UNDERSTANDING THE WORLD WOOL MARKET: TRADE, PRODUCTIVITY AND GROWER INCOMES

PART VI: THE COSTS OF GLOBAL TARIFF BARRIERS ON WOOL PRODUCTS; CONCLUSION*

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CHAPTER 6

THE COSTS OF GLOBAL TARIFF BARRIERS ON WOOL PRODUCTS

6.1 Preamble

The current Doha round of multilateral trade negotiations commits WTO (World Trade Organization) members to improving market access for both agricultural and non-agricultural goods (WTO 2001). Tariff barriers on wool products (i.e., raw wool, wool textiles and garments) represent a small but important subset of these negotiations, particularly for countries that are major producers and/or exporters of wool products (e.g., Australia, New Zealand and China). For these countries, understanding the effects of tariff barriers on wool products is of major interest. The current (August 2006) state of play with the Doha round is that it has not reached a successful conclusion. While the future of the round is somewhat uncertain, it is likely that the issue of agricultural trade reform will resurface in some form. The analysis here will be of use for those future discussions.

To analyse the effects of wool tariff barriers, it is necessary to account for any special features of the world wool market that may impinge on the analysis. What special features does the world wool market possess? We have earlier identified that wool passes through an extreme form of multistage production system before it is consumed by households in the form of wool garments (see Chapter 3, Section 3.1.1); this is a unique feature of the wool production system. Further, the regional pattern of output and exports at the primary end of the world wool market strongly diverges from the pattern of production and exports at the different production stages. For instance, at the spinning (or yarn) and garment-making stages the use of wool is concentrated in Western European countries (particularly Italy and the United Kingdom) and the Far East (particularly China). At the retail stage

Germany and France, as well as Italy and the United Kingdom, are important Western European consumers of wool, and Japan, as well as China, is an important Far East consumer of wool (TWC 2002).

In order to inform the debate on the Doha round, we analyse the distortionary effects of recent and current tariff barriers on wool products using WOOLGEM (the model outlined in Chapter 3), which (i) acknowledges the diverse regional pattern of output and trade in wool products, (ii) recognises the heterogeneous nature of these products, (iii) recognises the linear hierarchy that exists in the multistage production system through which wool passes. This is a comprehensive analytical approach with regard to the production, trade and consumption of wool products. Further, we account for any indirect effects of wool tariff barriers on the nonwool economy as the model explicitly recognises the production, trade and consumption of nonwool products. Also, the inclusion in the model of a cost-of-capital function for each region accounts for long-run capital accumulation and captures the long-run effects of wool tariff barriers on regional investment. Thus, the framework we apply is a comparative-static global general equilibrium model of trade and investment, with a detailed representation of the world wool market. As such, the research extends current practice by combining the (typically) detailed partial equilibrium analysis of commodities with the economy-wide computable-general-equilibrium approach.

The model is applied to estimate the distortionary effects on prices, output, trade and regional welfare of wool tariff barriers. The estimates are simulated under long-run conditions where each region faces a trade balance constraint and capital is free to accumulate or depreciate within each region. But there is no inter-regional mobility of capital or labour. Our experiments analyse the distortionary effects of tariff barriers from 1997 to 2005, and from 2005 onwards. The results are of value to policy makers, trade negotiators and producers, by aiding understanding of the global, regional and sectoral implications of past and current wool tariff barriers. The estimates are unprecedented in two respects. One, to our knowledge, no previous estimates of the effects of wool tariff barriers on wool industries and regional producers exist.[1] Two, the estimates are generated within a framework that captures the general interdependence between the wool and nonwool economies; this is also unprecedented. Thus, the estimates represent a major contribution to modelling wool industries and wool tariff barriers.

6.2 The nature of wool tariff barriers

Import duties on wool products represent an important input to this work. Such duties for 1997 are taken from TWC (2003) and applied to the model database (see Chapter 4, Section 4.3.2.1); table 6.1 presents average import tariffs in the model database after applying the wool tariff data. We note that the global average tariff for all goods is 4.9%. China has the highest overall import tariffs at around 13%. Taxes on imports of wool products are much higher than for nonwool products for all regions; the highest tariff averages for imports of wool products are for the USA (48%), China (28%), Australia and the ROW (32%). Globally, import tariffs are lower for raw wool commodities (i.e., greasy, scoured and carbonised wools, worsted tops, and noils) compared to wool textiles (i.e., yarns and fabrics) and wool garments; for instance, the average tariff rate on greasy wool (5.8%) is only around one-fifth of the rate on wool garments (28.5%).

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[1] There are many examples of studies analysing the global effects of trade barriers on broad classes of commodities and individual commodities. This includes: general-equilibrium analysis of agriculture, manufacturing and services (Francois et al. 2005); general-equilibrium analysis of agriculture (Kilkenny and Robinson 1990); general-equilibrium analysis of industrial products (Fernandez de Cordoba et al. 2005); general-equilibrium analysis of textiles and apparel (Trela and Whalley 1990); partial-equilibrium analysis of sugar (Elobeid and Beghin 2006); general-equilibrium analysis of sugar (Elbehri et al. 2000); partial-equilibrium analysis of wheat (Gomez-Plana and Devadoss 2004); partial-equilibrium analysis of rice (Sumner and Lee 2000); partial-equilibrium analysis of cotton (Pan et al. 2005). Partial-equilibrium studies capture the direct effects of trade barriers upon the commodity/industry in question; general-equilibrium studies capture the direct *and* indirect effects of trade barriers upon the commodity/industry in question.

Table 6.1 Average import tax rates in model database representing 1997 wool tariff barriers (per cent)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
					WOOL PRODUCTS					
Greasy wool	0	0	0	0	20.4	0	9.0	0	11.0	**5.8**
Scoured wool	0	0	0	0	20.4	0	9.0	0	11.0	**4.9**
Carbon wool	1.9	1.6	2.0	1.2	11.8	0	10.0	0	21.0	**2.3**
Worsted tops	1.9	1.6	1.4	0.9	11.8	0	10.0	0	21.0	**1.9**
Noils	1.8	1.2	1.8	1.5	11.8	0	10.0	0	21.0	**2.8**
Wool yarns	0.5	1.0	0.7	0.5	8.1	3.2	20.0	5.0	30.0	**16.0**
Wool fabrics	0.3	0.4	1.6	0.8	68.1	0	35.0	0	34.5	**25.4**
Wool garms	7.7	8.5	11.4	8.1	48.5	12.4	45.0	34.0	32.5	**28.5**
Average	*5.5*	*5.5*	*2.2*	*7.2*	*48.0*	*10.1*	*27.9*	*32.1*	*32.0*	***24.2***
					NONWOOL PRODUCTS					
Sheep meat	5.5	13.3	7.0	18.6	1.1	149.1	2.1	0.2	20.4	**16.4**
Synth textiles	4.3	5.3	5.0	5.3	8.8	8.1	25.0	13.9	10.1	**9.7**
Other goods	1.4	1.7	1.4	2.1	2.3	6.9	13.0	3.5	5.9	**4.7**
Average	*1.4*	*1.8*	*1.4*	*2.2*	*2.4*	*6.9*	*13.3*	*3.7*	*6.0*	***4.8***
					ALL PRODUCTS					
Average	*1.5*	*1.8*	*1.5*	*2.2*	*2.8*	*6.9*	*13.4*	*3.8*	*6.1*	***4.9***

One of the major aims of this work is to estimate the costs of recent (1997–2005) and current (2005) wool tariff barriers. The costs of recent wool tariffs are a function of the movement in tariff barriers over the period; table 6.2 presents the movement (percentage change) in wool tariffs from 1997 to 2005. These changes are based on 2005 wool tariffs sourced from TWC (2006) that have been mapped to the model database in the same way as 1997 wool tariffs. We can see that, overall, there has been a significant reduction in global wool tariff barriers of 40% over this period.

