13. Wool Price Determination: Macroeconomic and External Linkages

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Learning objectives

On completion of this topic you should be able to:

- understand economic developments in the wool market
- be able to evaluate the many domestic and foreign developments such as exchange rate fluctuations, changes in government policies, etc that affect the wool market
- be able to make strategic marketing decisions based on analytical evaluations of the market

Key terms and concepts

Market demand and supply, competitive market equilibrium, and the concepts of demand and supply elasticity.

Introduction to the topic

Australian woolgrowers' incomes are influenced by developments in the world and Australian economies within which they exist. The links between the macroeconomic and external forces summarised in the Figure 13.1.

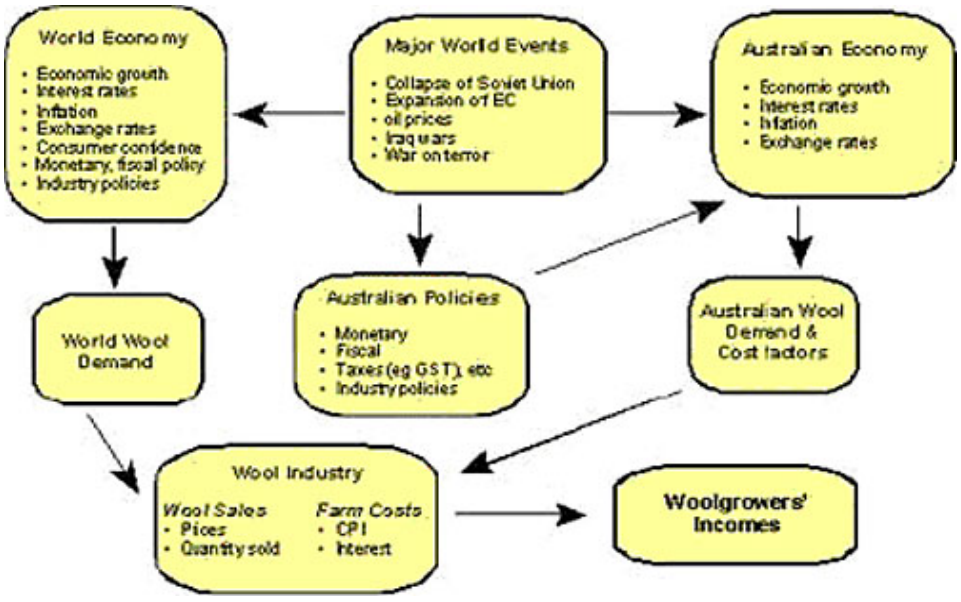

Figure 13.1 Woolgrowers in a World Setting.
Adapted from: Pearce, Vincent and McKibbin (1993).

The market's ups and downs can be traced to economic recessions, wars, the advent of new technology, droughts, government controls, policy failures by government, etc. The most striking feature of the wool price history of the 20th century is the phenomenal price boom associated with the Korean War in the early 1950s. These events are portrayed in Figure 13.2.

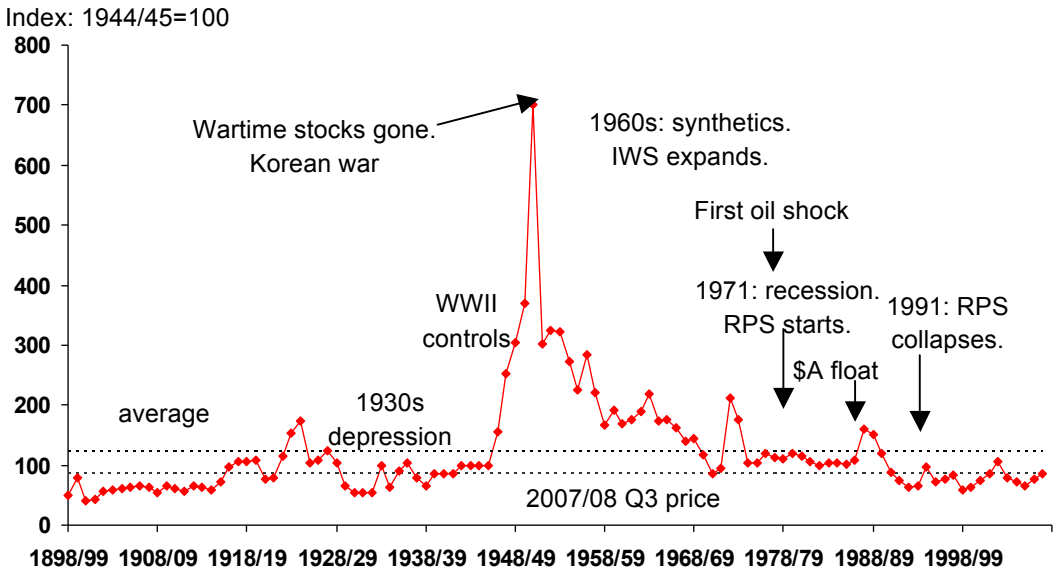

Figure 13.2: A Long-Term Perspective on Real Wool Prices
Sources: ABARE, AWC, AWEX, ABS

By the end of 1949-50, wartime wool stocks had dwindled to about 10% of production, well down from 122% of production at the end of 1945-46. The Korean War created a surge in wool demand from the military and, under the circumstances of that war, buyers paid enormously high prices to secure wool. This price boom added significant wealth to Australia and probably sustained investment in the wool industry for years afterwards. This was the period when stories of woolgrowers driving sheep around their paddocks in Rolls Royces surfaced. Unfortunately for Australia, that period has gone.

13.1 Characteristics of agriculture

Economics provides a framework for understanding the types of events identified in Figure 13.2. A fundamental tenant of economics is that, provided society is prepared to accept the initial distribution of income, the interactions of consumers and producers in free competitive markets will result in an efficient allocation of society's scarce resources. The competitive market is said to be efficient in an economic sense because it satisfies the maximum feasible level of consumers' wants at least cost. It does this by allocating goods and services to those consumers who value them most, ensuring that they are provided at least cost.

The necessary conditions for a competitive market are reasonably well approximated in agriculture where for the most part aggregate production outcomes are the result of decisions by individual producers whose output typically constitutes a very small part of the market total. It is useful to briefly review this and some of the other characteristics of agricultural industries, and particularly of wool, that can affect agricultural marketing before turning to market analysis, and producer and consumer behaviour.

Farming, certainly broadacre farming, is a land based and land-intensive activity and is location specific. The land based and biological nature of farming also mean that compared to non-farm activities, it can be difficult both to expand the business by increasing farm area or livestock numbers and to shift between enterprises. For instance, a large shed in a town can be used for many production activities but it is not sensible to convert steep country into prime cropping land.

The agricultural sector is typically made up of many relatively small owner-operated farms that are widely dispersed. Consequently weather conditions alone can cause both within season and between season variations in the quality of production. Differences in the abilities of farm operators are another source of quality variation. These factors lead to a requirement to assemble and grade output from different farms so the product can be sold in "marketable quantities" to buyers in "distant" markets.

In addition to the within season and between season variations in the levels of production due to weather, much of farm production comes in lumpy units such as the annual harvest of winter cereals or the annually shorn wool clip. These factors lead to a need to store products that are often perishable for relatively long periods between harvests.

Aside from the quality differences already mentioned, many farms produce similar products that are difficult if not impossible to differentiate in the minds of buyers. The production of individual farms or farmers is generally small relative to the aggregate industry output. But if farmers are all responding to a set of incentives and so all expand or reduce output simultaneously, then their collective action will have an appreciable impact on the market. The relatively small scale of individual farms also means that individual producers will not be able to recoup the costs of advertising or R&D expenditures they might want to undertake.

Whilst the types of distinctions just listed need to be recognised, they should not be blown out of proportion. There are many forms of family based businesses operating outside farming that share some of agriculture's characteristics. For example, non-farm family businesses probably face similar capital constraints to those that operate in agriculture.

13.2 Wool's characteristics

Wool is a long-established natural fibre that meets both "basic" and "discretionary" needs of human beings. This means many people know wool's positive (warmth, fire safety, etc) as well as its negative (prickle) attributes. The importance of the fashion element of demand, especially in richer countries, is that fashion goods have in-built obsolescence, needing to be replaced whenever fashion swings far enough. The fashion element of wool demand makes wool demand relatively income responsive amongst agricultural commodities. Wool's "natural/green" tag and the fact of the fashion element of wool demand probably make wool more promotable than other commodities, but also make the wool market more the captive of the economic climate.

Wool is a minor commodity on the world stage accounting for probably no more than three per cent of total fibre production. Since man-made fibres account for over half of all fibre output, an increase of perhaps five per cent in man-made fibre production could completely replace wool. So ultimately the world can easily do without wool, wool is a fibre of choice, not a necessity. Nevertheless, wool remains an important commodity for Australia. Australia accounts for some 25 per cent of world wool production and about half of total world wool exports. In fact Australia holds an even more significant position in the market than these aggregate figures suggest because wool is a heterogeneous commodity, as shown in Figure 13.3.

