to the 2007 dairy price spike was driven by a reform in 2003 to the Common Agricultural Policy (CAP) in the EU.

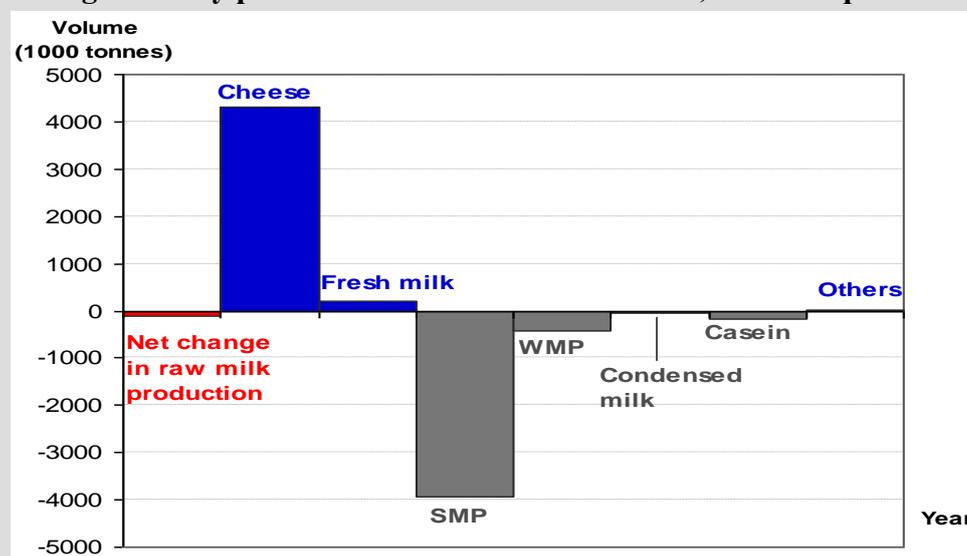
The dairy industry in the EU has been historically protected by import tariff barriers, export subsidies, production-linked farm payments, quota limits on production, and the subsidised withdrawal and storage of surplus product (public intervention). The CAP reform lowered butter and SMP intervention prices (by a total of 25% and 15% respectively), restricted the period and threshold volume for buying butter into intervention stocks each year (similar to earlier restrictions for SMP) and decoupled farm support payments from production. These changes were aimed at increasing the

incentive to produce higher value-added products such as cheese and fresh dairy products.<sup>27</sup>

Total milk production in the EU declined only slightly over 2003 to 2006, but the shift in product mix was very marked. In particular SMP production in 2006 was 30% lower than in 2003, with an almost corresponding diversion of milk to increased cheese production (see figure 16 for production changes in milk equivalents). Production of WMP and butter also fell.

Despite supplementation out of intervention stockpiles, dairy exports from the EU were significantly reduced. By 2006 inventories were exhausted and SMP exports had fallen by 74% relative to 2003. Drops of 23% and 16% occurred for WMP and butter over the same period. These shifts, in the order of 100,000-200,000 tonnes in magnitude, were highly significant as a share of global trade. In the case of SMP for example, exports out of the EU shifted down almost 250,000 tonnes against total global export levels of around 1,100,000 tonnes i.e. a loss of almost a quarter of global trade.

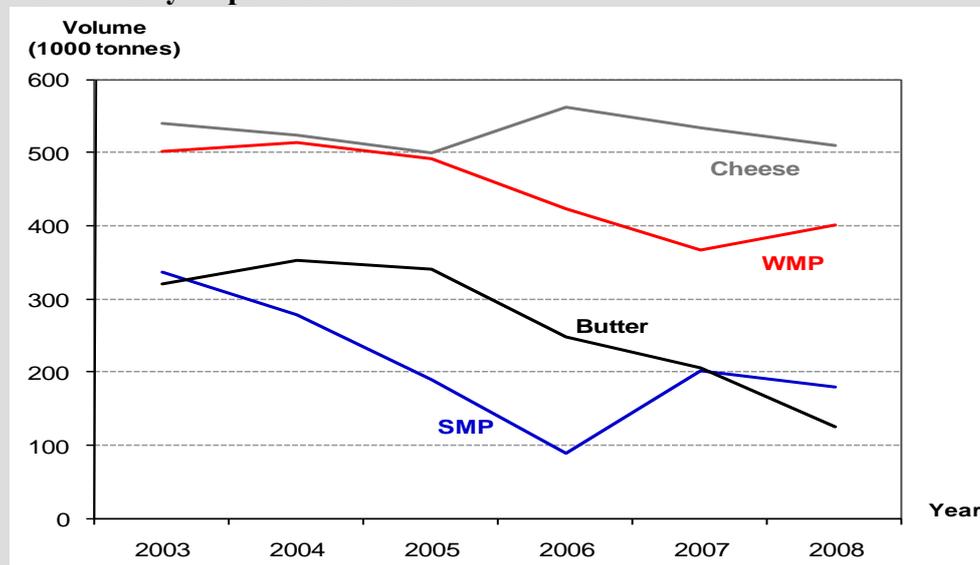
**Figure 16:**  
Change in dairy production from 2003-2006 in EU, in milk equivalents



Source: Commission of the European Communities (2007)

<sup>27</sup> Commission of the European Communities (2006).

**Figure 17:  
EU-27 Dairy Export Volumes**



Source: USDA (revised to include all 27 current member countries)

The CAP reform in the EU thus provides a very important context for the 2007 dairy price spike, both in terms of its role in depleting official intervention inventories that could otherwise have buffered any supply shortfalls, and for the downward level shift in export volumes of SMP, WMP and butter that resulted. This structural shift meant that despite SMP exports, for example, increasing by a staggering 128% in response to strong price signals during 2007, this was off a low base and the resulting volume of exports out of the EU was still 40% lower than in 2003.

### 3.3 The Dairy Price Spike

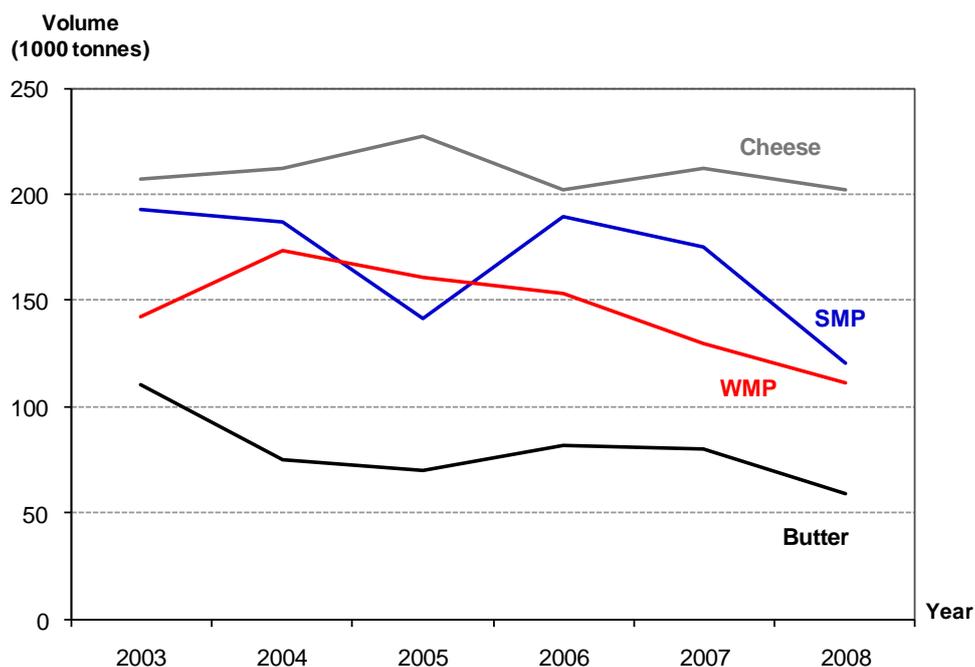
We now turn to factors that may have been important in driving supply shortfalls during the dairy price spike itself. These include adverse weather in Australia, Argentina and Uruguay, higher costs of production both for grain-fed and pasture-based production systems, and rising emerging market demand.

### 3.3.1 Adverse weather in Australia, Argentina and Uruguay

Adverse weather in 2007 significantly reduced dairy production in Australia, Argentina and Uruguay, contributing to supply shortfalls.

In Australia (which accounts for about 12% of world trade), severe drought saw a 5% decline in dairy production in the year ended June 2007 (see Box C). This came in the context of lower milk production and steadily falling dairy cow numbers after an earlier drought afflicted the country in 2003. Indeed milk production in 2007 was 15% lower than in 2002, the last unaffected year. Australian SMP, WMP and butter export volumes, which were just beginning to recover in 2006, fell again by 9%, 14% and 2% respectively (figure 18).

**Figure 18:**  
**Australian Dairy Export Volumes**



Source: Australian Bureau of Agricultural and Resource Economics

In both Argentina and Uruguay (which account for about 5% and 2% of world dairy trade respectively), severe flooding affected dairy production and hence exports in 2007. Most significantly, Argentina exports the

majority of its dairy product as WMP, and as such it is the world's third biggest exporter of WMP (after NZ and the EU). As a result of flooding, Argentina's WMP exports, which had been growing rapidly at an average rate of 28% over 2003-2006, dropped by 44% in 2007 relative to 2006, removing 93,000 tonnes of product from global supply<sup>28</sup>. The Argentinean Government also imposed export taxes in order to protect supply to domestic consumers.

### **Box C: Australian Drought Conditions**

Australia suffered widespread drought conditions in 2003, followed by a "1 in 1000 year drought" in 2006/2007. The Murray-Darling basin, which contains over 70% of Australia's irrigation resources, recorded record-low inflows, and total storage levels declined to an all-time low (active MDBC storage at 31 March 2007 was 672GL - the previous lowest active storage volume was 1134GL in April 1983<sup>29</sup>). Since 2003, Australia has seen a prolonged period of depressed milk production with steadily falling numbers of dairy cows.

Looking ahead, the prospects for longer-term Australian dairy expansion may be limited. Greater climate variability with declining average rainfall is expected, and with water reforms leading to market based water pricing this may mean higher cost structures for Australian dairy in the future.

### **3.3.2 Higher Costs of Dairy Production**

In 2007 dairy farmers world-wide were facing higher cost structures. In grain-based production systems this related to rising cattle feed costs, in part attributable to the increasing use of corn crops for alternative fuel production pushing up both corn and soybean prices (see Box 3). However pasture-based production systems were also affected by increased fertiliser prices as the cost of natural gas spiked (see Section C. Oil).

It is worth noting, however, that the increase in the milk price in 2007 was far more than what would have been necessary to compensate for higher cattle feed costs, at least in the case of the US. The marginal incentive to

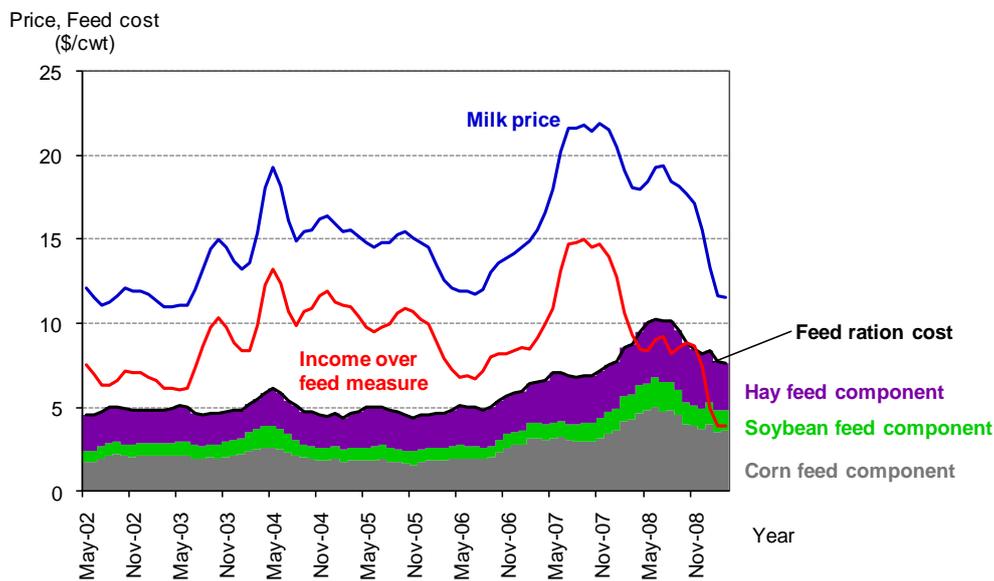
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<sup>28</sup> This represents circa 6% of global WMP trade (based on WMP exports from „total selected countries' in 2007 as reported by the US Department of Agriculture).

<sup>29</sup> Murray-Darling Basin Commission (2007).

produce for US dairy farmers can be quantified by the income-over-feed measure, which takes the difference between the price received per hundredweight of milk and the feed ration cost<sup>30</sup> (i.e. feed cost needed to produce a hundredweight of milk). And, despite the feed ration cost increasing by 40% from Aug-06 to Aug-07, the income-over-feed measure more than doubled to around \$15/cwt (well above the historic average of \$10/cwt, figure 19).

**Figure 19:**  
**Incentive to Produce for US Farmers**



Source: USDA

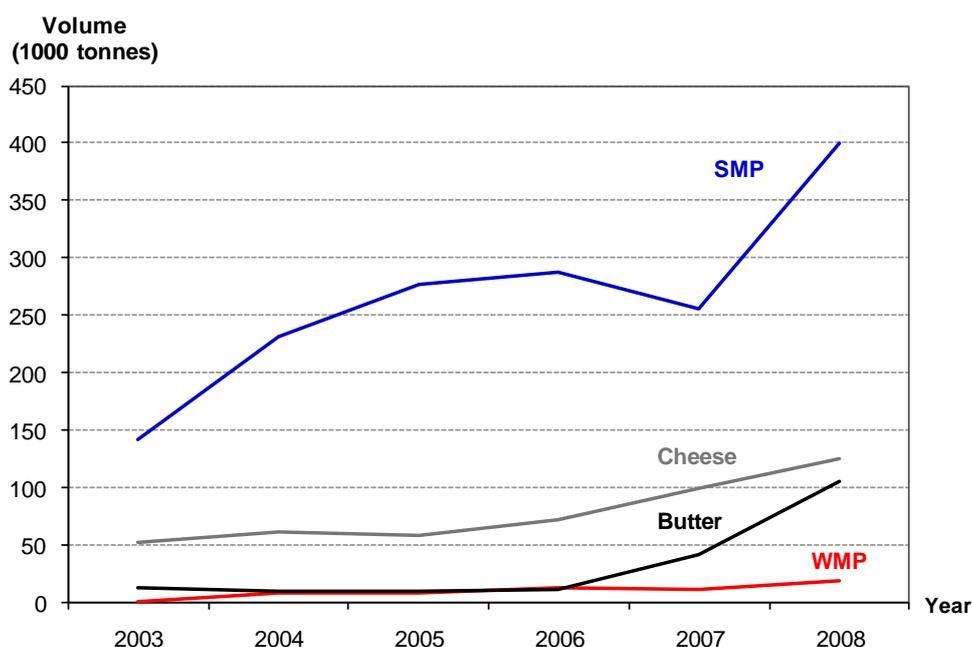
Moreover, consistent with an *increased* rather than decreased production incentive, was continuing trend growth in US milk production (up 2% in 2007 relative to 2006), and an increase in the combined export volume of NDM, WMP, butter and cheese<sup>31</sup>. Allowing for a lag in production response the effect becomes more pronounced with NDM, WMP, butter and cheese

<sup>30</sup> The dry feed ration of a typical US lactating cow is roughly one third corn, and the remainder alfalfa hay and soybean. The USDA provides a formula for calculating the cost of a dairy feed ration needed to produce a hundredweight of milk: Feed ration cost = Price of corn/bushel\*(51/56) + Price of soybean/bushel\*(8/60) + Price of Alfalfa hay/ton\*(41/2000).

<sup>31</sup> NDM exports declined in 2007 relative to 2006. This reflected increased cheese production (shift in product mix), as well as an end to the propping up of exports seen in 2003-2006 from use of NDM intervention stockpiles (refer back to figure 4).

export volumes in 2008 up 39%, 58%, 854% and 76% respectively on their 2006 levels (figure 20).

**Figure 20:**  
**US Dairy Export Volumes**



Source: USDA

Rising feed costs are likely to have been more critical in other grain-fed regions such as parts of Europe, where higher global dairy prices were passed only slowly to farmers as a result of long-term supply contracts with processors and retailers. This meant that higher feed costs adversely affected the profitability of milk production in 2007 for some member states<sup>32</sup>. On balance however it seems more convincing that the high dairy prices observed during 2007 reflected a „demand rationing price’ than a shift in global cost structures. With lower dairy supply available than globally demanded, limited ability for any short-run supply response and no buffering stocks available, purchases made on the spot market were subject to a massive run-up in prices.

<sup>32</sup> US Department of Agriculture Foreign Agricultural Service (2007).

#### **Box D: Biofuel Initiatives and their Impact on Cattle Feed Costs<sup>33</sup>**

From the early 2000s policy makers around the world began looking to alternative fuels as a way to address environmental concerns and reduce energy dependence on fossil fuels.