On a broad commodity basis, the largest reductions have been in wool textiles (yarns, –66%; fabrics, –60%); nevertheless, scoured wool and wool garments (–36%) have also experienced large, but smaller, reductions. Note also that the reductions in wool tariff barriers for the period 1997–2005 have contributed to a reduction in the global tariff average on all goods of 1.5%. Thus, despite wool commodities representing a small share of world trade, they have still made a small but observable contribution to overall tariff reductions during the period.

Table 6.2 Percentage change in average import tax rates, 1997–2005

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
					WOOL PRODUCTS					
Greasy wools	0.0	0.0	0.0	0.0	-8.3	0.0	116.7	0.0	-89.4	**22.5**
Scour wools	0.0	0.0	0.0	0.0	-8.3	0.0	116.7	0.0	-89.4	**-36.1**
Carbon wools	0.0	0.0	0.0	0.0	-41.5	0.0	105.0	0.0	-82.5	**2.7**
Worsted tops	0.0	0.0	0.0	0.0	-41.5	0.0	105.0	0.0	-82.5	**-14.2**
Noils	0.0	0.0	0.0	0.0	-41.5	0.0	105.0	0.0	-82.5	**-19.2**
Wool yarns	0.0	0.0	0.0	0.0	-25.9	-15.6	-75.0	0.0	-66.4	**-65.8**
Wool fabrics	-34.7	-34.7	-34.7	-34.7	-63.3	0.0	-71.4	0.0	-57.5	**-60.3**
Wool garms	-11.0	-11.0	-10.9	-11.1	-48.7	-14.3	-64.9	-48.5	-25.4	**-35.9**
Average	*-10.9*	*-10.8*	*-9.3*	*-11.2*	*-49.0*	*-14.4*	*-56.2*	*-48.4*	*-37.2*	***-40.4***
					ALL PRODUCTS					
Average	*-0.4*	*-0.4*	*-0.2*	*-0.3*	*-8.0*	*-0.2*	*-1.1*	*-2.0*	*-1.0*	***-1.5***

We observe a 22% increase in global average tariffs on greasy wools and a 3% increase on carbonised wools. The increases are driven purely by a doubling of the tariffs we apply for raw wool imported by China. This reflects a doubling of the out-of-quota tariff, from 15% to 38%, while the in-quota tariff has fallen: from 3% to 1% for greasy wools and from 5% to 3% for wool top. Based on assessments by Read (2004) and van Rooyen (2006), it seems reasonable to assume that the out-of-quota tariff does not often apply. Consequently, we assume in our simulations for the 1997–2005 period that the 1997 tariffs on raw wool applied by China remain unchanged.[2]

Four regions have enormously reduced tariff barriers over the period as reflected by average wool tariffs; the USA (–49%), China (–56%), Australia (–48%) and the ROW region (–37%). Much smaller reductions in average wool tariffs, in the order of 10%, have also occurred in all other regions. We note that the composite ROW region shows some of the largest individual reductions in wool tariffs, particularly on raw wool (80–90%). Given the size of these changes, it would be ideal for this region to be more disaggregated into the developing regions that have significantly reduced wool tariffs over this period.[3]

[2] The model database also captures the distortions of the Agreement on Textiles and Clothing (ATC) by including export tax equivalents of ATC quotas in place at 1997. These distortions are also left untouched in the simulations.

[3] Tariff data from TWC (2006) indicates that almost all of the reduction in ROW wool tariffs is driven by reductions in India.

Unfortunately, our source data for wool commodities, industries and regions do not allow for a further disaggregation. Despite this constraint, this work represents a significant advancement when placed in the context of the absence of previous work in this area.

In estimating the costs of 2005 tariff barriers we will assume complete removal of tariffs in place at that time. This provides a benchmark scenario for policy makers, trade negotiators and producers with which to place wool tariff barriers in the context of broader negotiations on trade barriers for all goods. For the purposes of comparison, table 6.3 presents average wool tariffs for both 1997 and 2005.

Table 6.3 Average import tax rates, 1997 and 2005 (per cent)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
					WOOL PRODUCTS: *1997*					
Greasy wools	0	0	0	0	20.4	0	9.0	0	11.0	**5.8**
Scour wools	0	0	0	0	20.4	0	9.0	0	11.0	**4.9**
Carbon wools	1.9	1.6	2.0	1.2	11.8	0	10.0	0	21.0	**2.3**
Worsted tops	1.9	1.6	1.4	0.9	11.8	0	10.0	0	21.0	**1.9**
Noils	1.8	1.2	1.8	1.5	11.8	0	10.0	0	21.0	**2.8**
Wool yarns	0.5	1.0	0.7	0.5	8.1	3.2	20.0	5.0	30.0	**16.0**
Wool fabrics	0.3	0.4	1.6	0.8	68.1	0	35.0	0	34.5	**25.4**
Wool garms	7.7	8.5	11.4	8.1	48.5	12.4	45.0	34.0	32.5	**28.5**
Average	*5.5*	*5.5*	*2.2*	*7.2*	*48.0*	*10.1*	*27.9*	*32.1*	*32.0*	***24.2***
					WOOL PRODUCTS: *2005*					
Greasy wools	0	0	0	0	18.7	0	19.5	0	1.2	**7.2**
Scour wools	0	0	0	0	18.7	0	19.5	0	1.2	**3.2**
Carbon wools	1.9	1.6	2.0	1.2	6.9	0	20.5	0	3.7	**2.4**
Worsted tops	1.9	1.6	1.4	0.9	6.9	0	20.5	0	3.7	**1.7**
Noils	1.8	1.2	1.8	1.5	6.9	0	20.5	0	3.7	**2.2**
Wool yarns	0.5	1.0	0.7	0.5	6.0	2.7	5.0	5.0	10.1	**5.5**
Wool fabrics	0.2	0.3	1.1	0.5	25.0	0	10.0	0	14.7	**10.1**
Wool garms	6.8	7.6	10.1	7.2	24.9	10.6	15.8	17.5	24.2	**18.3**
Average	*4.9*	*4.9*	*2.0*	*6.4*	*24.5*	*8.7*	*12.2*	*16.5*	*20.1*	***14.4***
					ALL PRODUCTS					
1997	*1.5*	*1.8*	*1.5*	*2.2*	*2.8*	*6.9*	*13.4*	*3.8*	*6.1*	***4.9***
2005	*1.4*	*1.8*	*1.5*	*2.2*	*2.6*	*6.9*	*13.3*	*3.7*	*6.1*	***4.8***

The most marked difference between pre-2005 and 2005 tariffs is the reduction in dispersion across production stages; for instance, the average tariff rate on greasy wool was only one-fifth of the rate on wool garments in 1997, whereas this ratio is just over one-third in 2005. This represents a significant reduction in dispersion and overall tariff levels given that the global average tariff on wool garments has fallen from 29% in 1997 to 18% in

2005. In general, tariffs on raw wool (i.e., greasy, scoured and carbonised wools, worsted tops, and noils) have fallen slightly from already low levels in 1997, while tariffs on wool textiles (i.e., yarns and fabrics) and garments have fallen significantly from high levels in 1997. Consistent with this, the highest individual tariff barrier has fallen from 68% to 25% (wool fabrics in the USA). The general pattern in global wool tariffs is reflective of tariff changes for all regions. Despite these reductions, significant average tariff barriers remain in the USA (25%), ROW (20%), Australia (17%) and China (12%), which suggests significant remaining costs from wool tariffs.