Figure 13.3 shows wool production by the major exporting countries (the "Others" are South Africa, Argentina and Uruguay) which account for nearly half of total world production and for nearly 75% of world raw wool exports. In Australia's case, wool exports in raw and semi-processed form make up 95% or more of the average clip. Note the demarcation shown in Figure 13.3 between the quality profiles of the major exporters. Australia dominates the finer

apparel segments of the market giving Australia, but not individual growers – some market leverage. What this leverage means today is that if unduly low market prices make wool unprofitable in Australia, the consequent production adjustments by woolgrowers will tend to cause prices to move upwards.

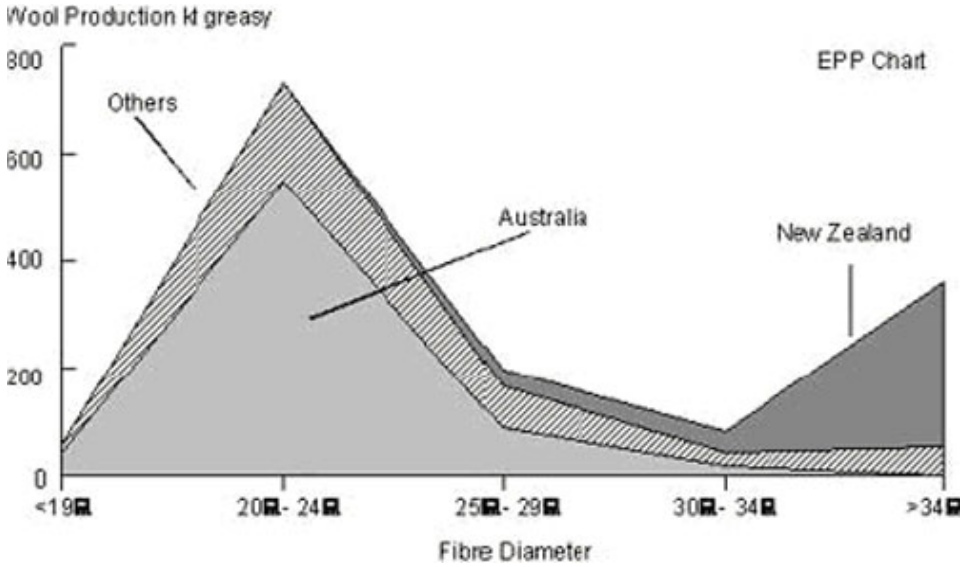

Figure 13.3 Wool Production: Major Exporters.
Sources: Wool International (1997); Connolly (1990).

The importance of wool in Australia has declined dramatically since the 1950-51 period (Heady1952, see Table 13.1). The changing position of wool reflects the phenomenally favourable period of 1950-51 as well as changes in wool production, down over 40% since 1990-91, relatively poor wool prices and, of course, more favourable trends for other farm sectors.

The declines in the relative importance of wool are not necessarily a cause for policy concern because they also reflect the maturation and diversification of the Australian economy. Moreover, half of all broadacre farms still run sheep and wool as a primary income source for roughly 11,000 farm properties. Unfortunately, ABARE survey data suggest sheep specialist properties have been a lagging sector of Australian broadacre agriculture. Since 1991, sheep specialists have accumulated business losses averaging $245,000 per farm and sheep specialist properties appear to be less profitable than other broadacre farms.

Woolgrowers have responded to the unfavourable levels of wool prices since 1991 by cutting production and turning to other enterprises where possible. Growers have also responded by shifting towards producing finer wools, which receive higher prices, as shown in Figure 13.4. The relatively sudden jump in the share of fine wools in the clip in 1991-92 is probably due to the appreciable price premium for the finer wools over the period 1987-88 to 1990-91.

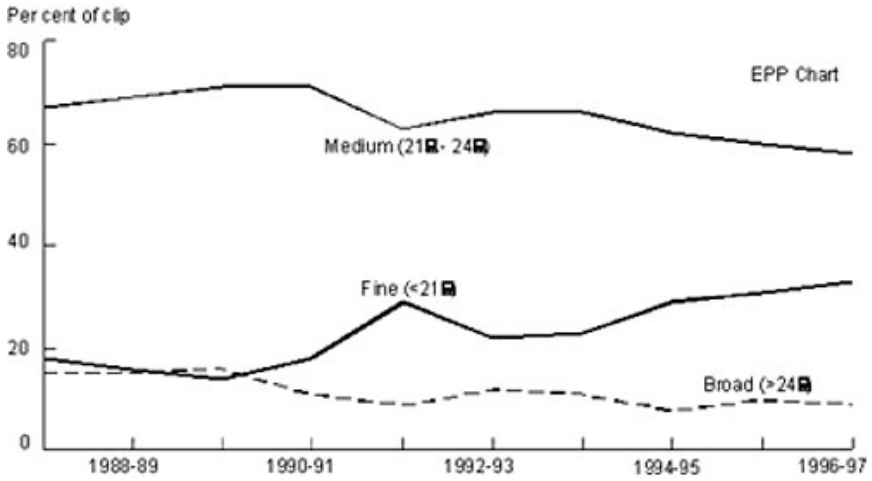

Figure 13.4 Changing Clip Composition.
Sources: Wool International (1997); Connolly (1990).

Table 13.1: Wool's Changing Position in the Australian Economy
Sources: ABS, AWEX, ABARE

	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07
Wool Industry								
Sheep Numbers (million)	109	147	172	134	163	119	101	91
Wool Production (kt greasy)	507	737	890	701	1066	652	508	471
Shorn wool (kt greasy)	467	667	800	638	990	602	461	430
Average Nominal Price (A$/kg clean)	4.49	1.63	1.10	4.08	6.31	6.82	6.78	8.31
Real Price A$/kg (2007/08 values)	84.00	18.76	9.79	13.23	9.68	8.35	7.18	8.55
Domestic Economy (A$ million)								
Gross Domestic Product	7,078	15,028	35,111	149,592	408,876	689,262	966,172	1,046,164
Gross Farm Production Value	1,924	2,745	3,569	11,580	21,207	34,761	38,417	34,426
Livestock products	1,259	1,674	2,092	6,274	12,086	15,703	17,819	18,166
Wool	1,237	637	576	1,795	4,093	3,303	2,364	2,678
Crop products	665	1,072	1,427	5,307	9,121	19,059	20,598	16,259
Wheat	250	391	404	1,684	1,989	5,130	5,195	2,609
Australian Exports (A$ million)								
All Merchandise Exports	1,974	1,884	4,244	18,718	52,155	115,794	154,425	159,034
Farm Exports	1,780	1,400	2,103	8,179	13,111	32,653	30,475	30,321
Wool & sheepskins	1,308	712	594	1,920	2,887	3,897	2,544	3,065
Wheat	216	309	434	1,577	1,643	4,197	3,296	2,765
Wool's Share (%)								
GDP	17.6	4.2	1.5	1.1	1.0	0.4	0.2	0.3
Value of Rural Production	64.3	23.2	14.6	14.2	19.3	7.4	6.2	7.8
Merchandise Exports	66.3	37.8	14.0	10.3	5.5	3.4	1.6	1.9
Farm Exports	73.5	50.9	28.2	23.5	22.0	11.9	8.3	10.1

13.3 Production analysis

Production analysis is concerned with the activities of people and firms. Production analysis has two foundations. The first is the state of production technology as summarised by the firm's production function at any given time. The second foundation stone of production analysis is a set of propositions about producers and their behaviour. These propositions are that firms or producers are well informed, are rational, seek to maximise their profits subject to the available technology, and produce only a small part of total market supply.

The production function

A firm's production function maps the nature of the technology available to the firm and shows the relationship between the quantities of inputs used and the resultant total production. Initially with no inputs there is no output, and as inputs are added output increases and then if too many inputs are used then output per unit of input decreases.

Figure 13.5 shows a typical or classical production function where, for the sake of simplicity, only a single input is required to produce the final product. Notice that at first the addition of extra inputs causes production to grow at an increasing rate. After a point, adding more inputs causes output to grow at a diminishing rate. Eventually output peaks and then declines as more inputs are added.