In the US, biofuel supply was almost exclusively from corn-based ethanol produced domestically. Federal policy was introduced to strongly support growth in the US biofuel industry including:

- The Energy Independence and Security Act of 2007 (EISA) which required US fuel producers to incorporate certain minimum levels of renewable fuels in their products. Ethanol use was mandated to grow to 13.2 billion gallons by 2012 and then 15 billion gallons after 2015. „Advanced biofuels’, such as biodiesel or cellulosic ethanol, were mandated to grow from current near-zero levels to 21 billion gallons by 2022.
- A credit of 51c/gallon of ethanol blended with gasoline.
- An import tariff of 54c/gallon on imported ethanol to protect the domestic US corn-ethanol market. This regime ensured minimal importation of ethanol from sugarcane producing countries, despite their comparative advantage in prices and in climate change metrics.

US corn-ethanol production increased five-fold increase from 1997 to 2007, to reach 6.5 billion gallons in 2007 (figure 21). However the rapid rise in ethanol production had a major impact on corn markets in the US, using more than 23% of the corn crop in 2007, a crop traditionally used primarily for animal feed (figure 22). Corn prices more than doubled by their peak in June 2008 and competition for land use, as well as low levels of soybean-based biodiesel production, saw similar increases in soybean prices occur.

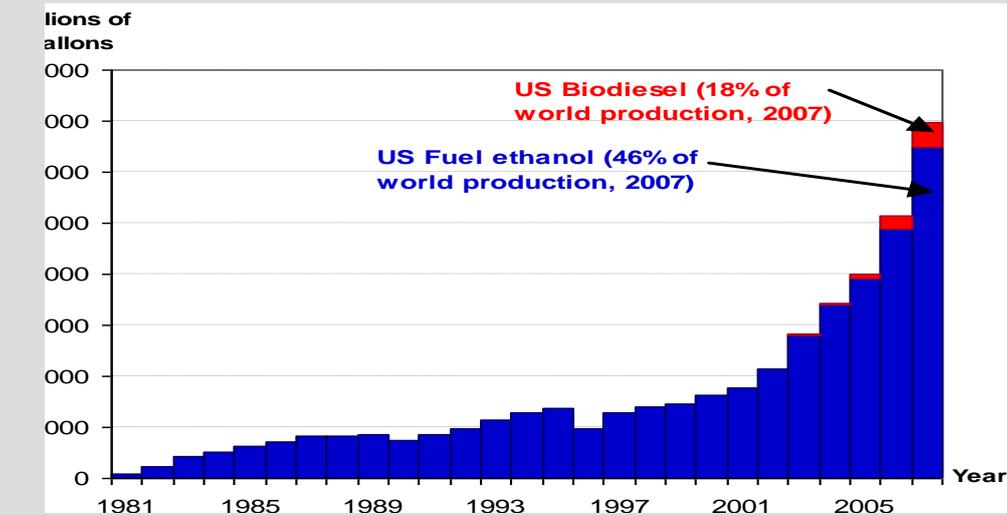
Rising biofuel production was certainly not the only factor that contributed to rising feed grain prices, with adverse climate conditions, rising demand and low stocks all pushing prices higher. Nevertheless studies estimate that biofuels had a sizeable impact. Baier *et al* (2009) found that over the 2 years ending June 2008, world-wide biofuel production accounted for 27

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<sup>33</sup> As of mid-2009 the political climate in the US had shifted with a bipartisan coalition of congressmen introducing legislation called The Affordable Food and Fuel for America Act. If passed, this Act would repeal support measures for bioethanol and instead favour „second-generation’ technologies such as cellulosic ethanol, in an attempt to minimize impact on food prices.

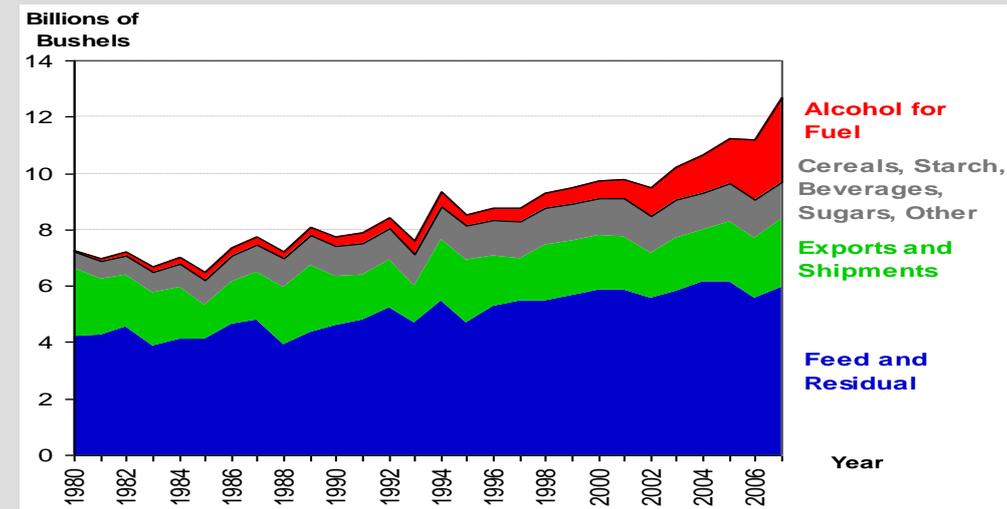
percentage points of the increase in corn prices, and 21 percentage points of the increase in soybean price. On its own, the increase in U.S. biofuels production (ethanol and biodiesel) was estimated to account for nearly 14 percent of the overall increase in corn prices.

**Figure 21:  
US Biofuel Production**



Source: IEA Annual Energy Review (2008)

**Figure 22:  
US Corn Use**



Source: USDA Economic Service

Higher costs of production are likely to be a key factor supporting higher dairy prices in the medium term. Indeed in 2008, as dairy prices eased from their peak, but corn prices remained elevated, dairy farmers in the US suffered from reduced margins with the income-over-feed measure plummeting to below \$5/cwt.

While the effects had not been seen by 2008 (the USDA reported that dairy production had “not buckled under high feed prices because herds are continuing to expand in response to last year’s favourable returns”<sup>34</sup>), this was expected to limit US dairy growth going forward.

Higher crop prices may also encourage shifting land use toward crop production and away from dairy production, and push up agricultural land values increasing the capital requirement needed for entry into dairy farming.

### **3.3.3 Emerging Market Demand**

Global demand for dairy products grew steadily over the early part of the decade underpinned by firm economic growth and rising incomes, particularly in developing economies. Rabobank estimate that growth in dairy demand was 2.6% over 2000-2005 (compound annual growth rate), as compared to supply growth of just 1.5% over the same period.

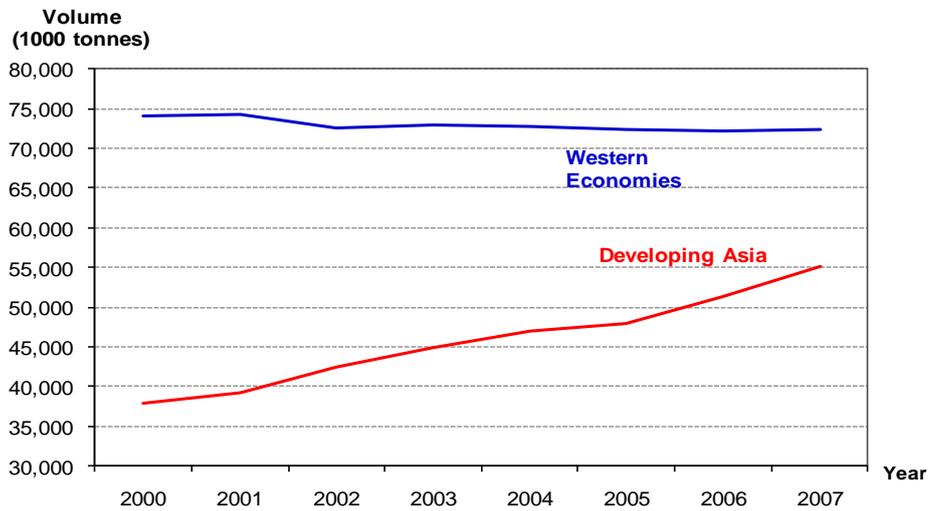
The bulk of global growth in dairy demand has come from developing economies, particularly in Asia (figure 23). China and India alone account for close to half of dairy consumption growth in recent years<sup>35</sup>. Population growth, rising per-capita incomes (and associated switch toward more protein-rich foods), urbanisation, increased eating out, advertising and government schemes promoting dairy products, have all helped to spur significant increases in dairy consumption (see Box D on China). The scope for demand increases in developed economies has been far more limited, and mostly concentrated in higher value products such as cheese.

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<sup>34</sup> US Department of Agriculture Economic Research Service (2008), p6.

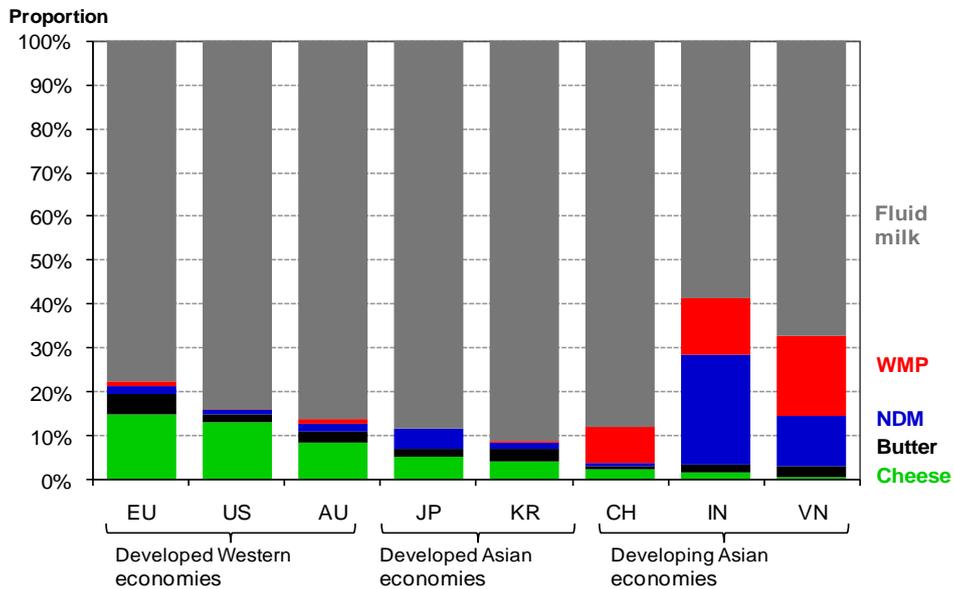
<sup>35</sup> Rabobank (2008b).

**Figure 23:**  
**Fluid Milk Consumption in Western Economies and Developing Asia**



Source: FAPRI<sup>36</sup> (2009), RBNZ.

**Figure 24:**  
**Dairy Consumption Shares by Product Type**



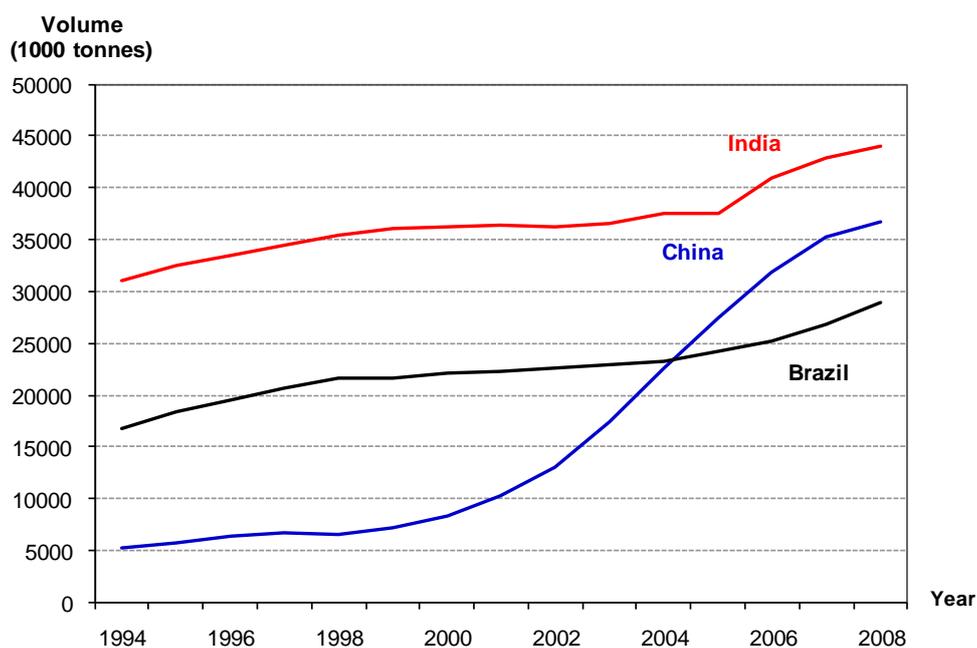
Source: FAPRI (2009)

<sup>36</sup> FAPRI is the Food and Agricultural Policy Research Institute, a dual-university research programme by Iowa State University and the University of Missouri-Columbia. Western economies includes the US, EU-27, Japan, Australia and New Zealand. Developing Asia includes China, India, Indonesia, Malaysia, Thailand and Vietnam.

Regions such as South East Asia, the Middle East and North Africa, which produce only a fraction of their own milk requirements (approximately 25%, 33% and 35-40% respectively<sup>37</sup>) have been dependent on external suppliers to meet their growing consumption needs.

However, many of the fastest growing consumer markets have been able to meet their own rising demand for dairy products with increases in domestic supply, and hence do not appear to have contributed to the shortage of dairy product on world markets that triggered the 2007 dairy price spike. India, for example, continues to be self-sufficient meeting its own demand requirements. And rapid production growth in Brazil (over 6% annually in 2006-2008) has seen it switch from being a net importer to a “minor exporter... starting to become a notable competitor particularly in whole milk powder markets”<sup>38</sup>.

**Figure 25:**  
**Dairy Production in China, India and Brazil**



Source: USDA

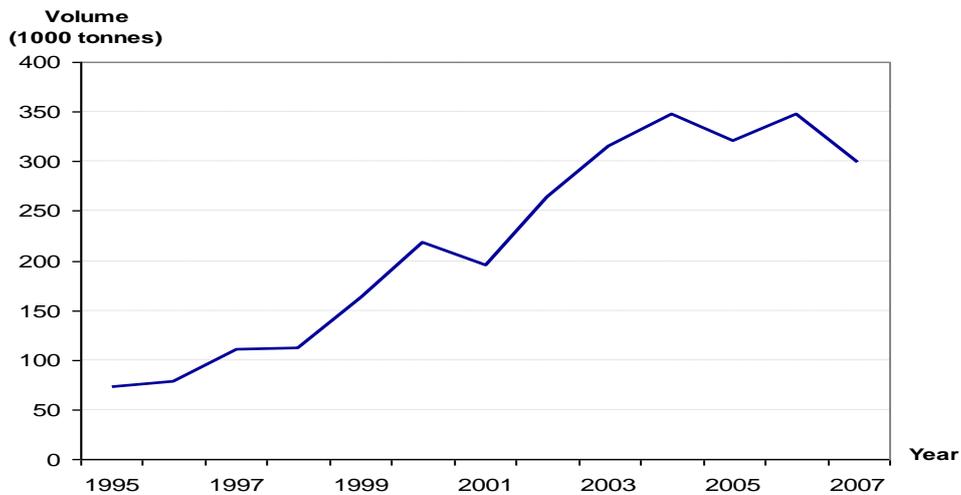
In China, dairy production from 2003 to 2007 grew at an average rate of

<sup>37</sup> Rabobank (2008b).

<sup>38</sup> US Department of Agriculture Foreign Agricultural Service (2008), p3.

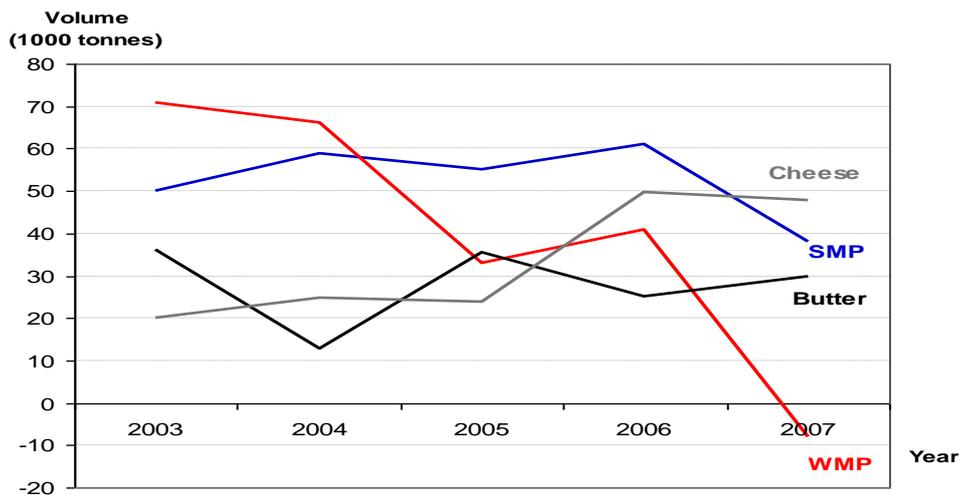
22% per annum to reach 35 million tonnes. As a result, although rising imports to China contributed to inventory rundown during the pre-spike period, total dairy imports by China were actually *falling* by the time of the dairy price spike in 2007 (figure 26). China even became a net exporter of WMP in 2007 (figure 27).