6.3 The costs of wool tariff barriers between 1997 and 2005

We simulate the changes in wool tariffs between 1997 and 2005 and analyse the changes on macroeconomic and microeconomic variables.

6.3.1 Macroeconomic effects

For a given region, there are two potential initial effects of the tariff reductions. First, the tariff reductions reduce the price of imported wool products; wool industries will substitute imported wool products for domestic wool products and, *ceteris paribus*, domestic wool industries will contract. Contracting domestic wool industries will reduce their demand for all inputs; thus, the demand for domestic nonwool inputs will fall and this will cause domestic nonwool industries to contract. Contracting wool and nonwool industries will reduce their overall demand for primary factors. Lower demand for primary factors will benefit the fixed factors, i.e., land and labour, and will disadvantage the variable factor, i.e., capital. Thus, the relative price of capital will increase causing industries to substitute land and labour for capital. The size of this initial effect is indicated by the percentage change in the average indirect tax rate due to the tariff reductions weighted by the share of the indirect taxes in GDP (table 6.4, row 1); thus, the initial effect is smallest in the European regions and Japan and largest in the USA, China, Australia and the ROW. The small size of these changes indicates that the economy-wide effect of cheaper wool products should not be large.

Table 6.4 Macroeconomic effects of changes in wool tariff barriers, 1997–2005 (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
1. Ind tax rate[a]	-0.0013	-0.0019	-0.0007	-0.0018	-0.0279	-0.0013	-0.0451	-0.0144	-0.0204	
2. Export tariff[b]	-0.1818	-0.6521	-2.4015	-0.1409	-0.0158	-0.0299	-0.5856	-0.1229	-0.4975	
3. Real GDP	-0.0012	-0.0003	0.0654	0.0062	-0.0152	-0.0007	0.0615	-0.0290	-0.0029	**-0.0012**
4. Value added	-0.0045	-0.0055	0.0549	0.0034	-0.0326	-0.0019	-0.0001	-0.0316	-0.0150	**-0.0137**
5. Capital stock	-0.0091	-0.0125	0.1020	0.0095	-0.0870	-0.0049	-0.0002	-0.0704	-0.0333	**-0.0327**
6. Ind tax base[c]	0.0203	0.0447	0.1742	0.0438	0.4982	0.0065	0.3438	-0.0054	0.1083	**0.1268**

a Indirect tax rate weighted by share of indirect taxes in GDP. **b** Tariff rate faced by exports weighted by share of exports in GDP. **c** This is *qnit* in equation (6.1); see text for explanation.

The second (potential) initial effect of the tariff reductions for a given region is increased demand for exports of wool products. Substitution of cheaper imported wool products for domestic wool products will favour regions from which the imported wool products are sourced. Increased demand for exports of wool products will cause domestic wool industries (in the exporting regions) to expand. Expanding domestic wool industries will increase their demand for all inputs; thus, the demand for domestic nonwool inputs will rise and this will cause domestic nonwool industries to expand. *Ceteris paribus*, expanding wool and nonwool industries will increase the overall demand for primary factors. Higher demand for primary factors will benefit the variable factor, i.e., capital, and will disadvantage the fixed factors, i.e., land and labour. Thus, the relative price of capital will fall causing industries to substitute capital for land and labour. A measure of the size of this effect is the percentage change in the average tariff barrier faced by exports weighted by the share of exports in GDP (table 6.4, row 2).

This measure indicates that, *ceteris paribus*, Italy is expected to experience far and away the strongest increase in export demand and this is because of the large share (5%) that wool textiles and garments comprise in *total* exports; wool textiles and garments experience far and away the largest reductions in global tariff barriers over 1997–2005. Germany, China and the ROW are expected to experience less significant increases in export demand as the export shares for wool textiles and garments are somewhat smaller than Italy's – 0.8%, 2.1% and 0.5% – but still much larger than in other regions. The pattern of exports also explain why Australia is expected to experience only a small increase in exports; its exports are heavily skewed towards raw wool and these products experience the smallest reductions in global tariff barriers over the period.

The relative sizes of the two initial effects will largely determine the size of the effects on economic activity in a given region (real GDP; table 6.4, row 3). The largest positive effects on real GDP are observed in Italy (0.065%) and China (0.062%); both of which experience large reductions in the tariff barriers faced by their exports (row 2). The UK is the only other region to experience a real GDP increase (0.006%). All other regions experience lower real GDP. The largest reductions are in Australia (–0.029%) and the USA (–0.015%); both are regions that experience relatively large increases in import demand (as measured by row 1) and relatively small increases in export demand (as measured by row 2).

The observed changes in real GDP will not be fully explained by our stylised explanation for how the tariff reductions determine which regions will gain and which will lose. In the long-run closure of WOOLGEM, the regional land and labour quantities are exogenous and their respective prices are endogenous, whereas regional capital stocks are endogenous and rates of return are exogenous (see Chapter 3, Section 3.17.2). Thus, to the extent that a region's capital stock changes due to the tariff shocks, real GDP will diverge from our stylised explanation.

Formally, we can define the percentage change in real GDP (*qgdp*) from the income side as a function of the change in the use of resources in the economy and/or the change in the efficiency with which resources are used in the economy, i.e.,

$$qgdp = SVAqva + SNITqnit\,; \tag{6.1}$$

where *qva* and *qnit* are the percentage changes in real value added and the quantity base upon which net (of subsidies) indirect taxes are levied, and *SVA* and *SNIT* are the shares of value added and net indirect taxes in GDP.

qva measures the change in the use of resources; as only capital is variable in the long run, any change in *qva* will be due to a change in the use of capital. The tariff changes cause *qva* to fall in most regions (table 6.4, row 4) and this is due to a fall in the use of capital (row 5). The changes in *qva* explain why *qgdp* expands in Italy and the UK – both experience an increase in the use of capital – and why *qgdp* falls in most other regions – where capital usage falls. But for China *qva* hardly changes but *qgdp* still increases. To explain this result we need to explain *qnit* (row 6).

qnit in (6.1) measures the change in the efficiency with which resources are used in the economy. This can happen via a change in tax rates (e.g., tariffs) and/or a change in the tax bases. Tax bases can change via price or quantity movements. The model distinguishes many indirect taxes (see Chapter 4, Section 4.4.5). *qnit* is defined as

$$\begin{aligned} qnit = {} & \sum_{j=1}^{J} SNITF_j\, qf_j + \sum_{i=1}^{3}\sum_{j=1}^{J} SNITF_{ij}^{F}\, qf_{ij}^{F} + \sum_{i=1}^{K}\sum_{j=1}^{J}\sum_{s=1}^{2} SNITF_{ijs}^{I}\, qf_{ijs}^{I} + \\ & \sum_{i=1}^{K}\sum_{s=1}^{2}\left\{SNITI_{is}qi_{is} + SNITH_{is}qh_{is} + SNITG_{is}qg_{is}\right\} + \\ & \sum_{i=1}^{K}\left\{SNITX_i\, qx_i + SNITM_i\, qm_i\right\}; \end{aligned} \tag{6.2}$$

where the *SN*s represent shares in total net indirect taxes and the *q*s represent percentage-change quantity variables. That is, *qnit* is defined in terms of the changes in all tax bases attributable to changes in quantities only. Reading across the right-hand side of (6.2), the tax bases are: output by the *J* industries; the 3 factors used by the *J* industries; the *K* intermediate inputs from different sources (domestic, imported) used by the *J* industries; inputs to investment, household and government consumption; and exports and imports.

Where the composition of sectoral outputs and sales do not change, all the *q*s in (6.2) will move together. In this case, *qnit* and *qva* in (6.1) will also move together, as *qnit* is the weighted sum of sales and *qva* is the weighted sum of (net) industry outputs. But the tariff changes will induce a change in each economy's production and sales structure; if the changes favour industries that are relatively highly taxed, *qnit* will be positive, if the changes favour industries that are relatively lightly taxed (or subsidised), *qnit* will be negative.