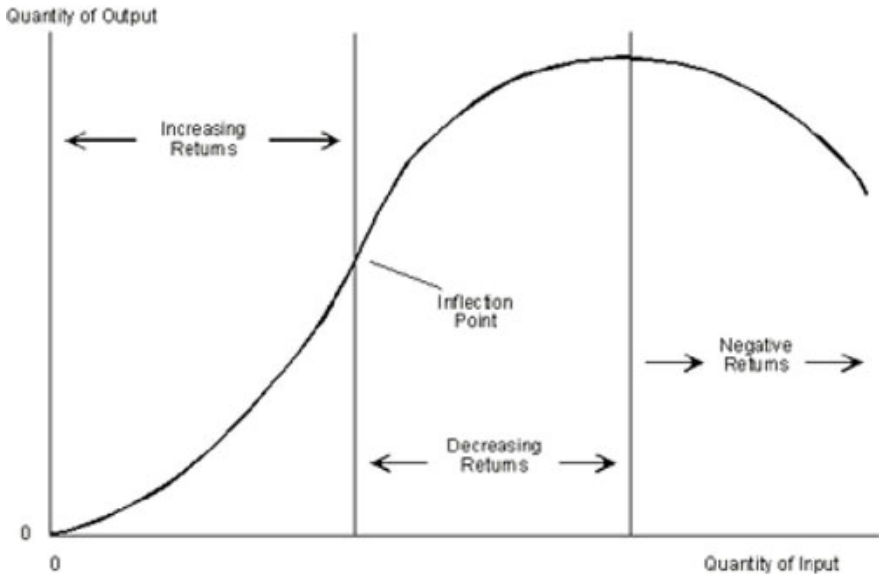

Figure 13.5 Classical production function.
Source: Haszler, Economic Policy Perspectives, (2006).

This changing relationship between additional input use and output is measured by the Marginal Product of the input, a critical concept in determining a firm's costs and output. **Marginal Product** (MP) is the extra or incremental output obtained from the last incremental unit of input used. It is measured by the slope of the production function.

As indicated above, marginal product increases up to a point, **the inflection point**, and then falls and eventually becomes negative beyond the point of maximum total output given by the highest point on the production function.

This relationship between marginal products and input usage gives rise to the **Law of Diminishing Marginal Returns** which states that if additional units of any one input are added to a production process, with all other inputs held constant, eventually additional usage of the input will cause total production to fall. Table 13.2 below provides some hypothetical examples of the law of Diminishing Marginal Returns. The crop example illustrates the well-known phenomenon of too much fertiliser "burning" a crop.

Table 13.2 Hypothetical Examples of Total and Marginal Product Relationships. Source: Haszler, Economic Policy Perspectives, (2006).

Crop Yield from Fertiliser			Wool Production per Hectare		
Units of Fertiliser	**Total Crop Yield**	**Marginal Yield**	**Sheep/ha**	**Total Wool Yield/ha**	**Marginal Wool Yield/ha**
1	10	-	2.5	11.4	-
2	19	9	5.0	22.6	11.2
3	26	7	7.5	33.2	10.6
4	29	3	10.0	42.4	8.2
5	30	1	12.5	49.6	7.2
6	29	-1	15.0	55.2	5.6
7	27	-2	17.5	55.1	- 0.1

The zones of increasing, decreasing and negative returns in Figure 13.5 have considerable significance in terms of managing real-life businesses (as indicated below).

- **Zone of increasing returns**: It does not pay competitive firms to operate in this zone, provided it is profitable to produce in the first place. The reason is that the marginal product of the input is increasing, so profitability also increases progressively through this range. The only reason an informed firm might produce in this zone would be if the firm was absolutely starved of the cash needed to buy additional inputs.
- **Zone of decreasing returns**: Producing somewhere in this zone will maximise the firm's profits.
- **Zone of negative returns**: It is economically irrational, and just plain wasteful, to produce in this zone. Any output level in this area can be produced with fewer inputs at an "earlier" point on the production function.

The foregoing discussion of the various zones of the production function provides the clue to the point that classical functions as shown in Figure 13.5 would generally be based on experimental data. Given enough time, etc we would expect commercial firms to end up operating in the zone of decreasing returns.

13.4 Market demand and supply analysis

Consumers and producers interact in markets to satisfy their consumption needs. A **market** is defined as a place, organisation or procedure that allows buyers and sellers of a commodity to communicate for the purpose of engaging in trade or exchange.

The market interactions of producers and consumers can be summarised in terms of market demand and supply curves. **Market supply and demand curves** are obtained very simply by adding quantities demanded and supplied at each price by all the market participants as illustrated in Figure 13.16.

In Figure 13.6, Demand curves for Tom, Dick and Harry are shown their aggregate market demand curve is represented by the TDH market. The figure is drawn to scale, so inspection will show that the quantities at each price on the TDH market demand curve are just the (horizontal) sums of the quantities demanded by Tom, Dick and Harry at each price.

Figure 13.6 Aggregating Individual Demand Curves.
Source: Haszler, Economic Policy Perspectives, (2006).

Aggregate market supply curves are also obtained by adding the supply curves of individual firms along the horizontal or quantity axis.

In the analysis that follows the market demand and supply curves are shown as linear functions. Students should note very carefully that this practice here and in many other economics texts is adopted purely as a matter of convenience. In fact, the "true" market curves are unlikely to be linear for two reasons. First, the laws of diminishing marginal product and diminishing marginal utility both imply that the individual functions are non-linear. Second, even if the individual functions were really linear, the aggregate functions will not be linear unless the slopes of each individual consumer's and producer's functions are identical. Otherwise, the aggregate functions will be kinked as shown in Figure 13.16. It should be obvious with a moment's reflection that the aggregate function will have as many kinks as there are different slopes for the individual consumer or producer functions. With many producers and consumers, the aggregate demand and supply curves are likely to approximate reasonably smooth functions.

This detail on aggregation and the slope of market demand and supply functions may appear rather academic. However, it can have some considerable significance in policy analysis. Supply and demand jointly determine prices. The wishes of buyers and sellers are communicated to each other through the "invisible hand" of market prices and variations in market prices reconcile demand with supply.

A market equilibrium is said to exist when, at some ruling market price, market demand equals market supply so there is no excess demand or supply and the market is said to be cleared. That is consumers get all they want at the price and producers sell all they have to sell. In equilibrium the forces operating on the market or economy over some given period are balanced so that there is no tendency for change in the absence of new "shocks" or disturbances to the system. However, because the economic system is subject to frequent shocks, as shown in the earlier graph of long-term wool prices, it is sometimes more realistic to think of economic equilibrium as *a tendency* rather than some fixed immutable *state*.

In Figure 13.7 the market starts off either with excess demand or excess supply. If demand exceeds supply (perhaps the Government has restricted output for some reason) consumers will begin to bid up the price in order to get access to the restricted volume.

If supply exceeds demand (for example too many cars are produced during a recession), retailers will begin to discount prices to attract customers in order to clear their unwanted stocks. In either case, prices move towards the equilibrium price, which will equate demand with supply. At the intersection of the demand and supply curves in the figure, demand equals supply and prices will remain at P_E unless some new shocks to the system shift demand or supply.

All the necessary conditions for a competitive market equilibrium are rarely met, even in agriculture. But where the conditions are met or closely approximated then, given the existing levels and distribution of income and the available technology, a competitive market equilibrium, generated by the interactions of many individually small consumers and producers, provides the maximum level of output, produced at least cost and distributed to the consumers who value it most. That result makes the market equilibrium position an important benchmark in policy analysis.

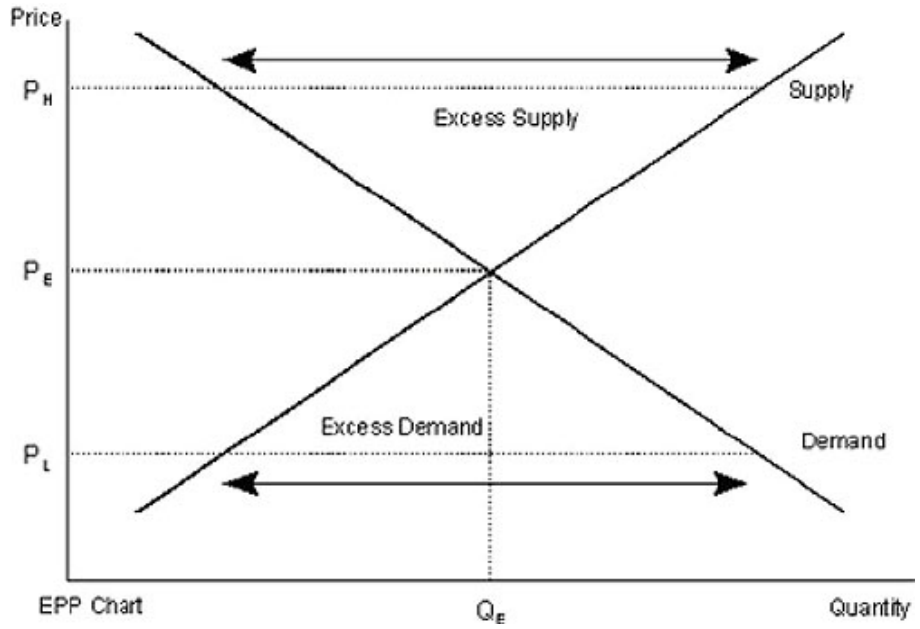

Figure 13.7 Market Equilibrium.
Source: Haszler, Economic Policy Perspectives, (2006).