**Figure 26:**  
**Total Dairy Imports to China**



Source: China Customs, provided by MFAT, NZ. Sum over HS96 categories 401-406

**Figure 27:**  
**Net trade (Imports-Exports) to China for Key Dairy Products**



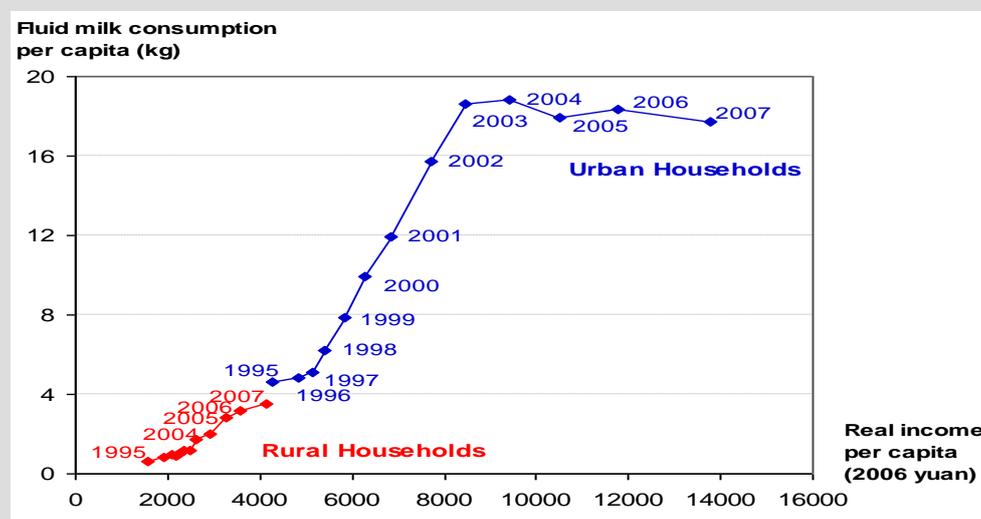
Source: FAPRI (2009)

This suggests that the role of the “BRIC” (Brazil, Russia, India, China) countries as drivers for the 2007 dairy price spike may be less significant than some have assumed.

### Box E: Dairy Consumption and Production in China

In China dairy consumption per capita has increased dramatically, driven primarily by rising incomes. Real urban household incomes doubled between 1995 and 2003, and this was associated with an increase in fluid milk consumption per capita from just 5kg/yr to over 18kg/yr (figure 28). The per capita level of urban fluid milk consumption since appears to have levelled off. By contrast fluid milk consumption per capita among rural households (approximately 60% of the population) remains low at only 3.5kg/yr in 2007. Urbanisation thus represents a significant growth prospect for total Chinese dairy consumption.

**Figure 28:**  
**Fluid milk Consumption against Real Income per Capita for Chinese Urban and Rural Households**



Source: China Statistical Yearbook. Data labels represent years.

Qualitative factors have also contributed to the increased popularity of dairy in China over this period. The Chinese Government launched a school milk programme in 2000 (although the scale has been small, reaching just 1% of the total student population in 2005), and included regular milk

consumption in their dietary recommendations. Greater numbers of Western-style food and coffee chains appeared. Brand awareness and advertising of dairy products also became more prevalent, with the emergence of supermarkets and convenience stores facilitating access to dairy products<sup>39</sup>.

Such drivers are likely to see Chinese milk consumption per capita continue increasing. South Korea and Japan may be relevant comparators here, due to similarities in diet and culture. In these economies milk consumption per capita grew rapidly before settling at around 30-40kg/yr, although this is still well below levels seen in Western economies such as in the EU or US (table 1).

**Table 1:**  
**International Comparators of Fluid Milk Consumption per Capita**

	Per capita fluid milk consumption (2007, kg/yr)
China (total)	9.1
China (urban, CNBS)	17.8
China (rural, CNBS)	3.5
European Union	68.0
United States	96.2
Australia	105.2
Japan	35.5
South Korea	34.3
Indonesia	1.4
Vietnam	1.5

Source: FAPRI (2009)

China has also seen impressive growth in dairy production, enabling it to meet an increasing proportion of its demand requirements. And there appears to be scope for production growth to continue in future years enabling China to become largely self-sufficient in dairy in the near future. Growth in milk production in China has been mainly driven by increasing numbers of dairy cattle, with an almost four-fold increase in the herd size from 1995 to 2007. Annual yields, at around 2-3 tonnes/head, remain low by international standards (the world average is 7-8 tonnes/head)<sup>40</sup>. Yields may be improved by importing higher quality genetic stock (indeed this has

<sup>39</sup> See, for example; Fuller, Beghin et al (2004), Fuller, Huang et al (2005), Gale et al (2007), Dong (2006).

<sup>40</sup> Rabobank (2006).

already begun) and through more efficient production systems (80% of milk production in China still occurs in small-scale household farms with fewer than 100 cows<sup>41</sup>). Government policy is strongly supportive of growth in the industry, with farm taxes eliminated in 2004, and breeding subsidies available.

Also there is evidence that Chinese dairy production can be cost competitive. The major costs for milk production in China are feed cost and amortisation of the value of the dairy cattle<sup>42</sup>. Both land and labour costs are relatively low. Simpson (2005) estimated that for a medium sized farm in Jilin Province, direct costs of production were US\$0.16 per kg, as compared to \$US0.24 per kg on medium sized farms in the US.

Quality concerns are the major challenge facing the competitiveness of China's dairy sector, as the Sanlu milk contamination crisis in late 2008 highlighted. Although official minimum quality standards are comparable to those of the US and New Zealand, these are poorly adhered too. While quality concerns remain, China is likely to continue to be dependent on imports of those high quality and high value added products that it lacks the capacity to produce.

### **3.4 Conclusion**

Temporary factors such as adverse climate conditions and lags in supply response clearly played a role in the 2007 dairy price spike. However there have been some underlying structural changes in global dairy markets including higher feed costs and an underlying strong consumption growth from developing economies that are likely to support prices in the medium term, while not at the heights seen in 2007, still quite a bit above historical averages.

The geographic composition of dairy production is likely to shift. In Australia, for example, dairy production is likely to be constrained by higher costs of irrigation and water shortages. Production growth in other traditional exporters will likely be limited to 2 to 3% p.a. yield-driven increases. The European Union is more uncertain, with the potential for growth in some member economies currently constrained by quotas. On the

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<sup>41</sup> Rabobank (2006)

<sup>42</sup> Ibid.

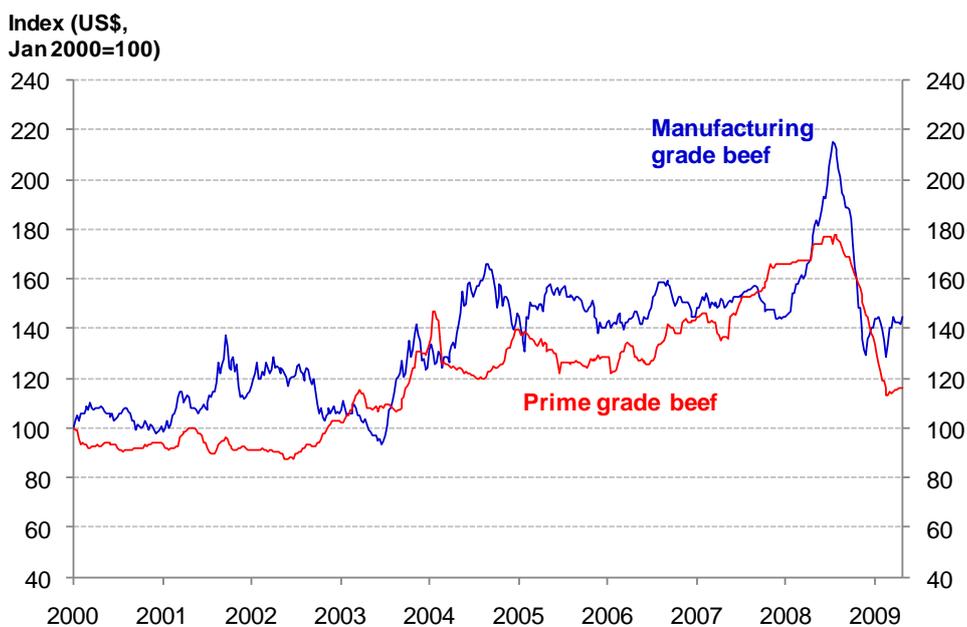
other hand, developing economies in China, India and South America are emerging as significant dairy producers.

Global dairy markets are also likely to be more volatile with low global stock levels (as prices dropped in 2008, some limited intervention buying recommenced in the EU and US). Also, with much growth occurring in countries such as India, Brazil and even China that are at or near self-sufficiency, the fraction of total dairy production that is traded internationally is decreasing. However this implies that small percentage shifts in world demand or supply may have a large impact on the balance of traded global dairy production, and hence its price on international markets.

## 4 Beef

New Zealand exports both manufacturing and prime grade beef, primarily to markets in North America and Asia. The prices received for New Zealand's beef exports firmed over the early 2000s and then spiked higher during 2008 (figure 29). This was particularly the case for manufacturing grade beef, where the CIF import price to the US increased by almost 50% from January to July 2008 (US\$ terms). Movements in New Zealand's beef export prices were similar to those seen for dairy (discussed in Section D. above) although less extreme and peaking later in the commodity cycle (mid-2008 versus 2007).

**Figure 29:**  
**New Zealand Beef Export Prices to the US**



Source: NZX Agri-fax (US primal steer price and US imported bull price, CIF US\$)

This section of the discussion paper explores possible factors which may explain price developments for New Zealand's manufacturing and for prime grade beef, particularly in 2008.

We find that:

- In the first half of 2008, demand for manufacturing grade beef was surprisingly firm, despite a slowing economy, as consumers appeared to trade down to lower quality beef products from more expensive cuts. This combined with lower imported beef supplies to the US to place upward pressure on prices.
- In contrast, in the market for prime grade beef, one of the key developments during 2008 was rising feed costs. This severely impacted the profitability of feedlots in the US, leading to rationalisation in the feedlot sector and tight prime beef supplies.
- By late 2008, as with the other commodities we examine, strong demand destruction associated with the global financial crisis resulted in falling prices across both manufacturing grade and prime beef products.

Finally, in section E.5, some of the medium run factors underlying beef demand trends globally are discussed.

## **4.1 Market Structure**

World beef markets are segmented by trade restrictions relating to both foot-and-mouth disease (FMD) and bovine spongiform encephalopathy (BSE, commonly known as mad-cow disease). In addition, beef markets in many countries are distorted by both tariffs and quotas.

### **4.1.1 New Zealand's Beef Export Destinations**

New Zealand's key beef export destinations are in North America and Asia, with access to these premium world beef markets enabled by our FMD and BSE disease-free status. New Zealand does face trade restrictions in the form of quotas and tariffs (table 2), but in recent years New Zealand has been comfortably within the US quota limit as a result of stable to falling total exports and a greater share of sales now going to Asian markets (Australia is in a similar position). Europe is not a key export destination for New Zealand beef as a result of prohibitive quota restrictions<sup>43</sup>.

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<sup>43</sup> NZ has a mere 1300 tonne quota above which high tariffs lower the effective price of NZ beef to below other export markets. However in 2008 NZ's beef exports to the EU tripled to 10,800 tonnes. This occurred because of restrictions on South American beef exports to

**Table 2:  
Trade Barriers to NZ Beef Key Export Markets (as at 2008)**

	<b>Tariffs and Quotas on NZ Beef</b>
US	Up to 213,402 tonnes at US\$4.4c/kg tariff. Imports over quota face 26.4% tariff.
Canada	Up to 29,600 tonnes duty-free. Imports over quota face 26.5% tariff.
Korea	Tariff of 40%.
Japan	Tariff of 38.5%. Snapback to 50% tariff if imports exceed certain percentage of the previous period.
Indonesia	Tariff of 5%.

New Zealand's major competitors in these markets are North American and Australian producers (although exports from the US to Asia have at times been restricted due to BSE fears). Uruguay has also been a competitor in the US despite very low quota access of just 20,000 tonnes<sup>44</sup>.

Brazil, the world's lowest cost producer, does not currently pose a competitive threat to New Zealand beef exporters. Because of FMD concerns, Brazil is excluded from supplying either North American or New Zealand's key Asian export markets. Brazilian beef from FMD-free zones is accepted in Europe<sup>45</sup>, and despite punitive tariffs (of 176%), Brazil's low cost structure means that it remains competitive.

#### **4.1.2 New Zealand's Beef Exports by Product**

New Zealand produces both manufacturing grade and prime beef. The available export data for New Zealand beef is split according to whether the beef is exported in frozen, or fresh or chilled form, rather than by grade of beef.

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the EU which raised the price of beef in Europe, enabling our exports to be competitive despite tariffs.

<sup>44</sup> Over 2003 to 2007 Uruguay has sold a significant amount of beef out-of-quota to the US. However in 2008 the emerging Russian market for beef appeared to offer Uruguay better returns than out-of-quota sales to the US.

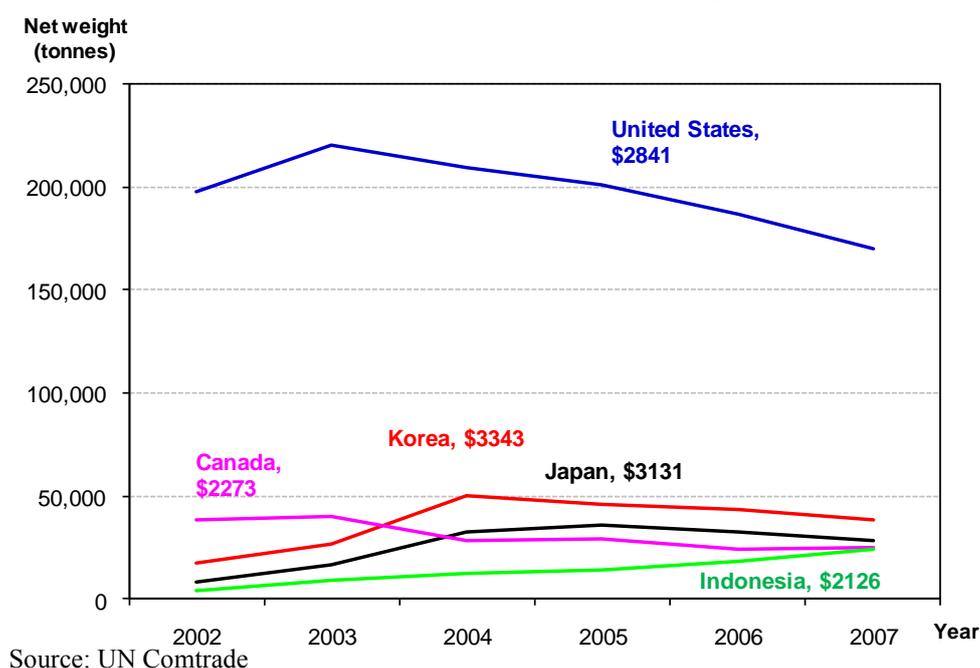
<sup>45</sup> Brazilian beef exports to the EU were suspended over January-July 2008 citing failure to meet FMD safety standards.

Manufacturing grade beef is exported in frozen form, however some prime grade beef is also exported frozen. The Ministry of Agriculture and Forestry estimated that manufacturing grade beef products likely represent about 40% of New Zealand's beef exports.<sup>46</sup> The markets for manufacturing grade and prime beef are quite distinct and price movements in each will be considered separately in sections 4.2. and 4.3.

Almost half of New Zealand's frozen beef exports go to the US, followed by Korea, Japan, Canada and Indonesia (figure 30). By contrast the export destinations for fresh or chilled beef exports are more diverse, but still predominantly based in Asian and North American countries (figure 31).

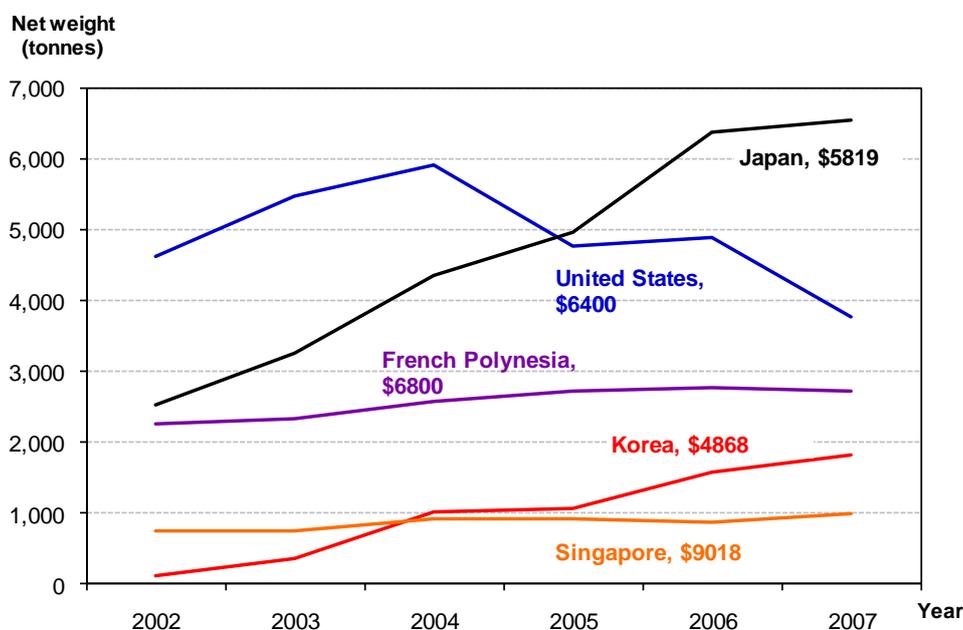
Over recent years the trade share of Asia in both our frozen and fresh or chilled beef exports has been increasing.