The compositional changes cause *qva* and *qnit* to diverge in all regions (cf. rows 4 and 6). Where *qgdp* exceeds *qva*, the excess represents the allocative efficiency gains from changing the composition of the economy in favour of activities that were discouraged (relative to optimum) in the pre-shock tax regime. This is what occurs in Italy, the UK and China; for China, all of the increase in *qgdp* is due to allocative efficiency gains, whereas for Italy and the UK the allocative efficiency gains are the dominant contributor to the gain in *qgdp*. Where *qgdp* falls but *qnit* rises, this is due to allocative efficiency gains reducing the negative impact of a fall in *qva*. This is what occurs in France, Germany, the USA, Japan and the ROW. Australia is unique in that it experiences an allocative efficiency loss; the tariff changes lead to compositional changes that favour activities that were encouraged (relative to optimum) in the pre-shock tax regime. This is explained more in the section on microeconomic effects.

6.3.1.1 The capital stock response

The tariff reductions cause differential effects upon regional capital stocks (table 6.5, row 1). The effects reflect what happens to the relative cost of capital as a response to the tariff reductions (row 2c). We see that the capital stock shrinks everywhere where the relative price of capital rises, which is most regions, and expands in Italy and the UK where the relative price of capital falls. Why do the relative prices of capital respond in this way? As explained earlier, one of the initial effects of the tariff changes is a contraction in domestic industries (due to substitution of imported wool products for domestic wool products) that, in turn, reduces the demand for primary factors in the economy. This will favour the fixed factors (land and labour) and discriminate against the variable factor (capital); the relative price of capital will rise and industries will substitute land and labour for capital.

Table 6.5 Effects on regional capital stocks and relative primary factor prices of changes in wool tariff barriers, 1997–2005 (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
1. Capital stock	-0.0091	-0.0125	0.1020	0.0095	-0.0870	-0.0049	-0.0002	-0.0704	-0.0333	**-0.0327**
2. Relative prices										
2a. Land[a]	0.0287	0.0168	0.0278	0.0068	-0.0121	0.0034	-0.0401	-0.3764	-0.0429	**-0.0250**
2b. Labour[a]	-0.0050	-0.0035	0.0435	0.0026	-0.0228	-0.0016	0.0046	-0.0127	-0.0138	**-0.0133**
2c. Capital[a]	0.0047	0.0043	-0.0366	-0.0049	0.0378	0.0024	0.0012	0.0331	0.0194	**0.0190**

[a] These are relative prices, i.e., the price of the primary factor deflated by the average price of all primary factors. Here all prices are purchaser's prices.

One way that the above-described initial effect on the relative price of capital might be offset is if the tariff reductions reduce the cost of creating capital (investment). As the rate of return is held fixed in the long run, a fall in the price of investment will in turn drive down the rental price of capital. Such an effect would work to offset the initial rise in the relative price of capital. But wool inputs are clearly not an important input to investment. In fact, the model database indicates that close to 100% of inputs to investment are made up of other (nonwool) goods. Thus, other reason cause the relative price of capital to fall in Italy and the UK.

Another initial effect of the tariff changes is to increase demand for a region's exports where tariff barriers faced by those exports are lowered. Domestic industries (in the exporting region) will expand in response to increased export demand. In general, expanding domestic industries will increase the demand for primary factors in the economy. *Ceteris paribus*, this will favour the variable factor (capital) and discriminate against the fixed factors (land and capital); the relative price of capital will fall and industries will substitute capital for land and labour.

Each region thus faces two countervailing effects on the general demand for primary factors; a contractionary effect from cheaper imports and an expansionary effect from increased export demand. If the contractionary effect is not fully offset by the expansionary effect, the relative price of capital will rise and the capital stock will shrink; this is what happens in most regions. If the contractionary effect is more than offset by the expansionary effect, the relative price of capital will fall and the capital stock will expand; this is what happens in Italy and the UK.

6.3.1.2 The trade response

The changes in wool tariffs lead to increased imports in all regions (table 6.6, row 2). In the long run, the trade balance to GDP ratio is assumed fixed in all regions. Thus, a rise in imports must be offset by a rise in exports (row 1). The more that the terms of trade improve (row 3), the less that exports must rise to maintain the trade balance to GDP ratio. The terms of trade improve the most for Italy (0.094%) and Australia (0.104%). Thus, for Italy exports rise by less than imports (0.43% versus 0.57%) due to its terms of trade improvement; this is what happens in most regions that experience a terms of trade gain.

Australia's terms of trade improvement is so strong and its increase in imports (0.036%) so small that its exports are able to fall (–0.083%) and still maintain the initial trade balance to GDP ratio. The terms of trade deteriorate for the USA (–0.036%) and the ROW (–0.016%); thus exports rise by more than imports: 0.193% versus 0.122% in the USA and 0.136% versus 0.125% in the ROW.

Table 6.6 Regional trade effects of changes in wool tariff barriers, 1997–2005 (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
1. Exports	0.005	0.010	0.430	0.013	0.193	0.058	0.777	-0.083	0.136
2. Imports	0.029	0.054	0.569	0.046	0.122	0.081	0.859	0.036	0.125
3. Terms of trade	0.023	0.043	0.094	0.033	-0.036	0.010	0.000	0.104	-0.016
3a. Export price	0.053	0.067	0.170	0.058	-0.016	0.026	0.023	0.128	0.018
3b. Import price	0.030	0.025	0.076	0.025	0.020	0.016	0.022	0.025	0.034
4. Export tariff[a]	-0.182	-0.652	-2.402	-0.141	-0.016	-0.030	-0.586	-0.037	-0.492
5. GNE	0.005	0.011	0.094	0.015	-0.018	0.000	0.064	-0.004	-0.003
6. GNE in export destinations[b]	0.009	0.006	0.001	0.003	0.004	0.003	-0.003	0.005	0.003
7. Price of value added	0.049	0.063	0.146	0.063	-0.009	0.025	0.129	0.043	0.045

[a] Tariff rate faced by exports weighted by share of exports in GDP. [b] For a given region, this is GNE in export destinations weighted by export shares.

Import prices rise in all regions (row 3b, table 6.6) due to substitution of cheaper imported goods for domestic goods but the variation in import prices across regions is small; that is, from 0.016% (Japan) to 0.076% (Italy). Export prices also rise in all regions (row 3a, table 6.6) except the USA (–0.016%). For all other regions the variation in export prices is larger than that observed for import prices; that is, from 0.018% (ROW) to 0.17% (Italy). Thus, the differences in terms of trade changes across regions are largely due to the differences in the prices of exports.

The differences in export prices partly reflect the degree to which demand expands for the exports of each region. This is largely a function of the degree to which tariff barriers faced by each region fall (row 4, table 6.6); Germany, Italy, China and the ROW experience the largest such reductions. The differences in export prices also partly reflect the degree to which demand conditions (GNE; row 5) in a region's export destinations (row 6) interact with lower domestic costs (row 7) in the exporting region. The USA's export prices fall due to the marginal reduction in tariff barriers faced by its exports and lower domestic costs. For China, the weak export price rise (0.023%) reflects a strong trade orientation with the USA and the ROW, both of which experience a reduction in GNE (–0.018% and –0.003%), offsetting the relatively large reduction in barriers faced by its exports and higher domestic costs (0.129%). Australia experiences the second largest export price rise (0.128%) even though its export barriers fall only marginally; it benefits from a relatively large rise in GNE in export destinations (0.005%) due to a strong trade orientation with Italy and China, which experience the largest increases in GNE (0.094% and 0.064%), and higher domestic costs (0.043%).