The discussion of supply and demand so far has proceeded largely in a two dimensional setting. But it has been indicated here and there that the two dimensional figures are all drawn subject to the assumption that other things are constant. This assumption is important in market analysis. Beyond two dimensions it is simpler to consider demand and supply by their underlying functions:

$\mathbf{QS_i = f_i (P_i}$ / P_j, Input prices, Technology, Weather, etc .....)
Market Supply

$\mathbf{QD_i = f_i (P_i}$ / P_j, Income, Tastes, Age, Gender, Advertising, etc.....)
Market Demand

where QS_i and QD_i are the quantities of product i supplied and demanded, P_i is the price of the product, P_j is the price of other substitutes or complements for i and the other variables are as spelled out.

The **supply curve** is the *schedule* showing the *relationship* between QS_i and P_i and it shows how the supply of a product will change as its price changes. Similarly, the *relationship* between QD_i and P_i is known as the **demand schedule** or curve and shows how consumption of a product will change as its price changes.

The other variables in the equations are known as supply and demand *shifters*. Their role can perhaps be better appreciated by reference to the equation for a straight line, namely Q = a + bP where a is the intercept of the function on the horizontal axis and b is the slope. Rewriting the two equations in that form gives:

$\mathbf{QS_i}$ = (P_j, Input prices, Technology, Weather, etc .....) + b**Pi**
Market Supply

$\mathbf{QD_i}$ = (P_j, Income, Tastes, Age, Gender, Advertising, etc.....) + b$\mathbf{P_i}$
Market Demand

In terms of the two-dimensional representations of demand and supply, therefore, changes in the variables shown in brackets change the intercepts of the functions and therefore move or shift the supply and demand curves in their entirety along the horizontal quantity axis.

This means that the quantity supplied or demanded of a product can be altered in two fundamentally different ways:

- Changes in the **product's own price**: this change cause movements **along the curve** with the result that, other things constant, the higher the price of a product, service or resource, the larger the quantity supplied of it, and the less consumed of it and *vice versa*;
- Changes in the variables making up the **composite intercept** term: these changes cause movements or shifts **of the whole curve** resulting in a change in quantity demanded or supplied at every price.

Changes in demand and supply affect industry and firm level revenues and ideally the demand curve would shift out to the right over time Demand-1 to Demand-2 in Figure 13.8 and this would increase revenues which are calculated by multiplying price and quantity. The increase in revenue would be P2 x Q2 – P1 x Q1. This is the area shown as Green and Blue in the figure.

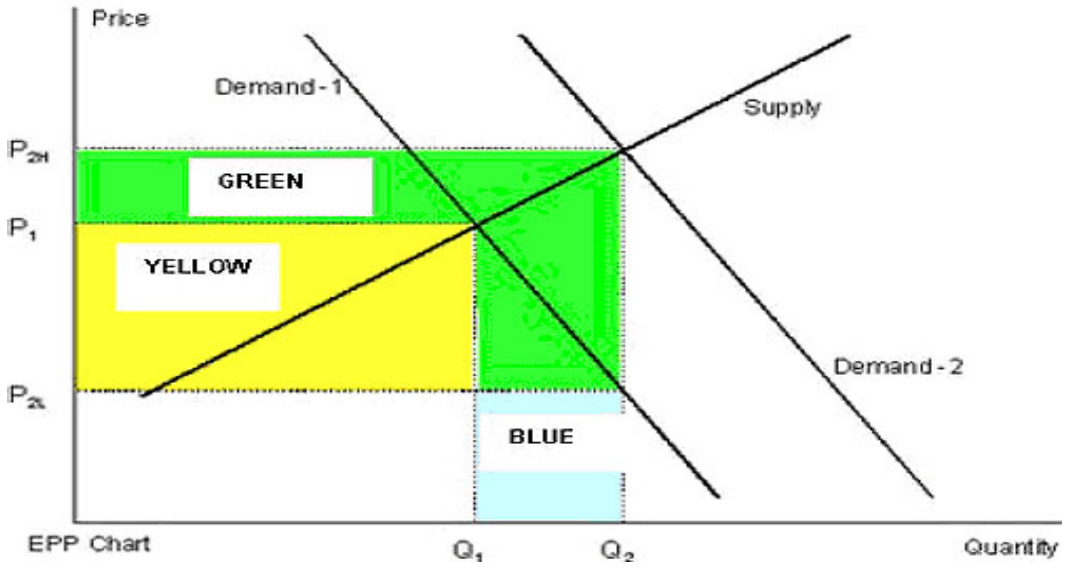

Figure 13.8 Buying Sales.
Source: Haszler, Economic Policy Perspectives, (2006).

Figure 13.9 summarises the impacts of some of the common supply and demand shifters. Consider the following types of changes on the supply side.

- Changes in the **price of substitutes** in production: if the price of wheat rises while the price of barley stays the same, to continue maximising their revenues farmers will swap between the two crops thereby increasing wheat production and reducing barley production;
- Changes in the **price of complements in production** or of **joint products**: an increase in the price of wool will eventually lead to an expansion of mutton production after the flock reaches some desired level and growers revert to normal culling for age.
- Changes in prices of **inputs/resources or factors of production**: increases in input prices reduce the profitability of the base product so, for example, an increase in wages may reduce production of clothing;
- Changes in **technology/productivity**: new technologies or production processes may favour some products over others, for instance transistors put crystal sets out of the market.

There are many ways that shocks can disturb the market equilibrium as shown by the panels in Figure 13.10. In the top right figure the increase in demand is greater than the increase in supply. Perhaps a new wave of first home owner's grants has boosted housing demand but the housing industry's capacity to respond fully is initially restricted by the time needed to organise land subdivisions, design houses, train builders, etc. The different demand and supply shifts shown in that panel increase prices for houses, at least for a while.

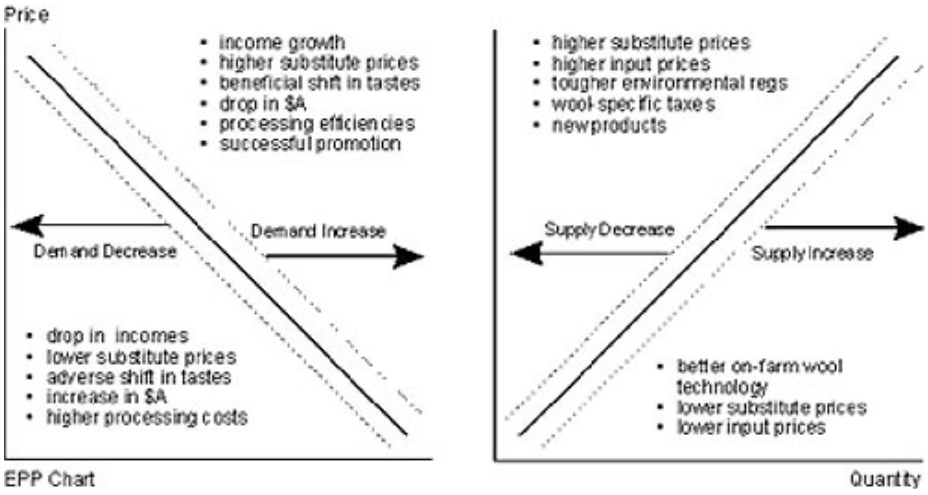

Figure 13.9 Principal Function Shifters.
Source: Haszler, Economic Policy Perspectives, (2006).

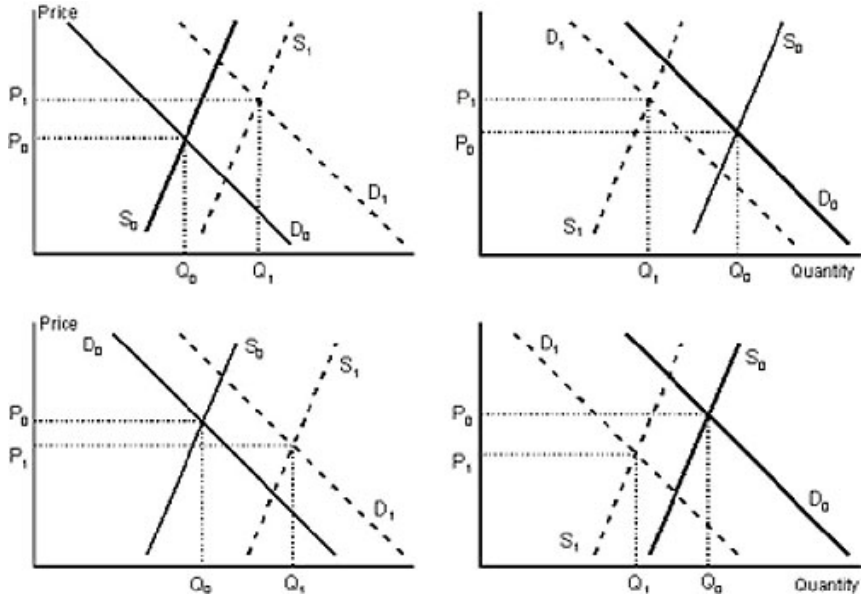

Figure 13.10 Supply and Demand Shifts.
Source: Haszler, Economic Policy Perspectives, (2006).