**Figure 30:**  
**Frozen Beef Exports by Trading Partner and FOB prices in 2007**



<sup>46</sup> MAF (2009). Estimate based on data of domestic slaughter type, as well as the available export information.

**Figure 31:**  
**Fresh/Chilled Beef Exports by Trading Partner and FOB prices in 2007**



Source: UN Comtrade

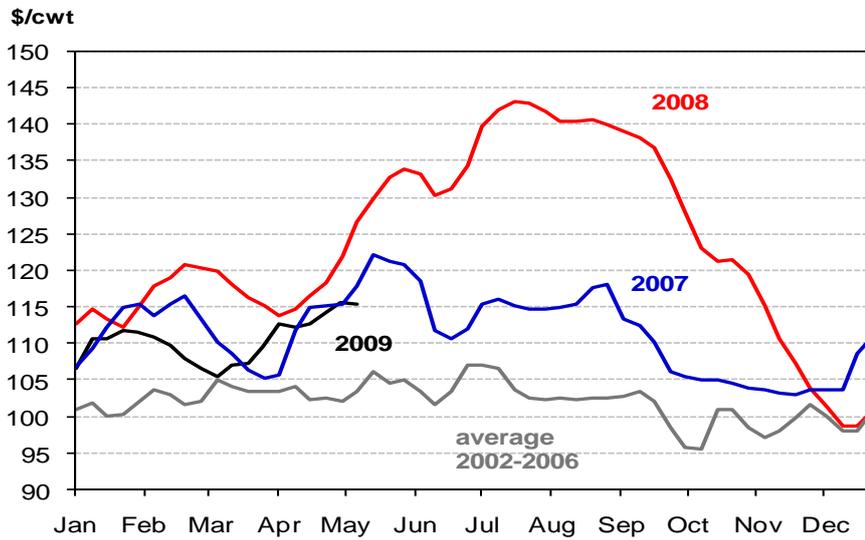
## 4.2 Manufacturing Grade Beef

The US is New Zealand's key export market for manufacturing grade beef and effectively sets market prices for the product. During 2008 the wholesale value of beef from cull cows in the US increased dramatically to well above levels seen in recent years (figure 32), and this translated into a marked increase in export prices for NZ manufacturing grade beef to the US both in US\$ and NZ\$ terms (figure 33). In this section we explore supply and demand factors which may explain the price movement that occurred.

### 4.2.1 In H1 2008 US domestic demand appeared strong for lower quality beef, while supply from traditional exporters to the US fell

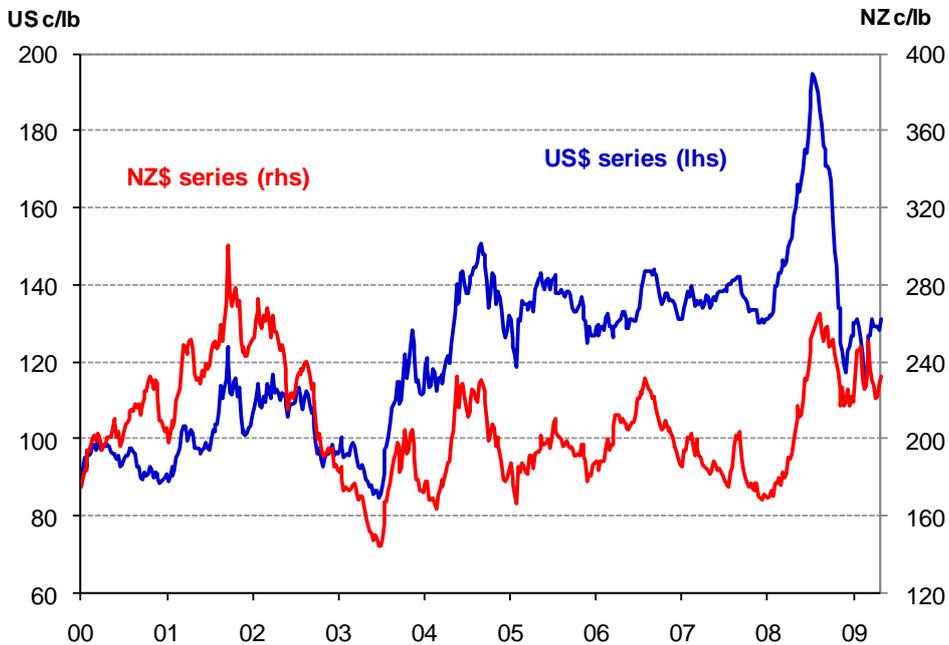
US demand for manufacturing grade beef was strong in the first half of 2008, despite a long-run trend of declining total per capita beef consumption (see Section 4.4) and a weakening domestic economy.

**Figure 32:  
Boxed Cow-Beef Cutout Value in the US**



Source: Livestock Marketing Information Center

**Figure 33:  
Price Received for NZ Manufacturing Grade Beef Exports to the US**

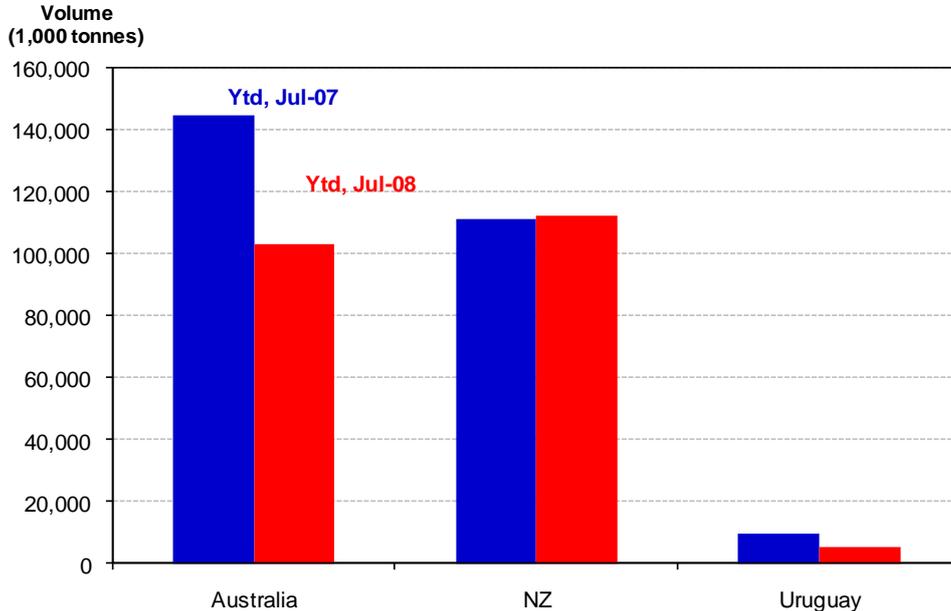


Source: NZX Agri-Fax

Rabobank (2008c) explains that US consumers typically “trade down” to lower priced beef items such as mince or hamburgers, before actually reducing the amount of beef consumed. According to Feuz (2008) of the Livestock Marketing Information Center (LMIC, Washington State University Extension), “a weakening US economy and rising fuel prices [shifted] consumer demand away from more expensive beef cuts towards lower priced beef products such as hamburger, which cows provide.”

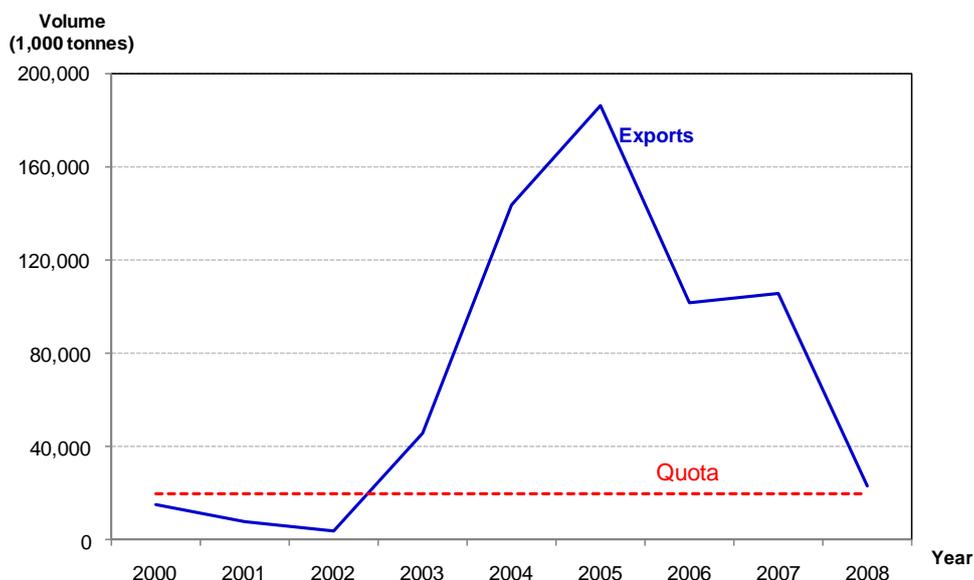
On the other hand, US imports of manufacturing grade frozen beef were falling in the first half of 2008. From 2003 to 2007, key suppliers to the US were Australia (46% of US frozen beef imports by volume in 2007), New Zealand (29%) and Uruguay (17%). For Uruguay, this involved sales substantially above their quota of 20,000 tonnes. While New Zealand’s beef exports to the US in the first half of 2008 remained firm (up 1% compared to the year-to-date July 2007), those from Australia were down by 29%, see figure 34. Further, Uruguay’s beef exports to the US appeared to be running at a pace even below quota level.

**Figure 34:**  
**Beef Import Volumes to the US in H1 2008 under the WTO**



Source: U.S. Customs, provided by Meat & Wool New Zealand

**Figure 35:**  
**Uruguay Frozen Beef Exports to the US (full year, including out of quota sales)**



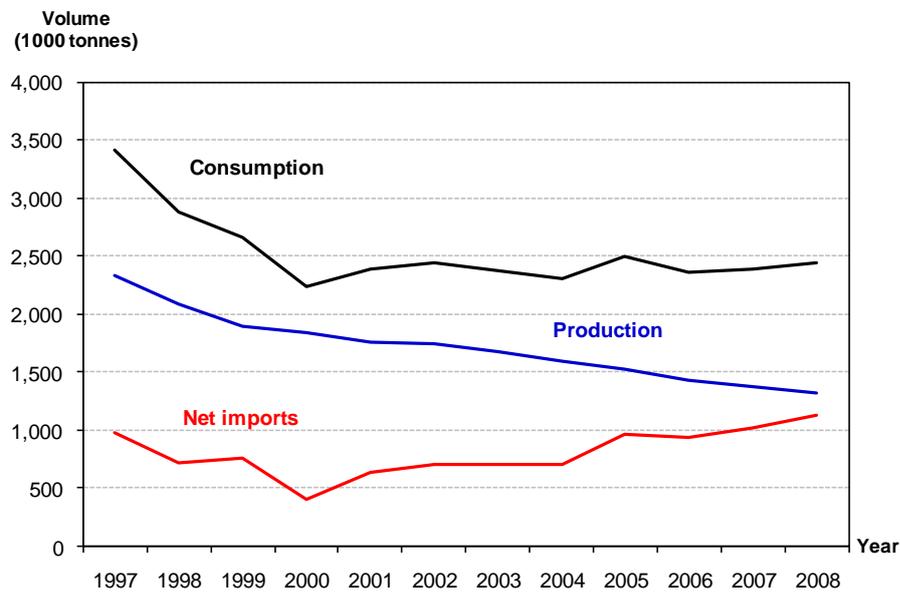
Source: UN Comtrade

One contributor to this drop in US imports may have been a supply shortfall in Russia diverting manufacturing beef exports to that market.

- In Russia beef production has declined continuously since the USSR break-up in 1991. The sector suffers from a lack of investment and inadequate infrastructure, according to the US Meat Export Federation. In 2008, there were 18 million head of cattle in Russia, down from 27 million head in 2000, according to USDA data. By contrast income growth has seen beef consumption stabilise in recent years and show tentative signs of increasing (although at around 16kg/yr beef consumption per capita in Russia is still only about half its 1991 level).
- Russian beef imports have been traditionally supplied by the EU and South America. However reduced European beef production following the 2003 CAP reform, an FMD-related ban on Brazilian beef exports to Russia from late-2005 to December 2007, and the Argentine Government's restriction on beef exports (in 2006 and again in 2008) left a shortfall in the Russian market. It appears that this was partially met by exports from Australia and Uruguay, which

in turn diverted manufacturing grade beef from the US market and contributed to upward price pressure in the US. For instance, beef exports to Russia from Australia were 12-fold higher in the first three months of 2008, compared to the same period the previous year<sup>47</sup>.

**Figure 36:  
Beef Production, Consumption and Net Imports in Russia**



Source: FAPRI, USDA

Drought in Australia may also have contributed to a decrease in their manufacturing grade beef exports to the US. Beef production requires more water per kg produced than any other plant and livestock product, at 15L/kg (compared to 10 L/kg for lamb and 6L/kg for poultry, Deblitz 2008). Australian drought from 2003 led to higher slaughter rates as farmers brought forward the slaughter of cattle. In the year to June 2008, however, ABARE reported that total cattle slaughterings fell by 3% to 8.8 million, which was mirrored in a 3% drop in beef production over the same period.

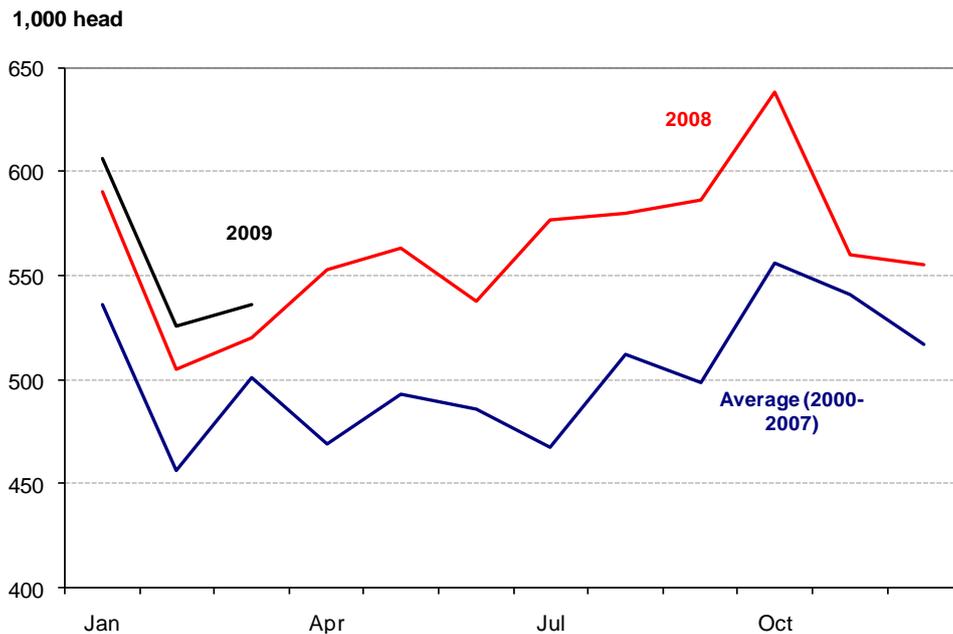
<sup>47</sup> The Cattle Site (2008).

#### 4.2.2 The US increased domestic slaughter, and as demand deteriorated further in H2 2008 prices stabilised back closer to historical levels

In response to high manufacturing grade beef prices, the US increased domestic slaughter of cows and bulls (figure 37)<sup>48</sup>. This relied in part on the import of live cattle from Canada for slaughter in the US (contributing approximately a third of the increase in the US slaughter rate).

Higher US domestic cow slaughter was one factor contributing to the decline in manufacturing grade beef prices to more typical historical levels in the second half of 2008 (around 2004-2007 historical average in USD terms).

**Figure 37:**  
**Slaughter of Cows and Bulls in the US**



Source: USDA

<sup>48</sup> Manufacturing beef is generally from cows and bulls in the US. It is worth noting that manufacturing grade cow and bull cull receives only half the price per cwt of corn fed steers and heifers, and this low value beef has never been bulked up through corn feeding.

In addition, the sharp deterioration in global confidence and economic activity associated with the global financial crisis, particularly post the Lehman Brothers collapse in September 2008, resulted in heightened uncertainty about final US consumer demand and more cautious behaviour by overseas buyers, despite still relatively strong fast-food service sales. Rabobank (2008d) reported that retailers and food service companies were “holding back” from purchasing significant quantities of beef in late 2008, and this was passing through to importers who were also constrained by tightened credit conditions and greater exchange rate volatility.