6.3.1.3 Welfare effects

The welfare effects of the tariff changes, as measured by real household income (row 5, table 6.7), are largely inconsistent with the real GDP effects (row 6); welfare rises in all regions except the USA, Australia and ROW.[4] For the USA and the ROW, the size of the welfare effects (–0.016% and –0.005%) are consistent with size of the real GDP effects (–0.015% and –0.003%). For Australia, the welfare loss (–0.04%) exceeds the fall in real GDP (–0.029%). Here, there is a relatively large rise in the income tax rate (row 2; 0.155%) reflecting the fall in allocative efficiency due to the tariff changes (see row 6, table 6.4). Thus, relatively lightly-taxed (or subsidised) activities expand due to the tariff changes placing pressure on government revenues. The government budget position is fixed in the long run (see Chapter 3, Section 3.17.2); therefore any pressure on government

[4] Real household income is a metric of the change in the Hicksian equivalent variation.

revenue is accommodated by the income tax rate adjusting upwards. The rise in the income tax rate is large enough to reduce nominal household disposable income (row 3, –0.019%); this is magnified by a small rise in the consumer price index (row 4; 0.021%) thus causing real household income to fall by –0.04%.

Table 6.7 Regional welfare effects due to changes in wool tariff barriers, 1997–2005 (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
1. Factor income[a]	0.045	0.057	0.201	0.067	-0.042	0.024	0.129	0.011	0.030
1a. Land inc[a]	0.059	0.071	0.167	0.067	-0.017	0.029	0.089	-0.375	0.003
1b. Labour inc[a]	0.044	0.059	0.189	0.066	-0.032	0.024	0.134	0.031	0.031
1c. Capital inc[a]	0.045	0.055	0.211	0.068	-0.058	0.023	0.130	0.006	0.031
2. Income tax rate	0.011	0.012	-0.031	0.008	0.125	0.012	1.870	0.155	0.142
3. Disp income[b]	0.040	0.048	0.213	0.065	-0.074	0.022	0.096	-0.019	0.007
4. CPI	0.040	0.045	0.119	0.048	-0.058	0.021	0.004	0.021	0.012
5. Real income[c]	0.000	0.003	0.094	0.017	-0.016	0.002	0.092	-0.040	-0.005
5a. US$ million	3	36	672	165	-982	53	689	-123	-366
6. Real GDP	-0.001	-0.000	0.065	0.006	-0.015	-0.001	0.062	-0.029	-0.003

[a] These are pre-tax nominal variables. [b] This is post-tax nominal household factor income. [c] This is post-tax nominal household factor income (row 3) minus the consumer price index (row 4).

For Italy, the UK and China, the positive welfare effects are consistent with the positive real GDP effects. France, Germany and Japan all experience marginal reductions in real GDP and marginal increases in real income. In these regions, the allocative efficiency gains are favourable enough so that the replacement of indirect tax revenue with direct tax revenue is only slight; thus, income tax rates rise by much less than factor incomes.

In summary, Italy (0.094%), China (0.092%) and the UK (0.017%) are the largest gainers from the movement in wool tariffs between 1997 and 2005; these gains are worth approximately $672, $689 and $165 million annually in 1997 US dollars.

6.3.2 Microeconomic effects

The response of a given industry's output to the tariff changes will be largely determined by the interaction of three forces. One, the degree to which the price of competing imports falls due to lower tariffs [panel (a), table 6.8]. Two, the degree to which the tariff barriers it faces in export markets fall [panel (b)]. Three, the effect on the relative price of the primary factor that it uses most intensively [panel (c)]. Comparing the magnitude of the three forces as reported in table 6.8, the size of the first two dominates the size of the changes in the third. Thus, we expect the first two effects to largely determine the changes in each industry's output.

Table 6.8 Changes in import tariffs, export barriers and relative primary factor prices due to changes in tariff barriers, 1997–2005 (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
					(a) Import tax rates				
Greasy wools	0.0	0.0	0.0	0.0	-8.3	0.0	0.0	0.0	-89.4
Scoured wools	0.0	0.0	0.0	0.0	-8.3	0.0	0.0	0.0	-89.4
Carbon wools	0.0	0.0	0.0	0.0	-41.5	0.0	0.0	0.0	-82.5
Worsted tops	0.0	0.0	0.0	0.0	-41.5	0.0	0.0	0.0	-82.5
Noils	0.0	0.0	0.0	0.0	-41.5	0.0	0.0	0.0	-82.5
Wool yarns	0.0	0.0	0.0	0.0	-25.9	-15.6	-75.0	0.0	-66.4
Wool fabrics	-34.7	-34.7	-34.7	-34.7	-63.3	0.0	-71.4	0.0	-57.5
Wool garms	-11.0	-11.0	-10.9	-11.1	-48.7	-14.3	-64.9	-48.5	-25.4
					(b) Import tax rates faced by exports				
Greasy wools	0	0	-5.84	0	0	0	-50.68	-32.92	-11.98
Scoured wools	-13.98	-89.36	-7.54	0	0	0	-70.32	-57.65	-18.17
Carbon wools	0	0	-33.95	0	-0.01	0.02	-8.81	-4.34	-14.68
Worsted tops	-80.06	-76.73	-82.54	-73.93	-4.49	-7.92	-37.83	-18.03	-10.88
Noils	-42.07	-41.52	-41.29	-41.05	0.00	-0.02	-23.84	-1.23	-29.29
Wool yarns	-66.82	-67.07	-68.03	-66.87	0	0	-59.71	0	-59.34
Wool fabrics	-58.66	-58.57	-60.61	-59.51	-58.50	-67.65	-57.36	0	-60.94
Wool garms	-26.40	-25.85	-29.75	-27.56	-22.23	-53.12	-28.37	-35.69	-40.88
					(c) Relative price of primary factors[a]				
Land	0.0287	0.0168	0.0278	0.0068	-0.0121	0.0034	-0.0401	-0.3764	-0.0429
Labour	-0.0050	-0.0035	0.0435	0.0026	-0.0228	-0.0016	0.0046	-0.0127	-0.0138
Capital	0.0047	0.0043	-0.0366	-0.0049	0.0378	0.0024	0.0012	0.0331	0.0194

[a] The price of the primary factor deflated by the average price of all primary factors.

In presenting industry and commodity results we aggregate the 56 commodities and 43 industries to 11 broad commodity and 8 broad industry classes in order to keep the discussion of the results manageable. Table 6.9 reports various commodity and industry results of the wool tariff changes. In most regions the distortionary price effects [panel (a)] of the tariff barriers are generally not large; for most wool commodities the tariffs have inflated prices in the order of 5–10%; the exception is noils where prices are estimated to fall by 21% in the USA and rise by 27% in Germany. The large price fluctuations for noils reflect its joint product characteristics in the production of worsted tops; thus, the supply curve for noils is quite steep and any changes in demand will cause large price fluctuations. The largest across-the-board price reductions are experienced in the USA and the ROW, which are the only regions to reduce wool tariffs across-the-board [see panel (a), table 6.8]. Tariffs on wool fabrics and garments are reduced significantly in all regions, but significant price reductions for these products only occur in regions where tariffs are reduced from a high initial rate, i.e., the USA, China and the ROW.