The four panels in Figure 13.10 demonstrate the following results concerning shifts of demand and/or supply:

- increase in demand > increase in supply: therefore price rises
- decrease in demand > decrease in supply: therefore price falls
- increase in demand < increase in supply: therefore price falls
- decrease in demand < decrease in supply: therefore price rises

13.5 Responsiveness or elasticity

Elasticities are used to characterise individual and market demand and supply functions such as the demand functions shown in Figure 13.10. The **elasticity** of a demand or supply function is measured as the proportional (or percentage) change in one variable due to a proportional (or percentage) change in another.

For a function such as Q = f (P), where quantity is the dependent variable and price is the explanatory variable, elasticity is defined as:

Elasticity = $\Delta Q/Q \div \Delta P/P = \Delta Q/\Delta P \times P/Q$

In words this is simply the change in Q for a change in P multiplied by the mean price divided by the mean quantity.

For a linear equation Y = a + b X the elasticity is $\Delta Y/\Delta X$ = +b times the mean of the price column divided by the mean of the X column.

Elasticity is related to the slope of a function or + b in the linear equation above.

Elasticities are measured as ratios of ratios and therefore are “unit-less”. That makes them easily transferable and comparable between commodities, countries, over time and between problems.

By contrast, slopes must be defined with respect to the units of measurement used to derive the slope coefficient and so are not very easily transferable. Nevertheless, the slopes of supply and demand curves can be the more important issue in policy analysis.

Demand (and supply) curves are often categorised as elastic or inelastic in a relative sense based on their slopes. Saying a curve is inelastic means that quantity shows a relatively low degree of responsiveness to changes in price and *vice versa*.

Figure 13.11 provides an intuitive method for determining the relative magnitudes of elasticities on two functions. Steeper functions are generally more “inelastic” that is they produce smaller responses.

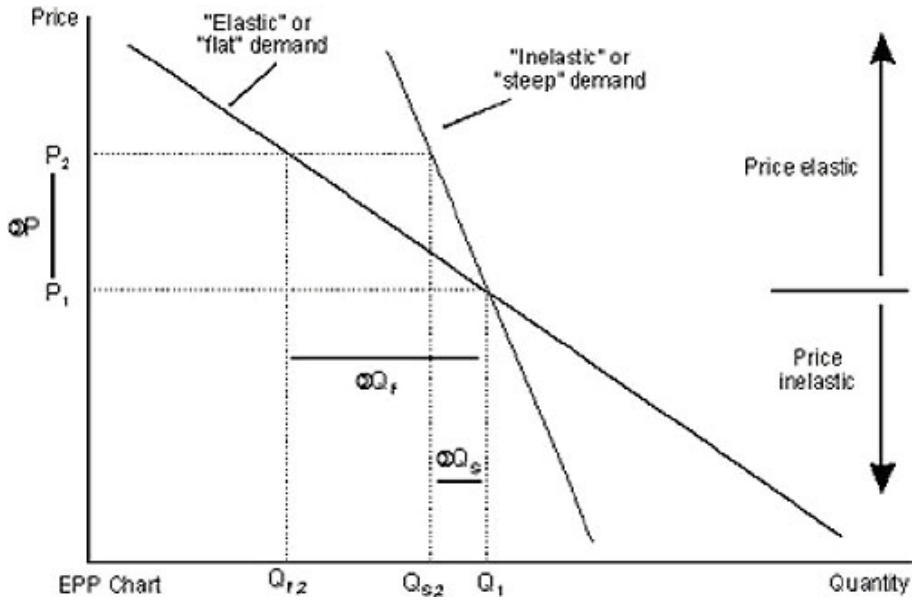

Figure 13.11 Elasticity Equals Responsiveness.
Source: Haszler, Economic Policy Perspectives, (2006).

For demand curves, an increase in prices means a decrease in quantity (run) so the slope coefficient b is negative and so is the own-price elasticity. For supply curves, an increase in prices (rise) means an increase in quantity so b is positive and so is the own-price elasticity.

The definition of elasticity as E = bP/Q for linear functions indicates that elasticities vary with P and Q and so vary all along linear functions and need to be expressed with respect to a particular point on the demand (or supply) curves. In fact there is a very specific pattern of elasticities along a linear demand function as follows:

- E > |1.0 | for quantities less than the midpoint of the data range;
- E = |1.0 | at the midpoint of the data range; and
- E < |1.0 | for quantities above the midpoint of the data range.

It is possible to define an elasticity with respect to any of the variables identified in the generic market supply QS_i and market demand QD_i equations shown following Figure 13.7 or indeed any other variables that may also affect demand and supply. However, the more commonly cited supply and demand elasticities are:

- **Own-price elasticity** $\Delta Q_i / Q_i \div \Delta P_i / P_i$

The own-price elasticity measures the proportionate or percentage change in quantity of good Q_i in response to the proportionate or percentage change in its own price P_i. The own-price elasticity is sometimes referred to in shorthand simply as the "demand elasticity" or the "supply elasticity".

Own-price elasticities of supply are positive and own-price elasticities of demand are negative and refer to movements **along** the supply and demand curves.

As noted already, for linear functions the own-price elasticity is given by $E_{ii} = b\ P_i./\ Q_i$. The subscript ii with E simply indicates that we are referring the elasticity of the quantity i with respect to its own price P_i. Some common own price and income elasticities are shown in Table 13.3

- **Cross-price elasticity** $\Delta Q_i / Q_i \div \Delta P_k / P_k$

The cross-price elasticity measures the proportionate or percentage change in quantity of good Q_i in response to the proportionate or percentage change in the price of some other commodity or product P_k (not its own price P_i). The term "cross-elasticity" is used as a shorthand form of cross-price elasticity.

Cross-price elasticities can take either positive or negative values depending on the circumstances. For a demand curve a positive cross elasticity indicates that the goods are substitutes such as tea and coffee. So if we are concerned with tea demand, a positive cross elasticity for coffee indicates that an increase in the price of coffee will stimulate consumers to drink more tea. All of these changes are needed to maximise the consumer's wellbeing under the new circumstances. In pursuing their self-interests, consumers engage in this sort of substitution without any need for outside direction or prompting.

By contrast a negative demand cross elasticity indicates that the goods are complementary in consumption, that is consumed together like milk and breakfast cereal. So a drop in the price of cereals will result in increased consumption of cereals and also some increase in milk consumption.

In the case of supply curves, a positive cross-price elasticity indicates the two products are complementary in production, like sheepmeat and wool. So in the case of wool supply, an increase in the price of sheepmeat increases the profitability of the sheep enterprise and so will result in some increase in wool production as well as an increase in sheepmeat output. Obviously a negative cross elasticity in supply means that the two products are substitutes in

production, like wheat and barley.

For linear functions the cross-price elasticity is given by $E_{ik} = b\ P_k./\ Q_i$. The subscript ik with E indicates that we are referring the elasticity of the quantity i with respect to the price of k this time, not i.

Table 13.3 Some Australian Own-Price and Income Elasticities.
Source: Pers. Comm.. R. Dumsday. Adapted from Dixon et al. (1992)

Product Group	Own-Price Elasticity	Income Elasticity
Books and Newspapers	- 0.21	0.38
Rail Transport	- 0.21	0.39
Soft Drinks	- 0.22	0.39
Confectionery	- 0.22	0.39
Beer	- 0.40	0.72
Motor Vehicles	- 0.58	1.08
Wine and Spirits	- 0.60	1.08
Health Services	- 0.68	1.20
Electronic Equipment	- 0.74	1.33
Communications	- 0.76	1.37
Restaurants	- 0.84	1.51
Air Transport	- 1.01	1.84

- **Income elasticity of demand** $\Delta Q_i / Q_i \div \Delta I / I$

The income elasticity of demand measures the proportionate or percentage change in the quantity of good Q_i demanded or consumed in response to the proportionate or percentage change in consumer's incomes, where I is income.

The income elasticity is positive for normal goods. In the case of inferior goods, income elasticities are negative instead of positive. The point is that the particular good is valued so little that an increase in income allows consumers to substitute more valued and more expensive goods in their purchases.

There are not many obvious examples of inferior goods. But in higher income countries soup bones, cheaper/fattier processed meats, such as Devon sausage, and perhaps some of the cheaper clothing brands can be inferior goods.

There is some evidence that in Australia the income elasticity of demand for mutton is negative these days. As their incomes have increased over past decades, it seems Australians are choosing to buy higher priced cuts of meat like lamb instead of mutton – that is when butchers give them the choice, which is not often these days.

Figure 13.12 splits the aggregate wool market into a variety of segments based on the own-price elasticity of demand in those segments. As all wools are not the same, there are differences in:

- the demand for **different qualities** of wool related to their differing processing characteristics, the products that can be made from them and the preferences of the consumers buying the products;
- the demand from **different countries** related again to the preferences and income levels of the consumers in those countries.