Another factor underpinning price declines over the second half of the year was a marked drop in beef demand in Russia as oil receipts sharply reduced and its stock market fell more than 70% in the wake of the financial crisis. Further, the USDA reports that Russian importers were forced to cancel contracts for meat imports in the fourth quarter of 2008 due to an inability to obtain credit and much higher expense in the face of a sharp currency declines<sup>49</sup>. The disappearance of the Russian market saw Australia and Uruguay redirect their beef exports back to the US market further adding to downward price momentum.

### **4.3 Prime Beef**

Dynamics in the market for prime beef are complex. Unlike manufacturing grade, this higher value beef is often bulked up by grain-feeding in many countries. And, at least in the US, this results in an elaborate, multi-step production chain. These factors may make prime beef (probably alongside lamb) the least ‘commodity-like’ product we review.

During 2008 beef feedlots were facing unprecedentedly high feed costs, in addition to other cost pressures such as high energy costs. There was some offsetting downward pressure on feeder cattle prices (those bought into feedlots), but only very limited upward movement in the price received for fed cattle. Moreover the extreme deterioration in global economic conditions, particularly in the last quarter of 2008, saw very large falls in retail prime beef demand. As a result of these factors many feedlots experienced negative margins throughout 2008, and rationalisation in the sector (ongoing as of 2008) would seem likely to limit prime beef supplies going forward.

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<sup>49</sup> US Department of Agriculture Foreign Agricultural Service (2009)

### **4.3.1 Rising Feed Costs reduced profitability through the beef supply chain**

A major development between 2006 and 2008 was the dramatic increase in the price of corn, driven at least in part by biofuel policies particularly in the US (see discussion in Section C. Dairy, Box 3).

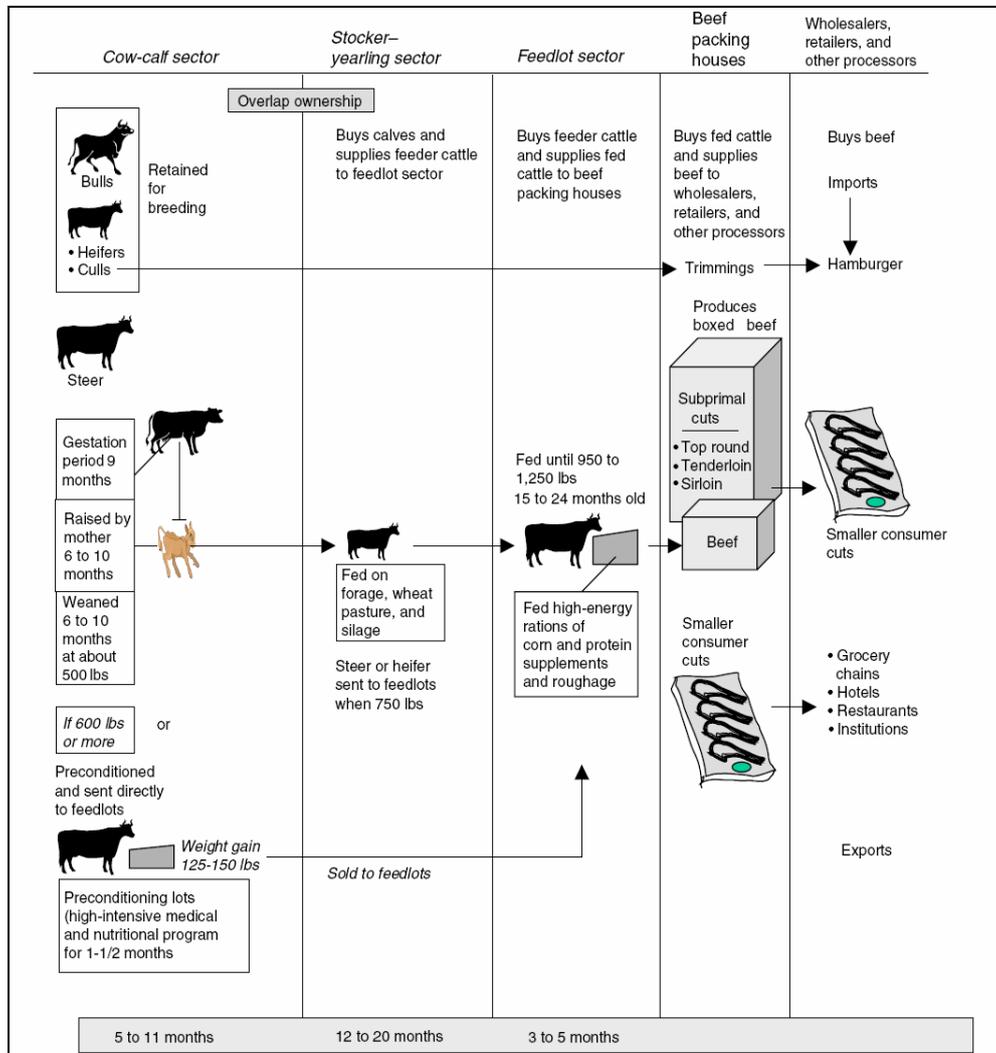
Corn can be a major component of feed for prime beef cattle. Deblitz (2008) identifies four major beef production systems globally:

1. Pasture. Grazing based systems found in the Southern Hemisphere, Ireland and UK.
2. Silage. Fermented high-moisture fodder made from maize, grass or soybean. Found in intensive farms in Europe and China.
3. Feedlot. Feedyards where cattle are fed a high-intensity diet of purchased feed such as corn, grain, soybean and hay. Found in the US, Canada, Australia and Spain.
4. Cut and Carry. Fresh grass cut and carried daily to the cattle. Found in smallholder farms in developing countries such as India, Indonesia and parts of China.

In the United States the beef production chain is fairly complex (figure 38). Cow-calf producers breed and rear calves which are then sold directly to feedlots, or else sold to stockers who put them on pasture until they are ready to go to feedlots (at a weight ~750lbs, age 12-20 months). Feedlots feed the steers or heifers (feeder cattle) a concentrated diet of corn and other grains to fatten them up for slaughter. Meat packing plants will then purchase the „fed cattle’ at 15-24 months of age, typically weighing between 950-1250lbs. Finally the beef passes onto processors, or directly into the wholesale and then retail markets.

The impact of higher feed costs on beef production or retail beef prices depends on whether there is any margin squeeze in this complex value chain, and whether price rises can be passed on to consumers without either a downshift to cheaper beef or import competition limiting price rises.

**Figure 38:**  
**US Beef and Cattle Industry from Animal Breeding to Consumption**



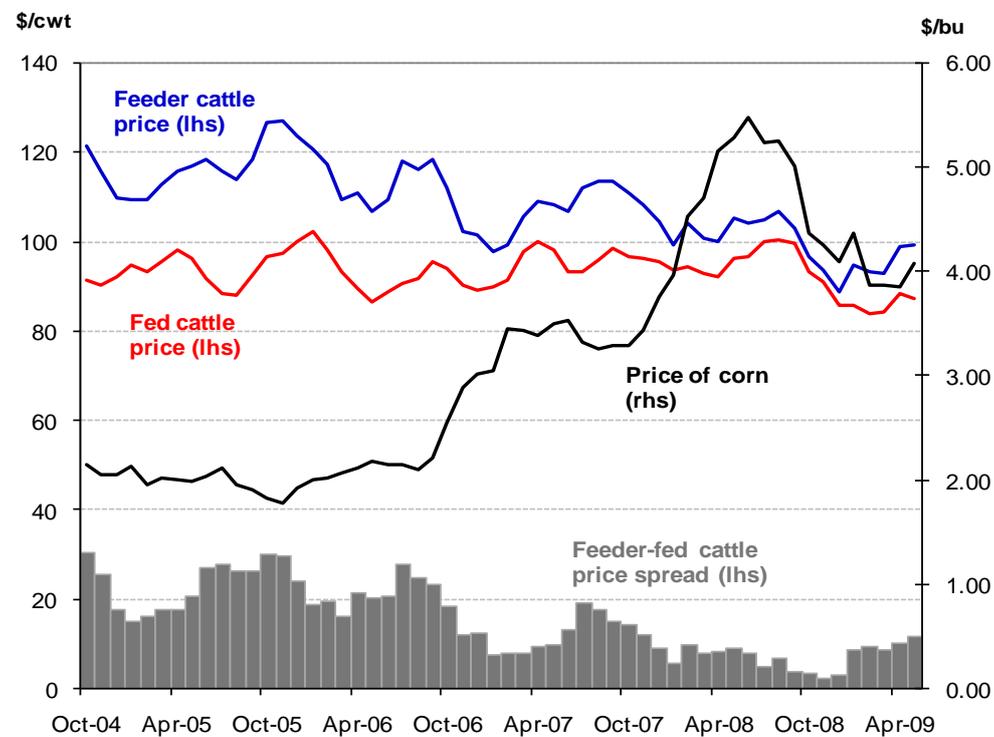
Source: US Government Accountability Office (2002)

Rabobank (2008c, p1) explains that traditionally, the cow-calf producer has been used to bearing the brunt of the market conditions with negative price movements and/or additional costs being passed down the chain from the packer to the feedlot operator and finally to the cow-calf producer. In this case higher feed costs would be offset by a reduction in the price that feedlots would be willing to pay for feeder cattle. The alternative, in order for feedlots to maintain margins in the context of higher feed costs, would

be to see an increase in the slaughter price received for fed cattle, which would in turn lead to higher retail beef prices for prime beef cuts.

For the most part the traditional response seemed to be in play. Some easing in feeder cattle prices was observed, with feeder cattle prices 13% lower in June 2008 (at the peak of the corn price spike) than their average over 2006 (pre the run-up in corn prices). Fed cattle prices, by comparison, tended to hold firm over this period, rather than showing any pass on of higher feed costs (figure 39)<sup>50</sup>.

**Figure 39:**  
**Fed Cattle, Feeder Cattle and Corn Prices in the US**



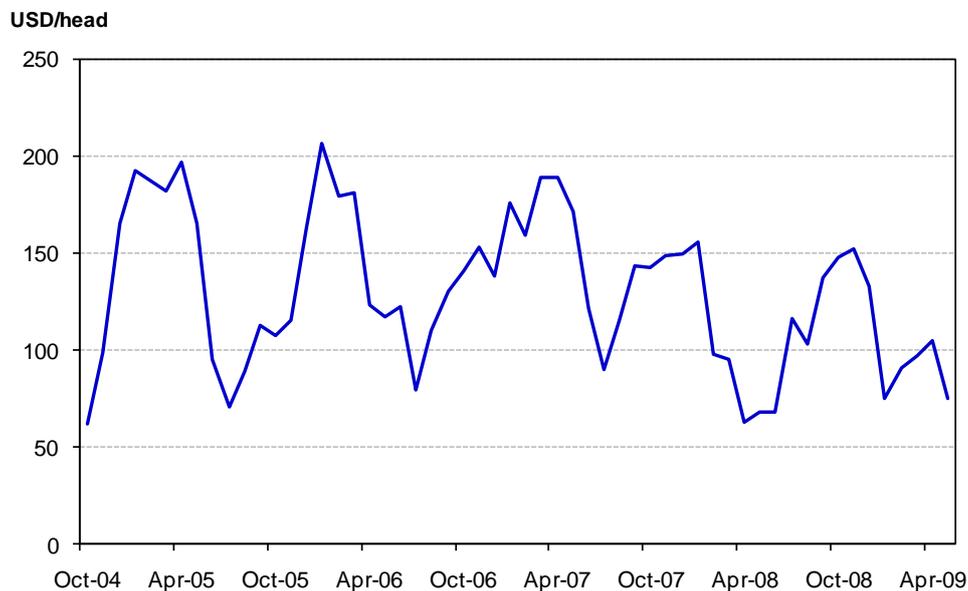
Source: USDA

However, these trends in fed and feeder cattle prices were not sufficient to offset rising feed costs. The LMIC (2008) estimates that based on a 750lb steer placed in a Southern Plains commercial feedlot and accounting for all

<sup>50</sup> The feeder cattle price is normally higher than that of fed cattle on a per hundredweight basis.

production costs, feeders for the first five months of 2008 on average lost over \$134 per head. Industry-wide feedlot losses are estimated at over \$100 million a week. This margin pressure can be seen in figure 40 which provides an illustration of feedlots' margin over the feeder cattle purchase cost and feed cost per head (i.e. not accounting for other costs of production)<sup>51</sup>. Over the first half of 2008 this estimated margin fell to historically low levels.

**Figure 40:**  
**Estimated Marginal Revenue per head in a Feedlot**



Source: RBNZ calculations

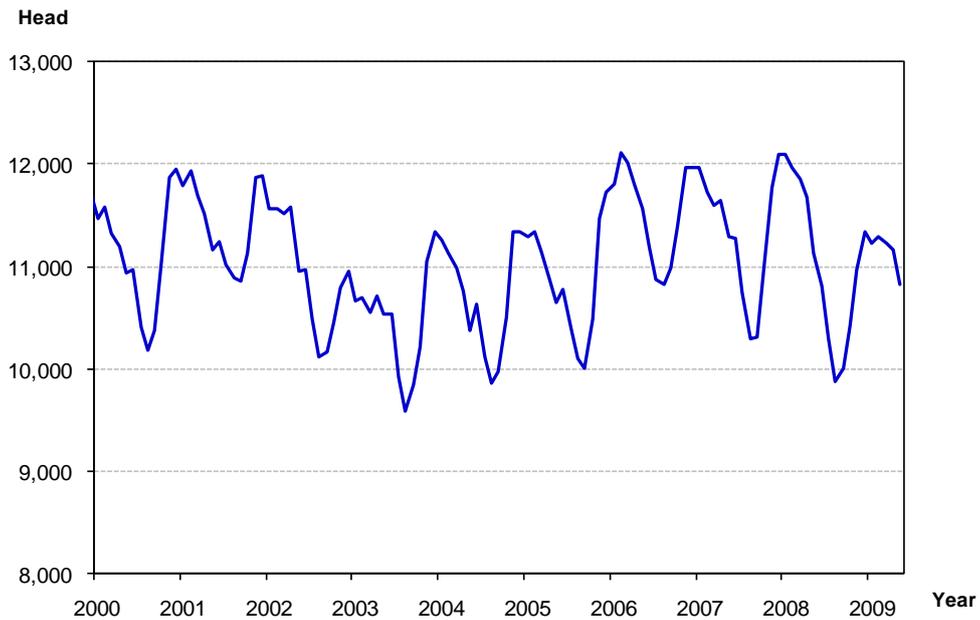
### **4.3.2 Tight supplies can be expected going forward, which will support prime beef prices once demand returns**

High feed costs, disappointing fed cattle prices and resulting negative margins affected feedlot supply decisions in the US in 2008, leading to a marked reduction in placements of cattle on feed. Lower prices for feeder cattle would be passed back along the supply chain, reducing the incentives

<sup>51</sup> The calculation is based on a placement weight of 750lbs, slaughter weight of 1200lbs, feed conversion ratio of 7lbs grain/lb beef gained weight (Anderson et al, 2000) and USDA fed cattle, feeder cattle and corn prices (a bushel of corn is 56lbs).

to cow-calf operators. The numbers of cattle on feed in the US in December 2008 was 6% lower than their level a year earlier and on a par with levels last seen in the BSE-affected years (2003-2005), figure 41.

**Figure 41 :**  
**Cattle on Feed in the US**



Source: USDA

As of 2008 rationalisation in the feedlot sector was continuing and seemed likely to continue to dampen supply. Indeed a number of feedlot bankruptcies occurred, and the LMIC (2008) estimated that it would take until mid-2010 for existing feedlots to recoup the losses they endured in the first 3 months of 2009 alone. According to Rabobank (2008c) there has historically been excess capacity in both the packer and feedlot sectors in the US. This would explain why feedlots, competing with each other for supply of feeder cattle, did not react more strongly to high feed costs by lowering their willingness to purchase feeder cattle.

## 4.4 Medium-Term Demand Trends

Finally we briefly discuss the medium term demand trends in North America and Asia, New Zealand's principal beef export destinations. In general we find evidence of a shift away from beef consumption in the US, but the potential for rising demand in Asia, associated with rising per capita incomes, which may not be offset fully by domestic production.

### 4.4.1 Falling beef demand in the US since the 1980s

The American consumer has high per capita beef consumption at over 30kg/yr, and a preference for beef among the red meats. In fact, the US population continues to represent the largest block of beef consumption globally. However over the past 20 years, US beef consumption per capita has been steadily declining, while per capita poultry consumption has increased markedly (figure 42). There is significant debate in the literature as to the drivers of this changing consumption profile.