The changes in industry output due to the tariff changes [panel (b), table 6.9,] are extreme and divergent reflecting the discriminatory nature of tariffs over this period. For instance, the output of carbonised wools in France doubles (101%) whereas in the USA it more than halves (–72%). Other extreme reductions also occur in the US wool yarns industries (–74%) and wool fabrics (–76%). These results seem consistent with what has been observed in US wool processing from the year 2000 onwards. Large changes are also observed for the carbonised wools industries in Germany (–41%), Italy (50%) and the UK (64%), and for the wool fabrics industries in Italy (43%), the UK (71%) and the ROW region (–40%). The results also indicate a relocation of wool garments production away from France (–11%), Germany (–9%) and Italy (–12%), largely to China (5%) and the ROW (6%).

Table 6.9 Selected industry and commodity effects of changes in tariff barriers, 1997–2005 (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
					(a) Commodity price[a]				
Sheep meat	0.11	0.16	0.16	0.10	0.06	0.07	0.32	0.50	0.44
Greasy wools	-6.06	-3.31	-5.46	0.41	-32.74	-2.46	-5.39	-1.13	-5.21
Scoured wools	-2.34	-2.21	-2.29	-2.03	-24.17	-4.63	-4.30	-0.60	-4.92
Carbon wools	-8.93	-1.84	-1.38	-1.96	-21.87	-5.19	-4.58	0.94	-3.30
Worsted tops	-4.20	-4.84	-3.75	-5.05	-5.72	-1.96	-4.39	-3.91	-6.16
Noils	24.69	27.41	25.33	3.32	20.89	2.58	14.34	24.78	7.19
Wool yarns	-0.22	2.44	3.21	-1.81	-9.33	-1.28	-1.35	0.09	-3.49
Wool fabrics	-0.30	-0.45	0.98	-0.21	-3.23	-0.53	-5.51	0.08	-5.14
Wool garms	0.06	0.02	0.28	0.06	-3.28	-0.06	-3.55	0.06	-2.79
Synth textiles	0.05	0.05	0.11	0.05	0.01	0.04	0.08	0.05	0.04
Other goods	0.05	0.06	0.13	0.06	-0.01	0.03	0.10	0.05	0.04
					(b) Industry output				
Sheep	0.50	0.41	0.16	0.29	0.07	0.22	-2.13	-2.59	-1.52
Scoured wools	-1.41	-12.46	-11.81	18.50	-51.83	-6.36	-16.82	5.59	-2.92
Carbon wools	101.13	-41.46	50.48	64.16	-72.40	9.04	-19.70	28.06	-21.19
Worsted tops	-7.74	-1.58	-12.87	-25.21	-29.88	-20.25	-23.32	0.13	10.75
Wool yarns	10.93	7.68	21.89	34.75	-74.41	2.31	-28.69	-3.70	-30.74
Wool fabrics	13.37	27.74	43.49	70.83	-75.85	1.56	1.08	-4.32	-40.43
Wool garms	-11.45	-9.26	-11.63	-2.51	1.58	-1.57	4.57	-3.61	5.99
Other indust	0.00	0.00	0.03	0.00	-0.02	0.00	-0.01	-0.02	-0.01
					(c) Domestic sales				
Sheep meat	0.11	0.07	0.14	0.18	0.12	0.22	0.00	-0.10	-0.16
Greasy wools	-7.94	0	0	0.74	-42.28	0.00	-9.69	5.15	-11.14
Scoured wools	-3.10	-12.47	-11.82	26.39	-62.47	-6.36	-17.71	14.83	-12.16
Carbon wools	44.03	-41.59	50.29	173.42	-72.61	9.04	-22.68	-15.39	-46.06
Worsted tops	-19.35	-0.11	-9.84	-24.00	-49.12	-18.79	-29.68	0	-36.62
Noils	-12.54	-3.73	-11.10	1.08	-78.01	-20.53	-43.15	0	-21.84
Wool yarns	2.72	57.60	26.21	71.73	-74.41	2.31	-58.01	-3.70	-77.71
Wool fabrics	-16.74	-24.21	-17.29	-8.70	-81.59	-2.53	-73.12	-4.32	-57.35
Wool garms	-9.70	-4.46	-3.05	-2.76	-0.90	-1.67	-6.84	-3.76	-1.03
Synth textiles	0.01	0.00	0.06	-0.01	-0.02	0.03	-0.03	-0.02	-0.01
Other goods	0.00	0.00	0.05	0.00	-0.03	0.00	0.00	-0.02	-0.01
					(d) Imports				
Sheep meat	-4.09	-3.05	-0.54	-3.81	-6.53	-1.55	-0.32	3.72	3.44
Greasy wools	-1.43	-12.45	-11.81	25.91	-68.80	-6.29	-21.33	0	33.96
Scoured wools	12.47	-2.24	50.37	36.69	-72.84	0.39	-70.63	0	35.77
Carbon wools	34.51	32.06	40.75	157.60	-76.30	-31.65	-72.46	53.54	549.19
Worsted tops	8.95	5.69	11.09	-9.99	-25.82	-7.55	-29.61	-66.27	537.48
Noils	-3.20	-20.64	8.41	233.96	-71.70	3889.38	124.62	-10.21	143.94
Wool yarns	1.90	23.26	25.04	11.97	-63.81	-4.50	96.98	-22.48	0.07
Wool fabrics	-11.41	-10.51	10.00	-4.53	572.60	0	122.99	0	97.58
Wool garms	5.60	4.01	60.23	1.31	6.83	14.77	86.57	13.31	5.92
Synth textiles	0.04	0.05	0.51	0.06	-0.31	-0.07	0.23	0.02	-0.03
Other goods	-0.01	0.01	0.20	0.03	-0.14	-0.03	0.12	-0.02	0.00
					(e) Exports				
Sheep meat	3.07	4.35	4.02	4.23	5.39	1.60	-0.11	-0.38	-4.60
Greasy wools	0	-4.35	-7.50	-1.80	1273.31	-3.26	0.58	-14.65	-2.34
Scoured wools	83.67	-1.48	-7.00	-9.28	5314.12	-1.25	-6.39	-7.54	24.92
Carbon wools	188.46	37.15	166.98	1.30	3128.93	-13.25	30.37	28.95	33.81
Worsted tops	-5.29	68.21	-21.90	-24.60	7.76	-44.87	24.54	2.17	35.83
Noils	-7.32	46.79	-19.33	-46.18	-21.30	1948.67	173.93	-1.03	13.90
Wool yarns	13.27	2.97	4.65	33.28	0	0	37.22	0	94.42
Wool fabrics	33.86	43.75	72.34	88.04	164.77	150.38	416.84	0	397.72
Wool garms	-14.30	-22.33	-19.15	-0.75	73.67	11.11	22.02	4.76	20.39
Synth textiles	-0.01	-0.06	-0.48	-0.09	0.27	0.06	-0.29	0.00	-0.01
Other goods	0.00	-0.03	-0.13	-0.04	0.11	0.02	-0.06	-0.03	-0.01

[a] This is the supply (or basic) price in each region.

The changes in industry output do not show any consistent pattern of relocation of production of wool products from one set of regions to another. This is to be expected as we are implementing observed changes in trade policy for wool products by many countries over the period 1997–2005. The observed changes are a combination of unilateral tariff reductions and the implementation of multilateral and plurilateral trade agreements. As such, the observed tariff reductions, and thus their effects, would not be expected to show any particular pattern of changes in output and trade across regions. Nevertheless, we are able to identify the driving forces behind the largest and most interesting industry effects of the tariff reductions.