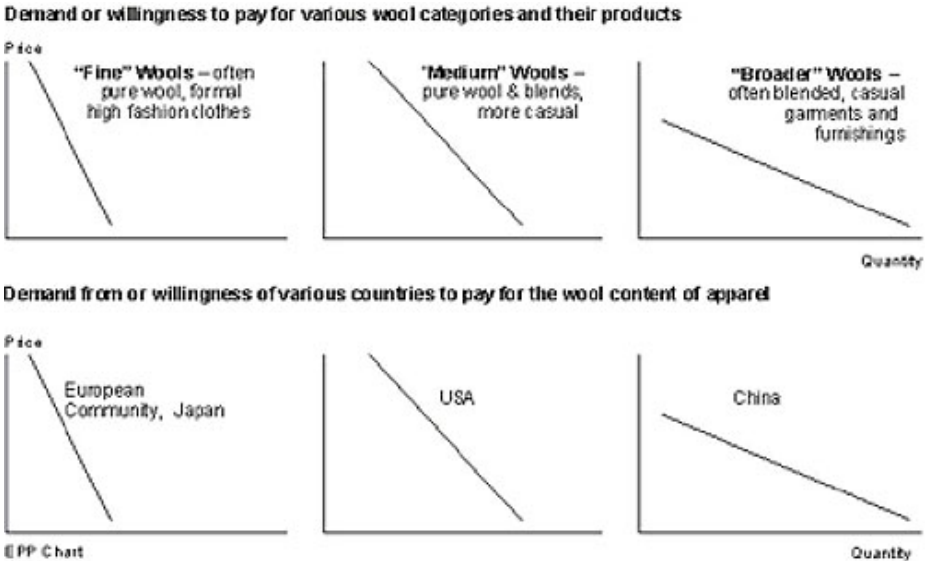

Figure 13.12 Characterisations of Wool Demands. Adapted from: Beare and Meshios (1990); Connolly (1992); Stoeckel, Borrell and Quirke (1990).

- Expenditure income and quality elasticities

So far demand has been defined in terms of quantities purchased. It is also possible to define demand in terms of consumer expenditures on a product, where expenditure is defined intuitively as $S = P_i Q_i$, where S is "spend" or expenditure and the income elasticity of expenditure ES is:

$ES_i = \Delta S_i / S_i \div \Delta I / I = \Delta S_i / \Delta I \times I/S_i$

The expenditure elasticity can be broken down into the quantity elasticity and a "quality elasticity" that measures how much consumers are prepared to pay for a class of goods, such as woollen sweaters as their incomes rise:

$ES_i = E_{il} + EV_{il}$

where ES_i is the income elasticity of expenditure just defined, EQ_{il} is the quantity income elasticity of demand defined earlier and EV_{il} is the income elasticity of quality (V for value), quality elasticity for short. The quality elasticity is an important concept for a commodity like wool where, typically, the value added in processing etc is large relative to the value of the raw wool in the final product. However, it is important to note that the above split into quantity and quality components is based on the assumption that prices indicate quality, so that a more expensive sweater is necessarily a "better" one.

Price levels often do "signal" quality. But, remember there is always someone around prepared to rip-off uninformed consumers.

13.6 Revenue and the own-price elasticity of demand

This discussion of elasticities is provided, not for its theoretical value, but because it has a practical application. Where firms do have a choice over their pricing decisions, the own-price elasticity of demand helps determine the firm's optimal pricing and sales strategies.

The importance of elasticity in the firm's pricing and sales decisions is illustrated in Figure13.13. If demand is relatively "elastic" (working with the left panel), dropping prices as shown will cause a change in sales revenue equal to the revenue gained (blue shaded area) minus the revenue lost (yellow shaded area). And if demand is relatively "inelastic (working with the right panel), dropping prices as shown will again cause a change in sales revenue equal to the revenue gained (yellow shaded area) minus the revenue lost (blue shaded area).

Clearly there is no advantage in dropping prices to improve sales revenue when demand is inelastic but, if the firm has the choice there is an advantage in raising prices. Provided the firm has the choice, it is not profitable to operate in the inelastic portion of the demand curve, and in that portion of the curve raising prices will increase revenue – because $|+\Delta P| > |-\Delta Q|$.

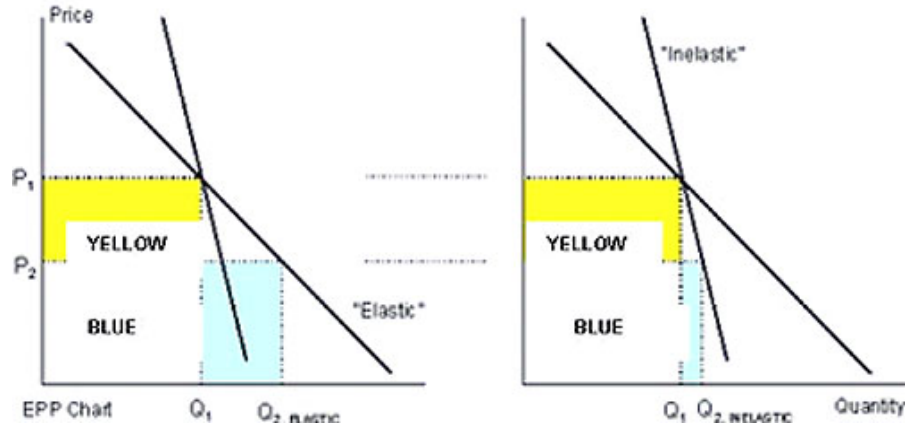

Figure 13.13 Elasticity and Revenue.
Source: Haszler, Economic Policy Perspectives, (2006).

13.7 Determinants of elasticities

Ultimately, consumers' preferences and the production technology determine demand and supply elasticities. So elasticities are likely to differ for different groups of consumers and producers and need to be determined for each group or individual of interest. Nevertheless the production and consumption attributes or circumstances of goods and services can indicate the relative orders of magnitude for their elasticities.

The determinants of supply elasticities include the following factors.

- **Other enterprises**: The more substitutes in production there are for some commodity, the higher will be its own-price elasticity of supply. Consider the case where a farmer can produce only one commodity, say wool. After some time the farmer will get to a position where he or she is producing the maximum quantity as efficiently as possible. A drop in wool prices that is perceived to be "permanent" is likely to lead to some cut in output. But the supply response to an increase in prices will be zero!

- **Size of operation**: It is easier to expand a small operation so the supply elasticities are likely to be larger for small operations. Contrast the aggregate wool supply with the aggregate supply of eggs in Australia and the possible responses to a doubling of wool and egg prices. Any substantial expansion of the wool clip would require significantly more land, which will need to be bid away from other activities. But an egg producing operation needs little land so it can be set up almost anywhere, without much disturbance to existing activities.

For their part, the determinants of demand elasticities include the following factors.

- **Substitute goods and services**: The more close substitutes there are for something the greater the chance for consumers to "cherry-pick" the relatively cheaper items as they seek to maximise their wellbeing. And that means that the greater the number of substitutes, the higher the (absolute) own-price elasticity.
- **Essentials**: This point follows from the previous one. An essential item has few – if any – substitutes, so its price elasticity will be low in absolute terms. The consumer simply has little or no choice and must pay "any" price to get the essential item.
- **Budget shares**: Price elasticities for items that make up a small part of the consumer's total expenditure are generally low. A consumer who spends, say, $3.50 per year on shoelaces will not be much affected even if the price doubles. But what about the effect of an increase in house rent if rent makes up 50 per cent of the consumer's budget. Obviously price elasticities are likely to be especially low for essential items that comprise a small share of the budget, like salt.
- **Income**: Income elasticities are generally relatively low for essentials and higher for luxuries. Obviously essentials have a "first call" on a consumer's income so that after some point increases in income may lead to very little if any additional consumption of essentials.

Note that the "essentials" and "budget shares" on the demand side have their counterparts in the "other enterprises" and "size of operation" factors on the supply side.

Table 13.4 Estimates off Some US Food Demand Elasticities: Retail Level.
Source: George and King (1971).

Product Demanded	Elasticity with Respect to						
	BF	LM	BU	MG	AF	NF	Income
Beef – BF	- 0.64	0.05	..	..	- 0.39	0.10	0.29
Lamb Mutton – LM	0.59	- 2.63	..	..	- 0.77	0.20	0.57
Butter – BU	..	..	- 0.65	0.16	- 0.43	0.11	0.32
Margarine – MG	..	..	0.42	- 0.85	0.00	0.00	0.00
All Food – AF	- 0.04	- 0.01	- 0.01	..	- 0.24	0.06	0.18
Non Food – NF	- 0.02	..	..	..	- 0.23	-1.02	1.24

Note: .. denotes less than 0.005 in absolute terms. These elasticities were obtained by direct estimation subject to the imposition of theoretical constraints such as the homogeneity condition which is illustrated by the fact the unrounded sum of the AF, NF and income elasticities = 0.