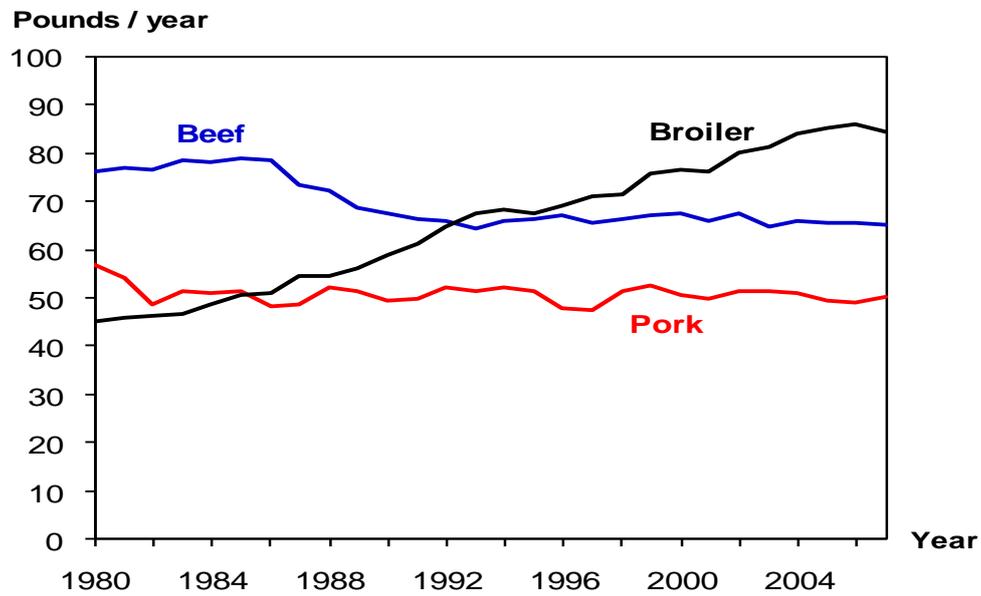
Schroeder *et al* (2000) argue that declining US beef consumption cannot be explained by changes in deflated retail beef prices (with beef consumption relatively inelastic<sup>52</sup>, and per capita beef consumption now lower at a given retail price, i.e. a leftward shift in demand, see figure 43). Beef consumption is somewhat sensitive to changes in relative prices for alternative meat products, although most estimates of the elasticities remain fairly low<sup>53</sup>. Moschini and Meilke (1989) find evidence of a structural change in US beef consumption in the mid-1970s, and argue that observed meat consumption patterns "cannot be fully explained by the dynamics of price and income" (p260). A declining appetite for beef, in favour of "white meat" such as poultry, may reflect an upsurge in health concerns, and desire to reduce intake of saturated animal fats and cholesterol. Indeed Yen *et al* (2008) find evidence that greater dietary knowledge has been associated with lower beef consumption. Others argue that increasing female workforce participation has placed an emphasis on convenience and favours poultry products, which take less time to prepare (Haley, 2001).

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<sup>52</sup> They find an own price elasticity of -0.61 (over 1982-1998). Schroeder *et al* also report on selected other analyst estimates which range from -0.28 to -0.85.

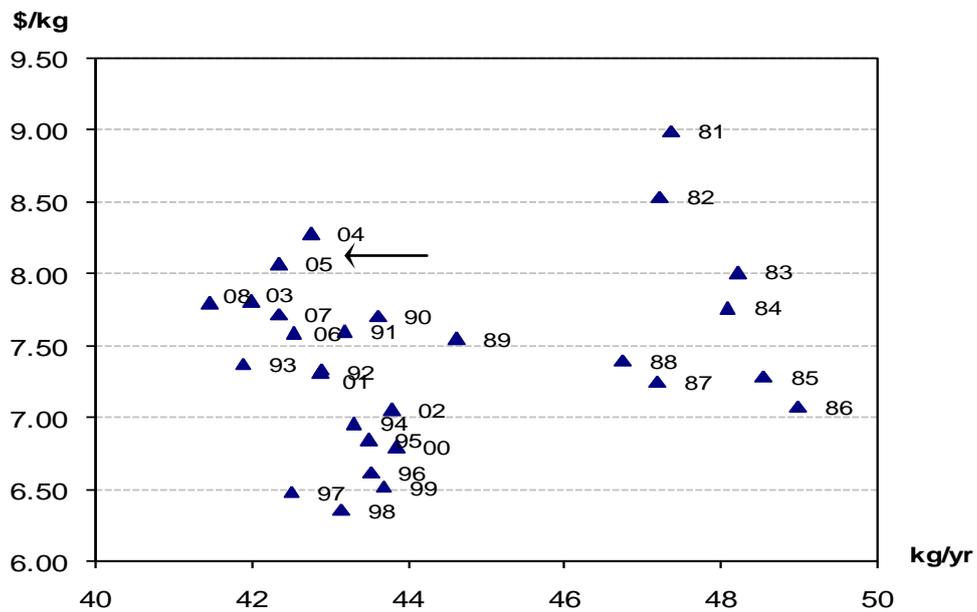
<sup>53</sup> Schroeder *et al* (2000) estimate cross price elasticities to pork and poultry of just 0.04 and 0.02 respectively.

**Figure 42:**  
 US Meat Consumption per Capita



Source: USDA

**Figure 43: US Beef Demand – Annual Deflated Retail Beef Price and**



Source: FAPRI

Finally demographics appear to have had an influence, with the USDA identifying age, race and income as influential to beef consumption, based on household survey data (Davis and Lin, 2005). The findings of this research lead the USDA to believe US per capita beef consumption will continue to decline out to 2020, as the US racial/ethnic landscape changes and the population ages.

#### **4.4.2 Developing nations present a potential growth market for New Zealand exports**

In Asia, per capita beef consumption remains considerably lower than in Western economies, with the potential for further growth in demand. Recent trends have been somewhat mixed (figure 44) with beef consumption in Japan and Korea, which is highly sensitive to food safety concerns, showing a notable decline since 2000 as a result of BSE scares (indeed beef consumption per capita in Japan in 2007 was around 20% lower than in 2000). Despite this, New Zealand's exports to these two markets have grown strongly (see figure 33) as a ban on US imports allowed for a gain in New Zealand's market share.

Fundamentally, rising income growth in emerging Asia can be expected to provide medium term support for beef consumption in the region<sup>54</sup>. Consistent with this, beef consumption per capita levels in China and Indonesia have been trending upwards, although both remain at very low levels (in China for example meat consumption is still dominated by pork with per capita levels of 35-40kg/yr in 2007<sup>55</sup>). In addition to income growth, trends of urbanisation, cultural change and population growth are all likely to support beef consumption (see Deblitz (2008), for example).

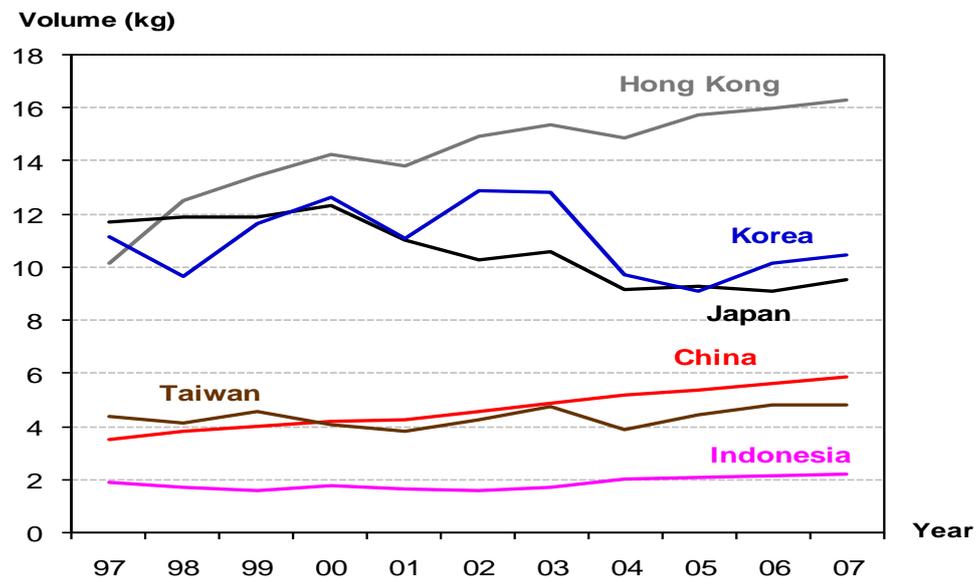
The OECD Food and Agricultural Organisation Outlook (2009) predicts that global meat consumption will rise by 20% by 2018 compared to the 2006-2008 average, with developing nations accounting for the vast majority of the additional meat consumption (figure 45). Indeed continued growth in

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<sup>54</sup> In Japan, a developed economy with an ageing population, the scope for consumption growth appears more limited.

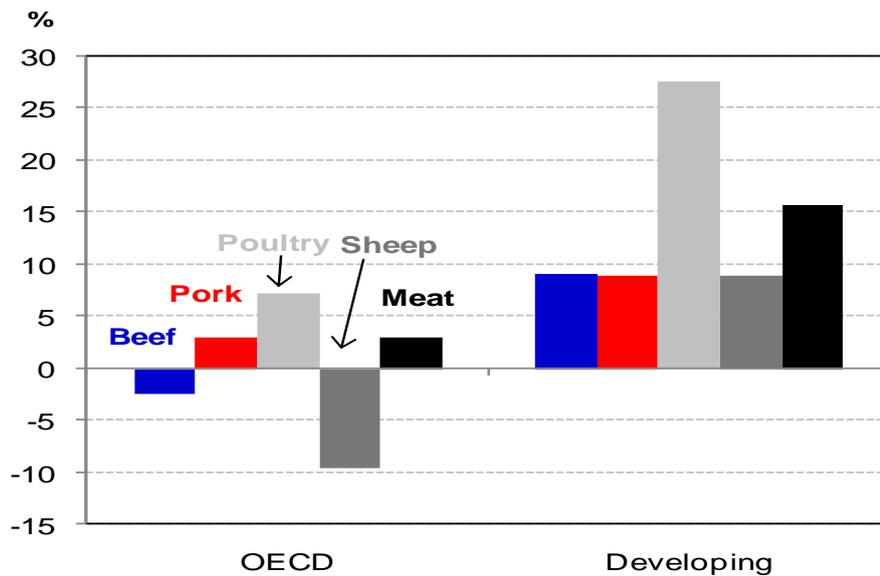
<sup>55</sup> Liu et al (2007) argue that the relatively high price of beef and unfamiliarity with its cooking methods have held back beef consumption. Cultural attitudes may also be important (Cai et al, 2004). Urban consumers in China have more readily adopted beef consumption with per capita levels over three times their rural counterparts (CNBS Yearbook 2007).

**Figure 44:**  
**Beef and Veal Consumption per Capita in Selected Asian Countries**



Source: USDA

**Figure 45:**  
**Projected Growth in Per capita Meat Consumption to 2018 by Product and Region**



Source: FAO Agricultural Outlook (2009)

beef demand is expected throughout South East Asia, in comparison to developed economies where beef consumption per capita is expected to decline<sup>56</sup>. For countries such as Indonesia, Malaysia, the Philippines and Thailand increased consumption will involve expanding imports. China, currently a small net exporter, may also become reliant on imports if growth in domestic production is unable to keep pace with production (this is currently embodied in the latest projections from FAPRI (2009), but not the FAO)<sup>57</sup>.

On this basis consumers in Asia are likely to become an increasingly important source of demand growth for New Zealand beef exports over the medium term.

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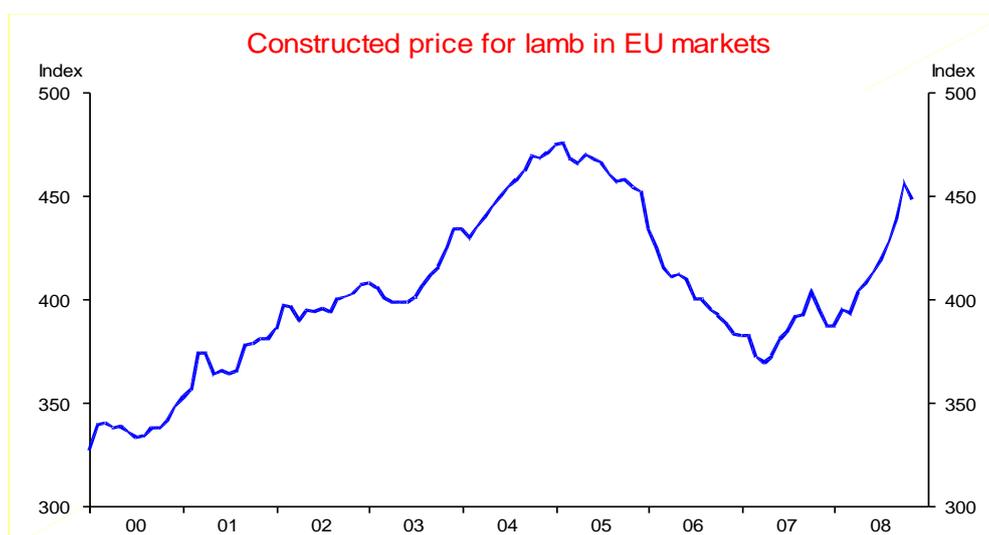
<sup>56</sup> Poultry consumption sees the strongest growth in meat consumption globally. Consumers in developed economies substitute toward poultry as a lean and easy to cook alternative. Demand for poultry is also firm in developing nations as poultry represents the cheapest source of meat protein.

<sup>57</sup> For discussion of factors affecting Chinese beef production see for example Liu et al (2007), Brown et al (2003) or Godfrey (2007).

## 5. Lamb

Prices of lamb – another of New Zealand’s major exports – moved in large cycles in recent years (figure 46). This has created significant volatility in revenue for New Zealand’s sheep meat exporters. In the final section of this paper, we examine lamb price movements in Europe – New Zealand’s largest lamb export market, and explore fundamental supply and demand drivers for these price movements.<sup>58</sup>

**Figure 46:**  
**Constructed price for lamb in EU markets**



We find that

- Lamb prices in European Union (EU) markets completed a large price cycle between 2000 and 2006, and started a new upturn phase from 2007 to 2008.
- Supply disruptions due to disease outbreaks (e.g. Foot and Mouth and Blue Tongue), and agricultural policy reforms in the EU played

<sup>58</sup> Key data sources: Agri-fax, Australian Bureau of Agricultural and Resource Economics, Eurostat, Food and Agricultural Policy Research Institute, Global Trade Atlas, Meat & Livestock Australia, Meat and Wool New Zealand, OECD, Rabobank, Statistics New Zealand, UK Department for Environment, Food and Affairs.

a significant role in driving an upswing in lamb prices from 2001 to 2004, and again in 2007. In contrast, local demand for lamb over this period remained relatively static.

- Climate-related production fluctuations in New Zealand and Australia – the EU’s largest external suppliers of lamb – also significantly affected the price dynamics in the reviewed period.
- The global recession in 2008-2009 may lead households to substitute lamb with cheaper alternatives. However, medium-term price prospects for lamb still look promising. Not only is world demand expected to rise steadily in the foreseeable future, sheep population in key exporting and consuming nations have been on a trend decline. This supply and demand imbalance is likely to provide an underlying support for lamb prices over the medium term.

## 5.1 Market Structure

Relative to the other commodities reviewed here, global markets for sheep meat, especially lamb, are considerably thinner and more segmented. As a form of animal protein, lamb is considerably less prevalently consumed globally compared to alternative meats, such as beef, pork and poultry.<sup>59</sup> But for those who do have an acquired taste for it, lamb is commonly viewed as premium protein and hence, generally commands higher prices relative to other meat.

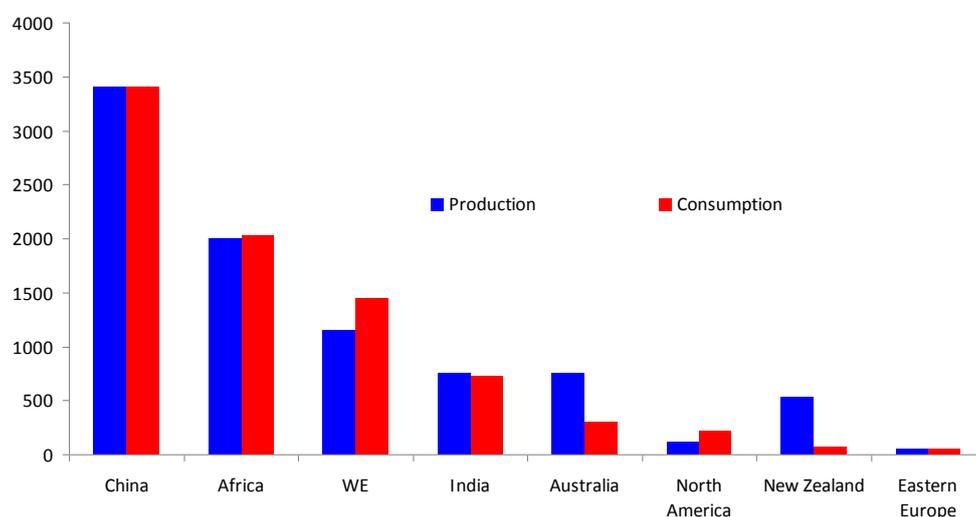
Per-capita consumption of world-traded sheep meat reflects the wealth level of different regions. Relatively expensive meat such as lamb racks, loins and legs are generally consumed in wealthy developed countries and regions, such as Western Europe (particularly the UK), the US and Japan. In contrast, relatively inexpensive meat, such as mutton, is more popular in the Middle East, developing Asia and the Pacific regions. In volume terms, total consumption of sheep meat in developing countries is almost 4 times that in the developed world, due to the much larger population base in developing countries (FAO-OECD, Agriculture Outlook 2008).