The single largest percentage change in industry output is that observed for the carbonising industries in France: these double in size (101%). The doubling of output is partly due to a 44% increase in domestic sales to the domestic yarns industries, which consume around 60% of domestically-produced carbonised wools and whose output expands by 11%, but mainly due to a 188% increase in exports [panel (d), table 6.9]. Table 6.8 [panel (b)] shows that the huge increase in exports is not due to lower tariff barriers on exports of carbonised wools from France. Instead, it is driven by a large fall in the cost of producing carbonised wools in France (–9%; see panel (a), table 6.9)] relative to most other regions. This is, in turn, is driven by a 10% fall in the price of imported scoured wools used by the carbonising industries; imported scoured wools comprises over 90% of total scoured wools inputs by the carbonising industries in France.[5] These imports are sourced from the USA, Japan, China and the ROW, which experience the largest reductions in the price of scoured wools [panel (a)]. This example demonstrates that besides the three forces

[5] Carbonising industries only use the shortest scoured wools as inputs. Thus, the 10% fall in the price of imported scoured wool referred to here is the price of the *shortest* imported scoured wool rather than the price of *all* imported scoured wool. Scoured wools of medium and greater length are only used as inputs by the worsted top industries.

identified earlier as determining the response of a given industry's output to the tariff changes, an industry may expand significantly simply due to cheaper imported wool inputs driven by tariff changes in other regions.

A large effect is also observed for the carbonising industries in the USA, which more than halve in size (–72%). These industries are almost completely domestically oriented and the large reduction in output is driven exclusively by a 72% fall in domestic sales of carbonised wools.[6] Although the import tariff on carbonised wools falls by 42% in the USA [panel (a), table 6.8], the domestic yarns industries, which are the users of carbonised wools, reduce demand for imported carbonised wools by more than for domestic carbonised wools, i.e., –76% versus –72%, indicating that the relative price of imported carbonised wools in the USA *increase*. Thus, despite the significant reduction in the import tariff on carbonised wools, the price of domestic carbonised wools fall by 22% [panel (a), table 6.8] and the price of imported carbonised wools fall by only 6%. The reason for this is the huge contraction observed in the domestic yarns industries in the USA (–74%) who are the only significant consumers of domestically-produced carbonised wools.

What causes the wool yarns industries in the USA to contract by 74%? We note that there is a 26% fall in the tariff on imported wool yarns in the USA. This causes substitution of cheaper imported wool yarns for domestic wool yarns. Nevertheless, demand for both domestic and imported wool yarns falls by 74% and 64%. The only consumers of wool yarns are the wool fabrics industries and these industries contract by 76% in the USA; thus, demand for all wool yarns in the USA falls. As the US wool yarns industries are completely domestically oriented, the huge contraction in the only purchaser

[6] Thus, the 3,129% rise in exports of carbonised wool from the USA [panel (d), table 6.9] are on an almost zero base and are therefore unimportant.

of their outputs (the US wool fabrics industries) drives a similarly huge contraction in their own output.

The largest single reduction in wool tariffs by the USA occurs for wool fabrics (–63%). Thus, imports of wool fabrics into the USA expand nearly five-fold (572%) [panel (d), table 6.9] and domestic sales contract by 82% [panel (c)]. At the same time there is a large reduction in the tariffs faced by exports of wool fabrics from the USA (–59%). Thus, exports of wool fabrics from the USA expand by 165% [panel (e), table 6.9]. As around 98% of the output of the US wool fabrics industries is sold to the domestic wool garments industries, the negative impact of the reduction in import tariffs on wool fabrics dominates the positive impact of the reduction in export barriers, so the output of the US wool fabrics industries contract by 76%.

Large changes are also observed for the carbonised wools industries in Germany (–41%), Italy (50%) and the UK (64%). For Germany, the contraction is driven by the indirect effect of changes in wool tariffs in other regions as tariffs on imports of carbonised wools into Germany do not change and neither do barriers on exports of carbonised wools from Germany. Almost all of the output of the carbonised wools industries in Germany is sold to the domestic wool yarns industries. Thus, the 42% contraction in domestic sales of carbonised wools determines that the output of the carbonised wools industries must also fall by a similar amount (–41%).[7] This reflects substitution of cheaper imported carbonised wools for more expensive domestic carbonised wools; thus, imports of carbonised wools rise by 32%.

For Italy, the 50% expansion in the carbonised wools industries is driven purely by an equivalent 50% expansion in domestic sales to the wool yarns industries. Even though

[7] The 37% rise in exports of carbonised wools from Germany has little effect on the output of these industries as exports comprise less than 1% of sales.

barriers on exports of carbonised wools from Italy fall by 34% and exports increase by 167%, the industry is almost completely domestically oriented and so the strong rise in exports has little effect on output. The strong rise in demand for domestic carbonised wools does not reflect strong substitution away from imports as they rise by 41%; it reflects a strong expansion effect due to a 22% increase in the size of the wool yarns industries.

In the UK the second largest industry expansion is that observed for carbonised wools: 64%. The expansion is driven purely by the indirect effects of tariff changes elsewhere as there is no change in tariffs on imported carbonised wools or on barriers faced by exports of carbonised wools from the UK. The UK carbonised wools industries are export oriented with around two-thirds of their output sold to foreign consumers. Nevertheless, exports only increase marginally (1%) and so make little contribution to the expansion in the output of these industries. In contrast, domestic sales nearly triple (173%) and with around two-thirds of output sold domestically output increases by around 64% (=0.37x173%). Imports of carbonised wools also expand strongly (158%) reflecting a small substitution effect and a strong expansion effect from the *woollen* yarn industries; the woollen yarn industries are the users of carbonised wools whereas *worsted* yarn industries are users of worsted tops; the blended and pure woollen yarn industries expand by 96% and 198% (see rows 23 and 24, table A6.1 in the Appendix). When aggregated across all yarn industries, total yarns output increases by only 35%.

The UK wool yarns industries are almost completely export oriented selling about 96% of their output overseas, so although domestic sales increase by 72%, this has little effect on output. In contrast, the 33% increase in exports almost completely drives the 35% expansion in output (0.96x33%=32%). The large increase in exports of wool yarns from the UK is driven by a 67% fall in export barriers for wool yarns from the UK.

Besides the carbonising and yarns industries, very large changes in output are also observed for wool fabrics industries in Italy (43%), the UK (71%) and the ROW region (–40%). Import tariffs on wool fabrics are reduced by 35% in Italy but export barriers on wool fabrics from Italy are reduced by 61%. Lower import tariffs reduce domestic sales (–17%) and encourage imports (10%). Lower export tariff barriers encourage exports (72%). As the wool yarns industries sell about two-thirds of their output overseas (mainly to Germany and the ROW), the strong rise in exports dominates the fall in domestic sales and drives output upwards by 43%.

The largest single broad industry effect in the UK is that observed for the output of wool fabrics (71%). Similar to Italy, the UK wool fabrics industries suffer from lower tariffs on imports (–35%) and benefit from lower tariffs on exports (–60%). We observe substitution of imported for domestic wool fabrics; imports fall by 5% and domestic sales fall by 9%. The contraction in the UK wool garments industries (–3%) reduces demand for both imported and domestic inputs. At the same time, exports of wool fabrics from the UK expand by 88%. With around four-fifths of UK wool fabrics exported, the strong rise in exports increases domestic output of wool fabrics by 71% ($\approx$0.82x88%).

The final industry effect that is worth understanding in detail is the 40% contraction in ROW wool fabrics industries. These industries experience similar changes in import tariffs and export barriers: –58% and –61%. Imports are substituted for domestic wool fabrics; imports rise by 6% whereas domestic sales fall by 57%. At the same time, exports increase nearly five-fold (398%). The ROW wool fabrics industries are domestically oriented; they sell about two-thirds of their output to the domestic wool garments industries. Thus, although exports rise strongly the fall in domestic sales dominates and output contracts by 40%.

6.3.2.1 Why does allocative efficiency fall in Australia

The reduction in tariff barriers over 1997–2005 would be expected to improve the efficiency with which resources are used in the economy. Earlier we defined allocative efficiency using the variable *qnit*, and we observed that *qnit* rose in all regions except Australia (see row 6, table 6.4). This is a counter-intuitive result that we now explain.