13.8 Length of run

The degrees of response of demand, supply and prices to various economic stimuli depend in part on the period of time over which the responses are measured. Obviously the related elasticities also vary with the time period under consideration. Consequently, economists commonly distinguish between the short-term, the medium-term and the long-term.

- In the **short-term** only very limited responses to changing economic conditions are possible because at least one thing remains fixed. Consumers' tastes might remain constant and firms do not have time to install new equipment, buy more land, organise an extra shift, etc. So the immediate response to some stimulus will be less than the response over a longer period.

- The response in the **medium-term** is greater than in the short-term because at least some of the firm's fixed factors of production become variable because, for instance, wage contracts and rental agreements may expire. On the demand side, consumers have, perhaps, had some time to identify and evaluate substitute goods or reduce their wardrobe stocks to justify buying new clothing.
- In the **long-term** firms have no fixed costs and established consumer tastes can change so demand and supply are much more responsive to varying economic stimuli.

The distinctions refer to the degree of response that is feasible and not to any particular length of time. So short and long-run mean different lengths of time in different industries. In agriculture, the short-term might vary from 6-8 weeks for vegetable crops, to 4-5 months for broiler production, perhaps one year for annual crops, to 2-3 years for sheep or cattle enterprises and 8-10 years for tree crops. In the case of the annual wheat crop, for example, farmers can only plant one crop of wheat per year, so supply is fixed for a year once the crop is planted.

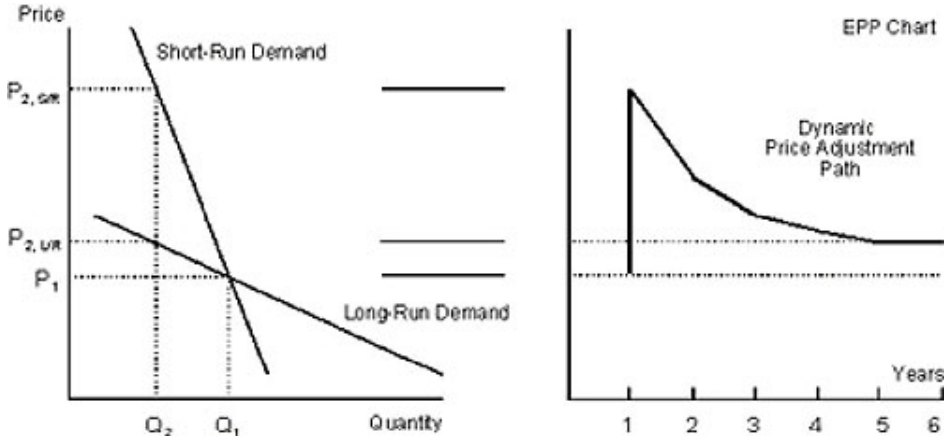

Figure 13.14 Short and Long-Term Impacts.
Source: Haszler, Economic Policy Perspectives, (2006).

The relationship between short and long-run demand curves is illustrated in Figure 13.14. A similar relationship exists on the supply side.

Imagine that the figure shows demand schedules for wheat and a drought reduces the crop from last year's Q_1 to this year's Q_2. In the short-term of one year, wheat supply would be shown as a vertical line at Q_1 and Q_2 respectively. Note that this means the short-run supply elasticity for wheat is exactly zero. Now what happens in the market?

Given that consumers' preferences are also fixed in the short-run, the only thing that can change to re-balance supply and demand is price, that is price changes must accommodate *all* the impact of the supply shift so the drought-induced reduction in wheat production causes a relatively sharp spike in wheat prices. So the supply shift interacts with the short-run demand curve and wheat prices increase from P_1 to $P_{2,S/R}$.

But the impact of the single supply shock is spread between quantity and price over the medium to long-run – periods in which consumers' can decide to learn about substitute products and farmers are able to change their plantings and crop rotations in response to the changes in wheat prices. If there are no further shocks to the system and consumers have time to respond fully to the change in wheat supply and prices then the market will reach a new equilibrium at a price of $_{2,L/R}$.

That is the medium and long-run-run supply and demand curves are much "flatter" than in the short-run and supply and demand shocks of the same size as before produce a much smaller price change in the long-run than in the short-term.

As noted already, there is a particular reason for maintaining the distinction between the short and long-term in the case of wool. As clothing and footwear are durable items, consumers do not necessarily have to replace these every day. So a drop in clothing prices may generate little immediate change in purchases as people deplete their wardrobe stocks first. But that constraint will disappear in the long-run so the ultimate response to a sustained drop in prices should exceed the immediate response.

13.9 Significance of macroeconomic and external shifters

The preceding material provides all the analytical material needed to evaluate the relative significance of the principal macroeconomic and external factors that affect the wool market. As a prelude, it is instructive to refer back to Figure 13.1 that provided a general overview of the world system within which the Australian wool industry operates. Figure 13.15 and Figure 13.16 illustrate some of the linkages more directly.

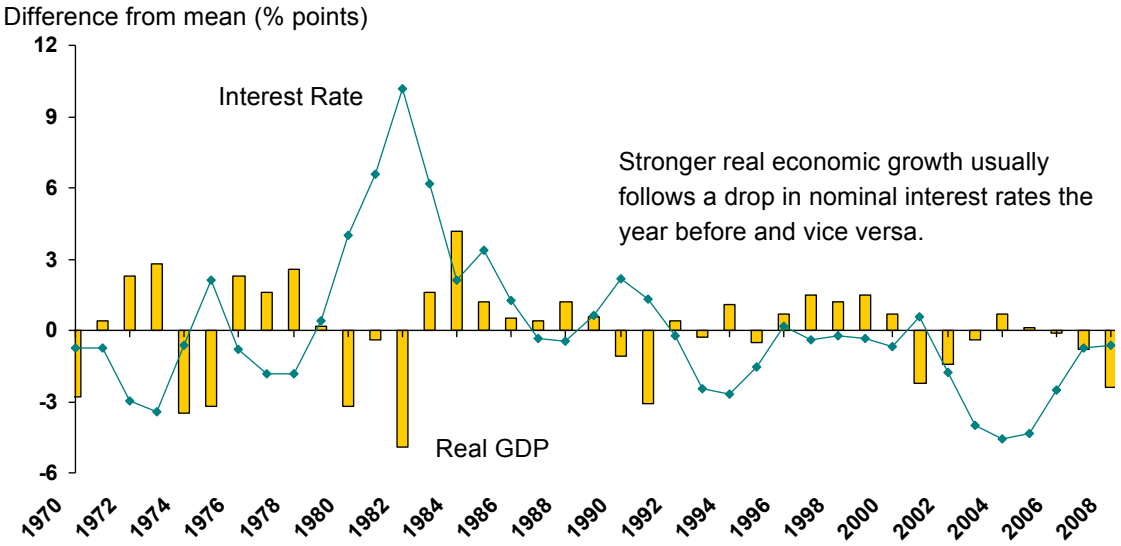

Figure 13.15: US Interest Rates and GDP
Source: Federal Reserve, Bureau of Economic Analysis.

Note: Data refer to growth in US GDP in the current year and prime lending rate the year before.

The US economy is one of the main "engines" of world economic growth because it is so large in an absolute sense and because income per head in the United States is high. So the US economy has many 'rich" consumers who buy products from all around the world and in so doing add to economic growth elsewhere. Figure 13.15 is presented here to illustrate one relationship between two key macro variables relevant to wool.

Figure 13.16 is designed to help demonstrate the central importance of changes in consumer incomes to the wool market. Naturally the full story is more complicated than shown in the figure. The levels of and changes in the former Australian Wool Corporation's stocks were also influenced, amongst other things, by:

- The levels of the minimum reserve price that were set under the scheme;
- The direct effect of interest rates in Australia and elsewhere in determining the value on the $A;

- Changes in wool production in Australia and competitor trading countries; and
- Differences between actual and anticipated market developments.

Nevertheless, a logical inference from the figure is that for much of the period over which the Reserve Price Scheme for wool operated, it was stabilising wool prices, through its stock purchases and sales, counter-cyclically against the world business cycle, as indicated by the variations in the growth of real US GDP.