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<sup>59</sup> World consumption of sheep meat was less than ¼ of the level of beef, 1/5 of poultry, and 1/7 of pork in 2007, according to FAO-OECD Agriculture Outlook 2008-2017.

Despite this larger demand, major developing regions, such as China, Africa and India, are by-and-large self-sufficient in sheep meat production and consumption (figure 48). The fact that the majority of world demand is met by internal production is the key reason why sheep meat is more thinly traded globally than other meat. In fact, around 90 percent of total world output of sheep meat is consumed within the producing countries and regions each year, leaving only 10 percent of it available for trade (this figure excludes trade within the EU).

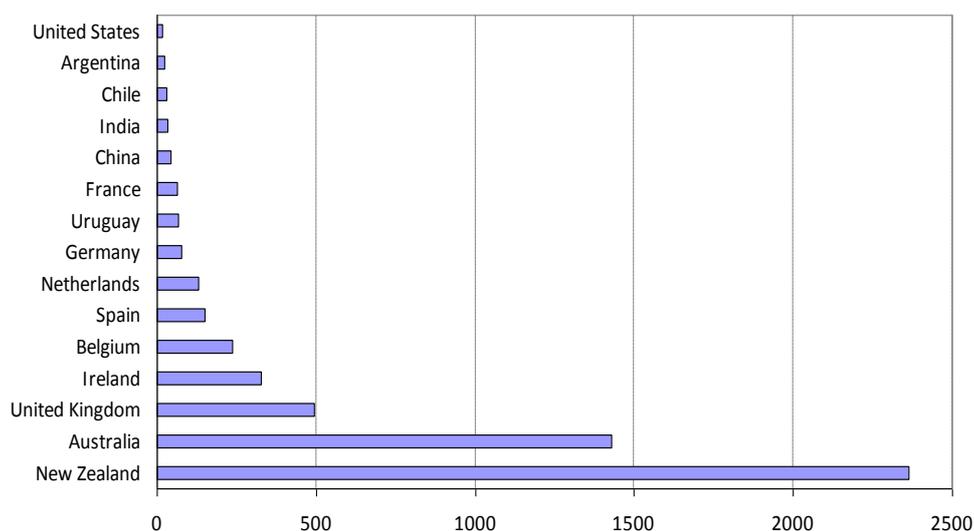
**Figure 47:**  
**Sheepmeat production and consumption, 2007 (in thousand tones)**



Source: OECD-FAO outlook, Rabobank 2008

Of the 10 percent of world production that is traded internationally, New Zealand and Australia are by far the dominant exporters. In NZ dollar terms, exports from Australasia accounted for around 70 percent of total world trade of sheep meat in 2007. If trade within the EU is excluded, this share is around 90 percent (figure 48).

**Figure 48:**  
**Export value of chilled and frozen sheepmeat of major exporting countries, 2007 (in million NZD)**

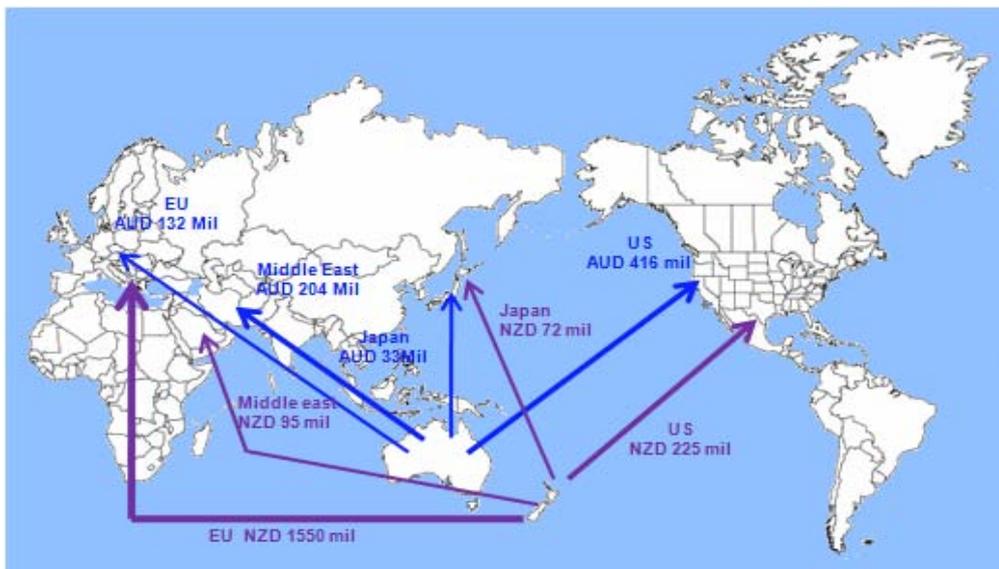


Source: Global Trade Atlas, Meat and Wool New Zealand

Developed countries are major markets for Australasian exports of premium cuts of sheep meat, such as lamb racks, legs and loins. In the case of New Zealand, exports to the EU and North America account for around 75 percent of total sheep meat exports in volume terms.<sup>60</sup> In comparison, less expensive meat from New Zealand and Australia, such as mutton and lower value-added lamb, are typically destined for developing Asia, the Pacific and Middle East regions (figure 49).

<sup>60</sup> Almost 10 percent of exports are destined to North Asia, where Japan has increasingly become a major consumer of these premium products.

**Figure 49:**  
**Global sheapmeat trade flows**



Source: Rabobank, RBNZ estimate

Similarly to beef, global trade of sheep meat is subject to rigorous quota systems, particularly in the EU. While the trade restriction has limited the amount New Zealand farmers can sell in these markets (with out-of-quota exports subject to significant tariff)<sup>61</sup>, the quota system in fact gives New Zealand an important advantage in market access over its major competitor, Australia.<sup>62</sup>

Relative to New Zealand, Australia relies more on domestic consumption. In 2007, the domestic market consumed more than 40 percent of local production of lamb and almost 80 percent of mutton (MLA, 2007). For meat that was exported, the largest destination for Australian product is the United States, taking over half of Australian total sheep meat exports in 2007. Unlike the EU, the US market is relatively free of trade restrictions; therefore, aggressive competition from Australian meat producers in recent years has seen their market share increase significantly at the expense of the market share of New Zealand exporters.

<sup>61</sup> Out of quota exports incur a tariff of 12.8 percent plus 90 to 300 euro tax per 100 kg (depending on the product).

<sup>62</sup> The EU granted 227,854 tonnes of lamb imports from NZ in 2007, while only 18,650 tonnes from Australia.

## 5.2 Construction of a “world price”

As noted above, the global market for sheep meat is thin and segmented, with rigorous trade barriers in some of the key regions where trade occurs. Consequently, price differentials for the same cut of meat can be quite large across different markets. In addition, changes in supply and demand dynamics in various regions, and for different cuts of meat, often result in significant relative price movements. These market imperfections make finding a representative „world price’ for sheep meat considerably more difficult than for commodities like oil, dairy and beef, whose markets are more liquid, and products more homogeneous and well-defined.

Instead, we have constructed our own price series for the following analysis. This constructed price takes into account the types of meat New Zealand exports, and the markets to which these products are sold.

In deriving the „world price’, we first look at the types of sheep meat New Zealand exports. Data from Statistics New Zealand suggest that the vast majority of New Zealand’s sheep meat exports have been high value-added products like lamb in recent years (around 90 percent, with mutton exports account for the remaining 10 percent). We therefore look at *lamb* prices exclusively in our analysis. While the exclusion of prices of less expensive meat is likely to create an upward bias to our price series, the extent of bias is unlikely to be significant due to the small share of less expensive product.

Second, in deriving the „world price’, or more precisely, the price that New Zealand exporters receive in overseas markets, we multiply the NZ dollar price by the relevant currency cross rates.<sup>63</sup> The exchange rates we use (the euro and Sterling) are weighted according to the share of exports sold in each market.<sup>64</sup> Once again, this transformation is imperfect as we fail to account properly for products sold to regions outside New Zealand’s key markets. In addition, the use of spot rate conversion fails to account for the extent of foreign currency hedging adopted by exporters. Information and data limitations are the key reasons for these assumptions.

Finally, to account for different cuts of meat, we equally weight loin and leg prices for our constructed series.

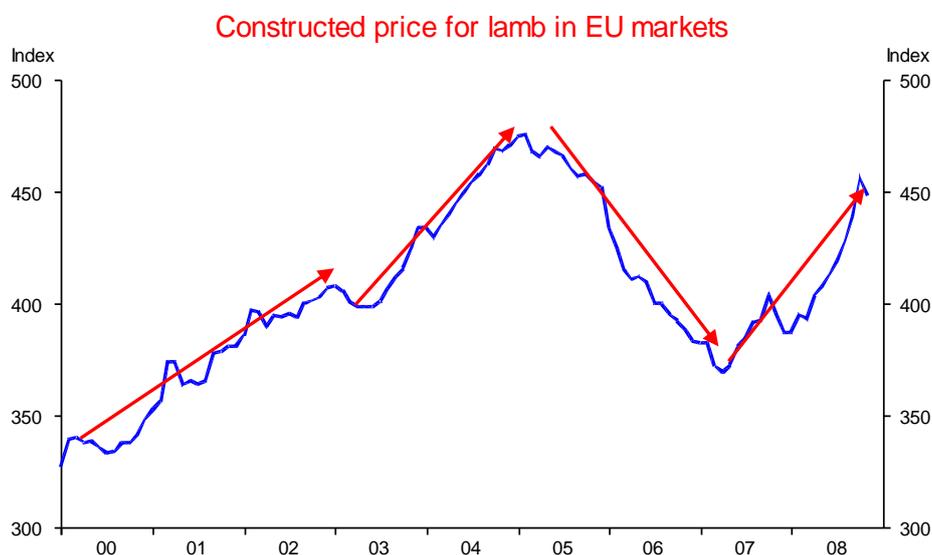
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<sup>63</sup> The NZ dollar price data are provided by Agri-fax.

<sup>64</sup> Weighting used are: 2/3 in the euro and 1/3 in the GBP. This is roughly consistent with relative export weights to these regions.

Figure 50 presents this constructed price from 2000 to 2008. As mentioned above, this price series is subject to imperfections, and therefore it should be treated with caution. However, our following analysis suggests movements in this price series are broadly in line with changes in supply and demand conditions over the period. This tends to suggest that the constructed price is adequate in providing a rough picture of price trends in these markets for the reviewed period.

**Figure 50:**  
**Constructed price for lamb in EU markets**



Source: Agri-fax, RBNZ estimate

### 5.3 Price movement and supply-demand dynamics

As figure 50 illustrates, lamb prices in the EU have gone through one complete price cycle since the start of this decade. In fact, there are four price trends that can be identified, with each lasting for roughly two years:

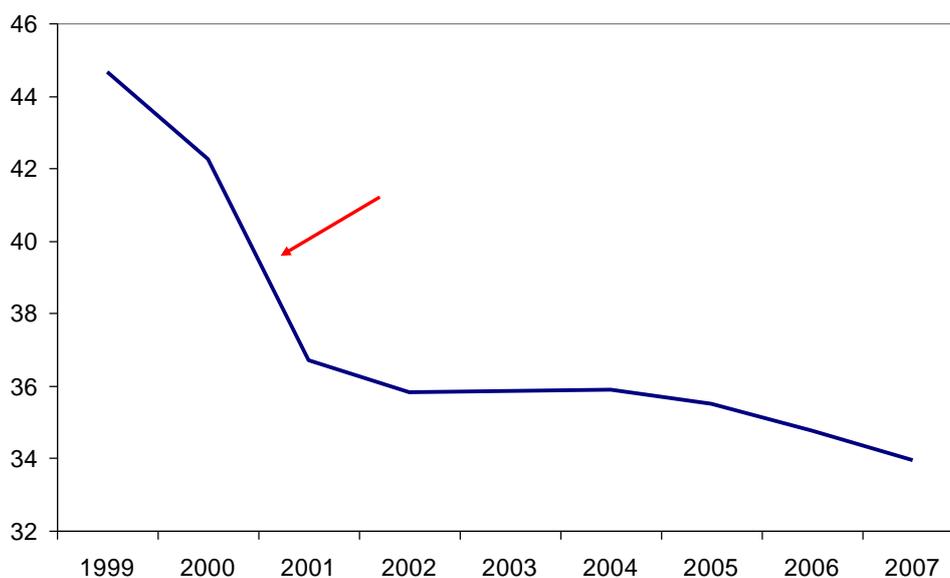
1. 2001 ~ 2002: a phase of steady upturn.
2. 2003 ~ 2004: a phase of acceleration.
3. 2005 ~ 2006: a phase of correction.
4. 2007 ~ 2008: a phase of recovery.

The following analysis discusses supply and demand conditions to explain the price movements in each of the four episodes.

### 5.3.1 The steady increase (2001 to 2002):

One of the key contributors to the price increase in 2001 was the large scale outbreak of Foot and Mouth Disease (FMD) in the UK. The disease had a devastating impact on the UK sheep population, resulting in a 30 percent fall in sheep slaughtered for sale in that year. At the same time, sheep flock numbers also took a big hit, falling 13 percent by the end of the season (figure 51).<sup>65</sup> Since the UK is the largest producer of sheep meat in Europe – accounting for one third of the EU-15’s output each year – EU production as whole suffered.

**Figure 51:**  
**UK sheep flock (in million heads)**



Source: UK Department for Environment, Food and Rural Affairs

Although the FMD outbreak raised consumer awareness of disease issues, consumption of sheep meat in the UK fell by far less than production,

<sup>65</sup> This stock depletion did not translate into an increase in meat output, which would normally occur to dampen prices in the near term (this happened in 2005~2006). This was because the killed sheep could not sold for meat due to disease concerns.

resulting in a supply shortfall. This supply and demand imbalance served as a major catalyst for the price increase in 2001.

Adding fuel to the price strength, New Zealand – the biggest external supplier of lamb to the UK – had experienced extreme weather conditions over the 2000-2001 farming season. The wet spring initially increased lamb mortality and reduced lambing percentages by between 5 to 10 percent. This was then followed by one of the worst droughts in decades in the late summer, which caused a significant increase in feed costs and delayed purchasing of trading stock.<sup>66</sup> As a result of these negative climatic impacts, NZ’s lamb slaughtering rate fell significantly for the season (figure 52).

**Figure 52:**  
**NZ and lamb and sheep slaughter**



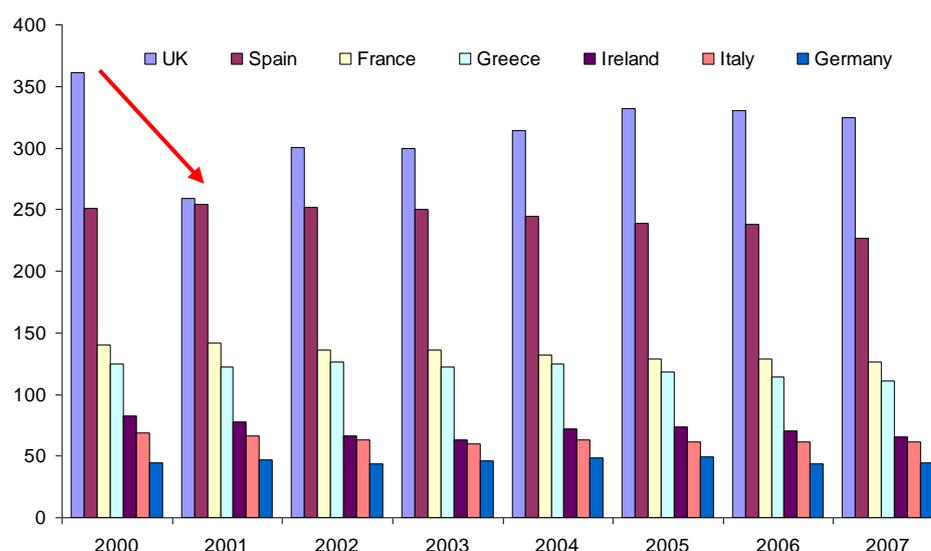
Source: Statistics New Zealand, RBNZ estimate

Following swift action by farmers and authorities in the EU, the 2001 FMD outbreak was relatively contained, with production of other major meat producing countries in Europe largely unaffected (figure 53). In the UK, after the initial decline, meat output recovered in 2002. However, this was

<sup>66</sup> Ministry of Agriculture and Forestry, (2001) <http://www.maf.govt.nz/mafnet/rural-nz/statistics-and-forecasts/farm-monitoring/sheepbeef-2001/sb-2001-11.htm>.

not enough to dampen lamb prices, as a pick-up in consumption, in line with easing disease fears, has underpinned a further price increase.

**Figure 53:**  
**Sheepmeat production in the EU (in thousand tonnes)**



Source: Eurostat

### 5.3.2 Acceleration (2003 ~ 2004):

From mid-2003 to 2004, lamb prices in the EU accelerated, rising almost 20 percent. The key reason behind the surge in prices was the Common Agriculture Policy (CAP) reform.

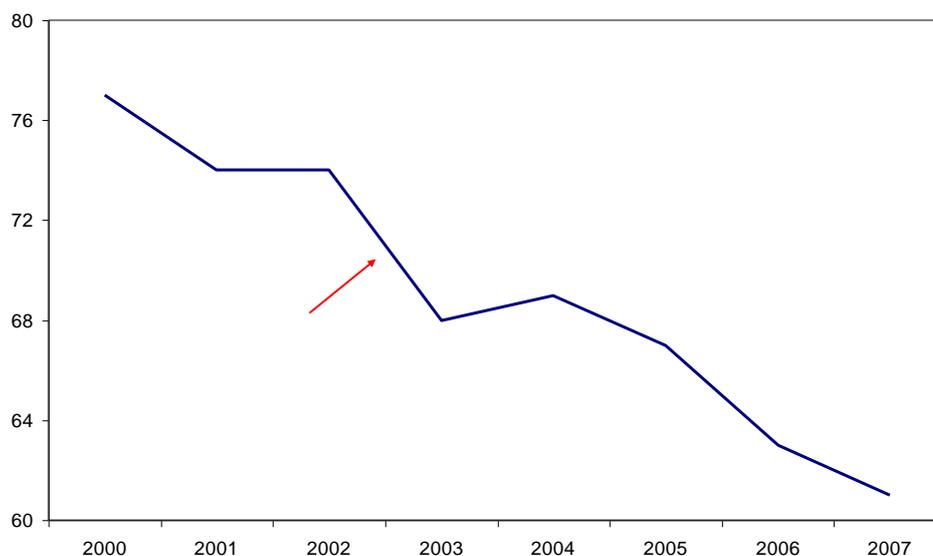
Introduced in 2003, the CAP reform changed the landscape of the agriculture sector in Europe. For animal farmers in particular, the transformation was profound. The reform altered the return structure for sheep meat producers by removing the linkage between production levels and government subsidies. Instead, subsidies are now paid according to land size, with further criteria, such as food safety and animal welfare standards, to be met before farmers can claim government support.

Some reports suggest that the Ewe Premium (the production-linked subsidies previously paid to sheep farmers) made up approximately 30

percent of a UK sheep farmer's gross margin on average prior to 2003 (Rabobank, 2006). Therefore, the abolition of the old regime removed a very significant incentive for sheep farmers to maintain a flock base that is larger than what is consistent with market conditions.

Because of the CAP reform, UK sheep farmers saw no incentive to rebuild their stock base after the FMD outbreak. In fact, EU flock numbers in total shrank by a further 8 percent in 2003 (figure 54).<sup>67,68</sup> The depletion of stock, combined with a recovery in demand as FMD fears subsided, saw the domestic consumption gap rise significantly. Exacerbating this internal supply and demand imbalance, the lingering impact of drought in the previous season resulted in sharply lower lamb slaughtering in New Zealand for the 2003-2004 season. This added further impetus to the price increase over the period.

**Figure 54:**  
**Sheep stock in the EU (in million heads)**



<sup>67</sup> There were also reports suggesting that sheep farmers previously might have over-reported the size of their flock to earn subsidies. Since the new payment structure detaches the flock size and subsidy payout, a paring back of those misreporting might have also contributed to the decline in the stock data.

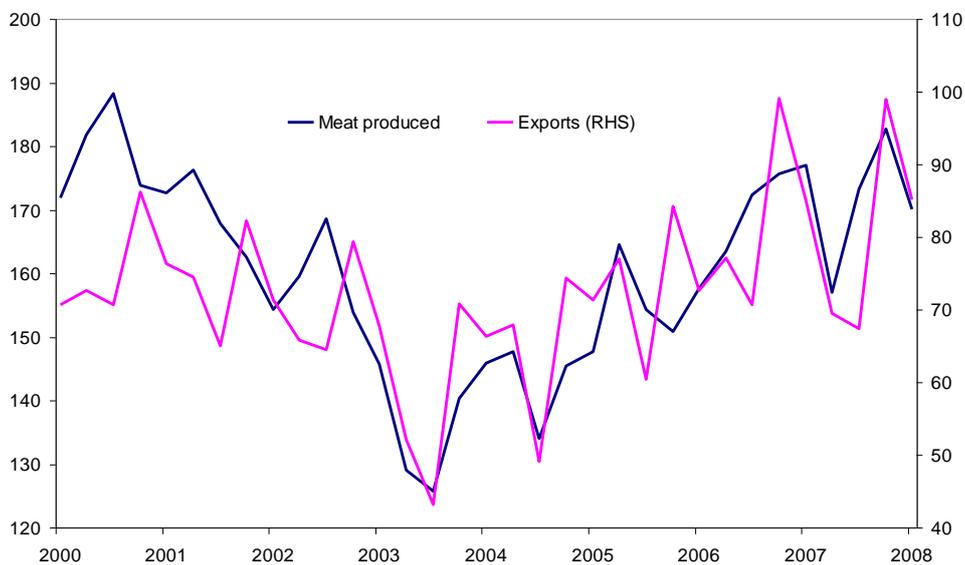
<sup>68</sup> Agriculture and Rural Development, European Commission, (2003) [http://ec.europa.eu/agriculture/capreform/index\\_en.htm](http://ec.europa.eu/agriculture/capreform/index_en.htm)

### 5.3.3 Correction (2005 ~ 2006):

By early 2005, prices of lamb in the EU had reached their highest levels in recent history. Some anecdotes at the time suggested that signs of consumer resistance in some parts of Europe, particularly in the UK, had emerged. In addition, as the CAP reform further spread across other major European countries, farmers accelerated stock depletion in light of high meat prices. This saw a wave of new supply coming onto the market, which served as a trigger for the price correction that followed.

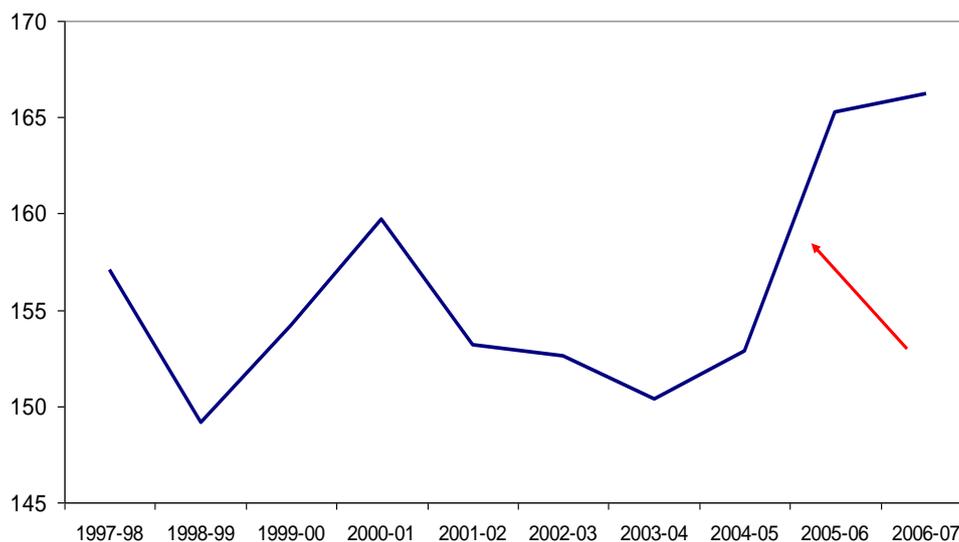
During this period, the EU's major external meat suppliers, New Zealand and Australia, also saw their meat output rise sharply as severe dry weather conditions hit Australia in both 2005 and 2006, and New Zealand in 2006 (figure 55). Poor weather conditions saw New Zealand farmers slaughter a greater number of their stock than usual, resulting in a 10 percent increase in lamb exports to the EU (figure 56). Confronted with rising supply both internally and externally, lamb prices in the EU declined significantly.

**Figure 55:**  
**Australian sheapmeat production and exports (in thousand tones)**



Source: Meat & Livestock Australia

**Figure 56:**  
**NZ export of lamb to the EU (in thousand tonnes)**



Source: Meat and Wool New Zealand

#### **5.3.4 (2007 ~ 2008):**

The run-up in lamb prices in 2007-2008 was evidence of further intensification of supply and demand imbalance in the EU markets. After two years of output increases, slaughter declined in the UK, as stock depletion decelerated and a new equilibrium of a much smaller flock base was reached. This, combined with the discouraging effect of falling prices in the previous years, saw production within the EU decline significantly. Taking the EU as a whole, domestic meat deficits (or required imports) rose 15 percent over 2006 and 2007.

Disease outbreaks also added momentum to the price increase. The Foot and Mouth Disease was discovered again in 2007 – albeit on a much smaller scale than was the case in 2001. Furthermore, there were over 8,000 cases of Blue Tongue disease identified in Europe, compared to less than 400 in the previous year.

Production declines in Australia and New Zealand were also a factor promoting stronger prices initially. Although New Zealand's production

picked up later in the season, as farmers increased slaughtering in response to drought, this did little to dampen prices. In fact, market commentaries at the time overwhelmingly focused on concerns that the sharp declines in stock numbers in Australasia would foreshadow further supply shortfalls in the future.

In addition to the drivers mentioned above, commentators pointed to higher production and transportation costs in the form of rapid increases in feed, fuel and fertilizer prices over the course of 2007 as reasons for the spike in meat prices. In this regard, synchronised price increases in other meat, like pork, beef and poultry over the first half of 2008 would also be consistent with this explanation. Cost increases were also prevalent for the production of these meats.

#### **5.4 Other drivers of the 2008 price spike**

Besides the aforementioned factors that supported the surge in lamb prices over 2008, there are a number of other factors also worth considering. Some of these are presented below:

- In addition to the severe drought experienced in New Zealand in the summer of 2007-2008, increased dairy conversions during this period – driven by relatively favourable returns on dairy production – would also have contributed to the sharp decline in domestic sheep numbers (total sheep population declined by around 4 million or 10 percent over that season).
- As mentioned in the analysis of beef prices, competing land use from corn production for alternative energy in some parts of the world, particularly in North America, could also limit sheepmeat production, providing a boost to prices.
- Higher feed costs – as a result of rising grain prices – could have provided additional support for meat prices over the first half of 2008. Not only does Northern Hemisphere animal farming typically rely on grain feed, farmers in Australia and New Zealand, who traditionally grass-feed their stock, were forced to use supplementary feed at the time of drought during the 2007-2008 season. This made rising feed costs a global phenomenon for sheep farmers, and the collective

action to pass on these extra costs might have contributed to the strength in meat prices.

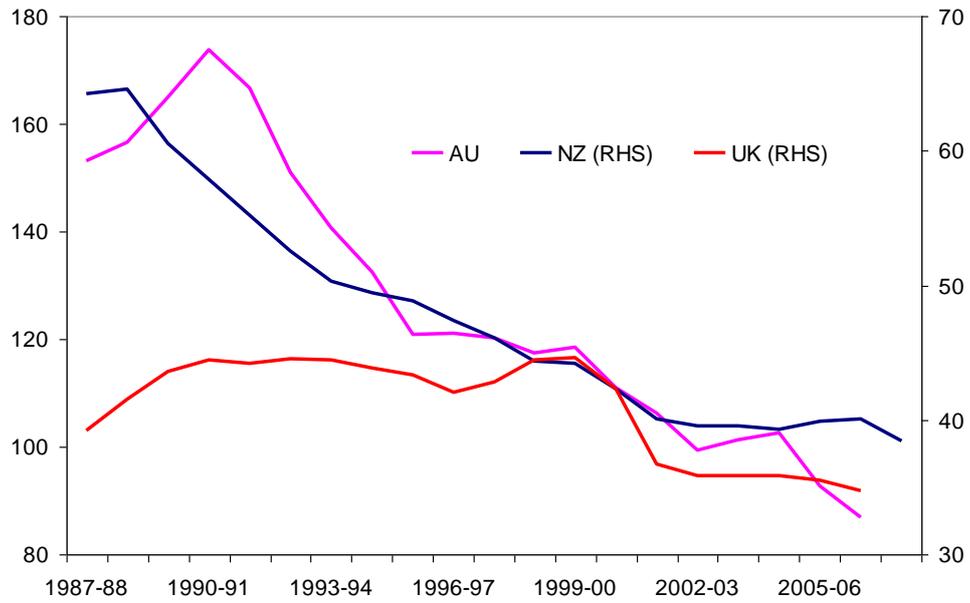
While supply side factors remain consistent with firm meat prices, demand conditions became less favourable in 2008, with the adverse impact from the global economic downturn being a big counterbalancing factor. The economic hardship faced by households in some country saw consumers cut back their spending on premium meat in an attempt to manage their food budget, resulting in some declines in meat prices, including lamb.

## **5.5 Medium-term outlook**

Despite some emerging weakness in fundamentals at the end of our reviewed the period, we think supply and demand dynamics for lamb over a longer horizon remain consistent with higher prices. Underpinning this price outlook is the persistence of the supply and demand imbalance for sheep meat in the global market. On the supply side, sheep stock levels in many of the key producing countries and regions are in a chronic decline, and there are little signs of these trends reversing any time soon (figure 57). Furthermore, higher feed and energy prices and growing environmental protection, such as the introduction of carbon pricing for the agriculture industry in many countries, mean that costs of farming are significantly higher at the end of the review period than previously. Given that these cost increases are likely to be structural rather than transitory, they are more likely to be passed onto final meat prices.

On the demand side, an eventual recovery in world growth is likely to see world demand for sheep meat resume its long-run growth in line with rising population and income levels. In particular, continued urbanisation and rising income levels in developing countries, including Asian, Middle Eastern and African countries, will likely see demand in these regions drive overall growth of world demand for sheep meat in the future. While supply in these countries could also rise in tandem, there are reasons to believe that reduced availability of land for agriculture use due to industrial expansion in these countries would hinder the extent of domestic supply response. As a result, demand for meat imports from these regions is likely to rise, and thus, adding upward pressure to world prices. In addition, higher quality products demanded, i.e. leaner and tenderer meat, could also lift the average price for lamb globally.

**Figure 57**  
**Sheep stock in major meat producing countries**



Source: Australian Bureau of Agricultural and Resource Economics, Statistics New Zealand and Meat and Wool New Zealand, UK Department for Environment, Food and Rural Affairs

## 6. Conclusion

The period from 2000 to 2008 was characterised by a very large, long and generalised boom in the prices of commodities on international markets. The background macroeconomic conditions of strong growth in both industrialised and emerging markets, generally loose monetary policy settings and favourable credit conditions contributed to an underpinning of demand across all markets. But as the detailed analysis of specific markets in this paper suggests, idiosyncratic supply-side factors for key producers competing with New Zealand in food commodity markets in particular, as well as shifting consumption demand patterns, appear to have played a significant role in price dynamics over the period.

Important supply factors in competing economies were the effects of major changes in protectionist agricultural policy (dairy and lamb), disease outbreaks (lamb), bad weather (dairy and lamb) and inadequate capacity to keep up with growing demand (beef). On the demand side, changing food consumption patterns with income in populous countries (dairy) appear to have played an important role. In the case of oil, the evidence suggests that crude oil production may be peaking. In all markets, inventories clearly have substantially buffered and modulate the dynamics of market prices in response to shocks – and when inventories have been run down to low levels, the price responses have been highly magnified.

In addition, commodity markets have influenced each other, with cross-market effects generally supportive of prices. Most obviously, on the supply side, oil and energy prices are a key component of the costs of agricultural commodities. Increasing biofuel demand (in some cases boosted by biofuel policy changes) appears to have rippled fairly widely through agricultural markets also (although the effect on prices has not always been straightforward to discern). On the demand side, rising incomes in commodity-exporting countries have boosted consumption of higher-priced food, which New Zealand food commodity exports tend to be.

The heavy presence of commodities on both the imports and exports side of New Zealand's terms of trade means that some level of disaggregation by market is essential to understand the dynamics of the terms of trade overall. While this paper has relied on documentary evidence and casual inspection of the data, future research should be more structural. At the level of

individual markets, the quantitative importance of factors common to other commodity markets relative to idiosyncratic factors should be explored (e.g. as in the dynamic factor approach of Vansteenkiste, 2009). The diverse cross-market influences and interconnections also should be modelled more formally.

Finally, this paper focuses primarily on the boom period through to 2008, which was when the bulk of our work was undertaken. Although subsequent movements in commodity prices have also been quite large, at the time of writing, the kinds of market-specific factors that we have explored in the discussion of the boom period have been less well documented.

The financial crisis and severe global recession of 2008-2009 is the prime candidate to explain the extraordinary depth, sharpness and synchronicity of the bust in prices across virtually all commodity markets from mid-2008 to the beginning of 2009. But in 2010, a number of the broader background factors that had supported the four markets we explored in this paper seemed to reassert their influence. In particular, the surprisingly large revision to prospects for emerging market growth coincided with a generalised and fairly rapid recovery of most commodity prices. Among the four commodities examined in this paper, oil and dairy prices in the first half of 2010 were roughly back at their mid-2007 levels. Commentary at the time of writing (May 2010) suggests that prices even at these levels will continue to receive support from growing demand in emerging economies (IMF, 2010; FAO Committee on Commodity Problems, 2010).

The striking boom-bust pattern of the latter half of the 2000s is reminiscent of the experience of the early 1970s, which also featured a startlingly sharp and generalised rise in commodity prices (Cooper and Lawrence, 1975). Then, as now, explanations ranged from the emergence of chronic shortages of raw materials, to financial laxity, to speculation. With the benefit of a further large cycle in the dataset, future research should also look anew at identifying the importance of these various macro factors relative to each other, as well as relative to the market-specific factors on which this paper has focused.

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