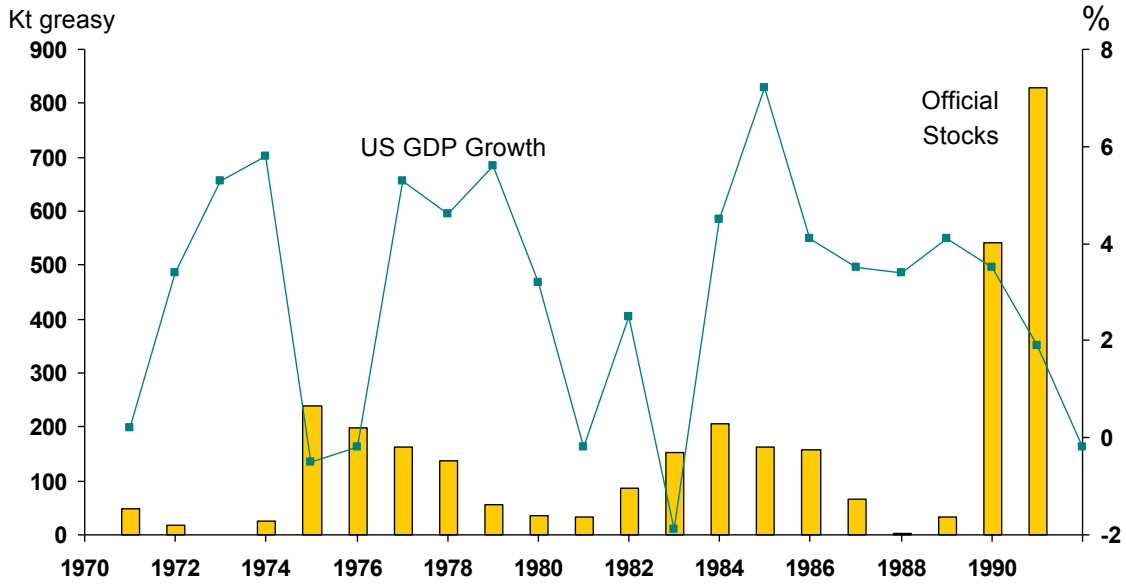

Figure 13.16: Income and Wool Market Impacts: Official Stocks
Source: US Census Bureau, AWC.

Note: Data refer to ending official stocks in the year shown and the growth of US GDP the year before.

The final element needed to complete the market analysis jigsaw is the information on Australian wool elasticities provided in Table 13.5. The estimates provided in the table rely on a variety of studies carried out up to 50 years ago and on data spanning back by up to 70 years. Clearly, the empirical research confirms the theoretically based analysis, namely that long-run elasticities are greater in absolute terms than short-run elasticities. The key point is that the raw wool market is inelastic in the short-run but, as the theoretical analysis indicates, is more elastic in the long-run. In fact, wool demand appears to be just "elastic" in the technical sense in the long-run.

Table 13.5 Plausible Australian Wool Elasticities. Source: Haszler (2003).

	Short-Run	Long-Run
Australian Raw Wool Demand		
Wool price	-0.35	-1.05
Cotton/synthetics price	0.10	0.30
Income per head	0.40	1.20
Wool promotion	0.05	0.15
Australian Raw Wool Supply		
Wool price	0.05	0.80
Price of sheepmeat	-0.01	-0.18
Price of beef & veal	....	-0.17
Price of beef	-0.01	-0.18

Figure 13.17 supports the notion of a fundamental change in the way that changes in prices of other commodities shift the wool supply function. Up until the late 1960s land utilisation for livestock (pastures) and crops expanded roughly together, due partly to the gradual opening up of new land, which was in turn supported by the progressive spread of the fallow rotation system throughout the mixed broadacre farming regions.

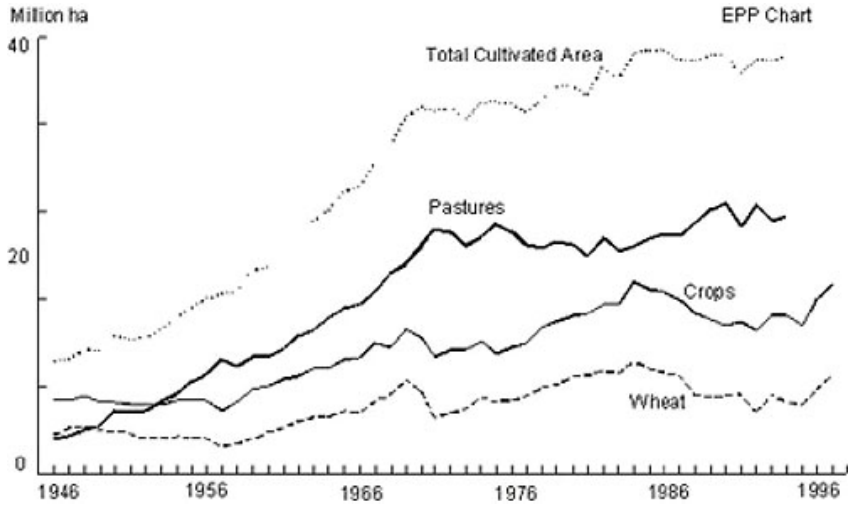

Figure 13.17 Land Utilisation in Australia. Source: Haszler (2003).

In the late 1960s the wheat crop reached a then record level and because of excess wheat stocks in major exporting countries, the Australian Government imposed delivery quotas, effectively a restraint on production, on wheat, then by very far the major broadacre crop. The delivery quotas seem to have forced farmers to investigate new types and combinations of farm activities. At that point what appears to have been a broadly complementary relationship between crop and livestock production seems to have been replaced by a more competitive relationship. That is the cross-price elasticities of supply between wool and many other broadacre enterprises seem to have switched to being negative.

Summary

This topic provides the basis for the following four key insights relevant to the economics of wool marketing.

First,. Technology available to firms at any given time, as represented in the firm's production function, and the consumer's preferences drive supply and demand. Economics links the behaviour of individual producers and consumers to develop aggregate supply and demand curves. Those curves measure the firm's production costs and the value of consumption to consumers.

Second, analytical methods and models provide an understanding the interactions of consumers and producers in markets. That model relies on market demand and supply curves, which also measure costs and value, obtained by horizontally summing over individual consumers and firms.

Third, elasticity, or responsiveness, is a fundamental concept having relevance to pricing decisions of firms and to the magnitude of the various external shocks that regularly affect the wool market.

Finally, market supply and demand analysis can be used to understand, monitor and to help anticipate developments in the wool market. Demand side factors such as income growth and exchange rate fluctuations explain much of the short-term variation in the wool market.

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Glossary of terms

The definitions of standard terms in microeconomics are probably common property these days. However, it is professionally polite to note that the following owes much to Samuelson and Nordhaus (1989).

Equilibrium (Consumer)	The position in which the consumer is maximising his or her wellbeing, that is, the consumer has chosen the bundle of goods and services which given the consumer's preferences, income and market prices best satisfies the consumer's wants
Equilibrium (Producer/Firm)	The position or level of output at which the firm maximizes its profits subject to any constraints such as the state of technology; for competitive firms, equilibrium is where marginal cost equals marginal revenue equals market price
Fixed Cost	A cost that is independent of the level of output and, therefore, has no effect on the short-run production decisions of competitive firms
Fixed Input(s)	Those inputs whose quantity used cannot be varied in the short-run
Income	The flow of earnings received by an individual.
Income Elasticity of Demand	The percentage change in the quantity of a product demanded in response to a percentage change in consumer incomes
Inferior Good	a good whose consumption declines as income rises

Law of Diminishing Marginal Utility	The law that states that as more and more of any one commodity is consumed, the incremental value or utility of each additional unit declines
Law of Diminishing Returns	The law of production stating that, when all other inputs are held constant, the incremental output from successive units of the variable input will eventually decline; that is that the marginal product of the variable input declines after a point
Law of Supply and Demand	The analytical result that under perfect competition market price will move to a level at which the quantity that consumers wish to buy just equals the quantity that firms wish to produce, so that there is no excess demand or supply
Long Run	A period or length of time over which all the factors of production become variable and the firm can choose its optimum level of production and technology
Marginal Cost	The change in total cost resulting from a unit change in output. Because fixed costs are fixed in the short-run, marginal cost also equals the change in variable costs due to an additional unit of output
Marginal Product	The change in total product or output resulting from a unit change in the use of a variable input while all other inputs are held constant
Marginal Revenue	The change in total revenue resulting from a one unit change in the quantity sold
Market	Any arrangement that facilitates buying and selling (trading) of goods, services, factors of production or future commitment
Opportunity Cost	The best alternative foregone
Price Elasticity of Demand	A measure of the degree to which quantity of a good demanded by buyers responds to a change in its own price. Measured as the percentage change in quantity purchased divided by the percentage in price that caused the quantity change
Price Elasticity of Supply	An analogous measure to the price elasticity of demand.
Production Function	The relationship that describes how maximum levels of output change in response to changing levels of inputs. The production function is determined by the technology available to the firm
Profit	In economics defined as the difference between total sales revenue and the full opportunity cost of all the resources involved in producing the goods. In accountancy, profit is the difference between total revenue and costs "property" chargeable against the goods sold. The distinction between economic and accounting profit lies in the difference in the valuation of costs
Short run	The period in which at least one of the firm's factors of production are fixed

Substitutes	Two goods which "compete" with each other as do tea and coffee. There are complements in supply as well as demand.
Supply Schedule (Curve)	A schedule or curve showing the quantity of a good that an individual firm (individual supply curve) or firms in aggregate (market supply curve) would produce at each price, holding other things constant
Total Cost	The sum of all the costs of all the inputs used in production
Total Revenue	The total revenue received from sales of a product, which equals quantity times price
Variable Cost	A cost that varies with the quantity of output