We redefine *qnit* into net (of subsidies) indirect taxes levied on industries, $qnit_j^{IND}$, and net indirect taxes on commodities, $qnit_i^{COM}$, as follows:

$$qnit_j^{IND} = SNITF_j\, qf_j + \sum\nolimits_{i=1}^{3} SNITF_{ij}^{F} qf_{ij}^{F}\ ; \tag{6.3}$$

$$qnit_i^{COM} = \sum\nolimits_{j=1}^{J}\sum\nolimits_{s=1}^{2} SNITF_{ijs}^{I} qf_{ijs}^{I} + \sum\nolimits_{s=1}^{2}\left\{SNITI_{is}qi_{is} + SNITH_{is}qh_{is} + SNITG_{is}qg_{is}\right\} + SNITX_i\, qx_i + SNITM_i\, qm_i\ . \tag{6.4}$$

As before, the *SN*s represent shares and the *q*s represent percentage-change quantity variables. That is, $qnit_j^{IND}$ is defined in terms of the changes in the quantity bases of taxes on industries, i.e., taxes on output and primary factor usage; $qnit_i^{COM}$ is defined in terms of the changes in the quantity bases of taxes on commodities, i.e., taxes on intermediate input usage, inputs to investment, household consumption, government consumption, and exports and imports. We also define concomitant Divisia indices for $qnit_j^{IND}$ and $qnit_i^{COM}$;

$$qnit^{IND} = \sum\nolimits_{j=1}^{J} SNIT_j^{IND} qnit_j^{IND}\ , \tag{6.5}$$

$$qnit^{COM} = \sum\nolimits_{i=1}^{K} SNIT_i^{COM} qnit_i^{COM}\ . \tag{6.6}$$

Table 6.10 presents the values of $qnit_j^{IND}$, $qnit_i^{COM}$, $qnit^{IND}$ and $qnit^{COM}$ for Australia from the simulations.

Table 6.10 Industry and commodity allocative efficiency effects in Australia due to changes in tariff barriers, 1997–2005 (percentage change)

(a) Commodity tax base: $qnit_i^{COM}$		*(b) Industry tax base:* $qnit_j^{IND}$	
Sheep meat	-0.34	Sheep	1.79
Greasy wools	4.27	Scoured wools	-5.20
Scoured wools	28.12	Carbon wools	-21.98
Carbon wools	28.95	Worsted tops	-7.00
Worsted tops	2.17	Wool yarns	-3.41
Noils	-1.03	Wool fabrics	-4.36
Wool yarns	-22.48	Wool garments	-3.62
Wool fabrics	0	Other industries	-0.02
Wool garms	13.15		
Synth textiles	0.00		
Other goods	0.00		
Total: $qnit^{COM}$	0.14	*Total:* $qnit^{IND}$	-0.04

We see from panel (a), table 6.10 that overall allocative efficiency from commodity sales in Australia improves by 0.14%. In contrast, panel (b) indicates that allocative efficiency from industry output falls by 0.04%; this is driven by a fall in allocative efficiency from all industries except the sheep industry. The sheep industry is subsidised in net terms. Thus, when it contracts [see panel (b), table 6.9] it makes a positive contribution to allocative efficiency (1.79%). The early-stage processing industries (i.e., scoured wools, carbonised wools, and worsted tops) all expand from the tariff changes, but these industries are already larger than optimum as they are also subsidised in net terms. Thus, they make a negative contribution to allocative efficiency: –5%, –22% and –7%. All other industries are taxed in net terms (i.e., wool yarns and fabrics, and the other industries composite). Thus, they are smaller than optimum. So when they contract from the tariff changes they make a negative contribution to allocative efficiency: –3%, –4%, –4% and –0.02%. In sum, allocative efficiency falls in Australia because most of the industries that contract are already smaller than optimum and all the industries that expand are already larger than optimum.

6.4 The costs of 2005 wool tariff barriers

Having imposed the changes in wool tariff barriers between 1997 and 2005, we now completely remove 2005 wool tariffs and examine the micro and macroeconomic effects.

6.4.1 Macroeconomic effects

We noted earlier that there are two potential initial effects of tariff reductions. First, wool tariff reductions reduce the price of imported wool products; wool industries will substitute imported wool products for domestic wool products and, *ceteris paribus*, domestic wool industries will contract. The size of this initial effect is indicated by the percentage change in the average indirect tax rate due to the tariff reductions weighted by the share of the indirect taxes in GDP (table 6.11, row 1). For all regions except China, this effect is larger (sometimes up to 10 times larger) here than for the changes in recent (1997–2005) wool tariffs. For China, this effect is slightly smaller here than for recent wool tariffs. This suggests that all regions except China will experience a much larger initial contractionary effect from current (2005) wool tariffs compared to recent wool tariffs.

Table 6.11 Macroeconomic effects of the complete removal of 2005 wool tariff barriers (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
1. Ind tax rate[a]	-0.013	-0.019	-0.011	-0.016	-0.037	-0.009	-0.043	-0.017	-0.040	
2. Exprt tariff[b]	-0.318	-0.748	-4.311	-0.197	-0.071	-0.032	-1.725	-0.193	-0.849	
3. Real GDP	-0.046	-0.064	-0.076	-0.012	-0.040	-0.020	0.048	-0.035	-0.026	**-0.032**
4. Value added	-0.048	-0.068	-0.080	-0.016	-0.046	-0.020	0.014	-0.036	-0.034	**-0.038**
5. Capital stock	-0.095	-0.154	-0.148	-0.044	-0.123	-0.051	0.038	-0.080	-0.075	**-0.091**
6. Ind tax base[c]	-0.034	-0.027	-0.036	0.029	0.133	-0.022	0.203	-0.029	0.042	**0.031**

[a] Indirect tax rate weighted by share of indirect taxes in GDP. [b] Tariff rate faced by exports weighted by share of exports in GDP. [c] This is *qnit* in equation (6.1); see text for explanation.

The second initial effect of wool tariff reductions is increased demand for exports of wool products, which will cause domestic wool industries (in the exporting regions) to expand. A measure of the size of this effect is the percentage change in the average tariff barrier faced by exports weighted by the share of exports in GDP (table 6.11, row 2). Export barriers fall by more for current wool tariffs than for recent wool tariffs; this is as expected given that we are simulating the complete removal of all remaining wool tariff barriers. Nevertheless, for most regions the fall in export barriers for current wool tariffs is only one to two orders of magnitude larger than for recent wool tariffs. Similar to the effects of recent wool tariffs, this measure indicates that Italy and China are expected to experience far and away the strongest increases in export demand, and the USA the smallest.

Globally, the largest tariff barriers in place in 2005 are on wool fabrics (10%) and garments (18%), see table 6.3. For Italy and China, the average import tariff faced by exports of wool fabrics and garments is 15% and 17%. Combined with the large share that wool fabrics and garments comprise in *total* exports for these two regions, i.e., about 5% and 3%, gives Italy and China the strongest increase in export demand from the removal of current wool tariffs. Only Australia has an export pattern that favours wool products to such an extent but this is for raw wool, which comprises about 4% of total exports, and faces an average tariff barrier of only about 2%. Thus Australia is expected to experience one of the smallest increases in exports from the removal of current wool tariffs.

The relative sizes of the two initial effects will largely determine the size of the effects on real GDP effects (table 6.11, row 3). Given that all regions except China experience much larger contractionary effects from cheaper imports, compared to recent wool tariffs, and only slightly larger expansionary effects from lower export barriers, compared to recent wool tariffs, we should expect that most regions should experience less favourable real GDP effects from current wool tariffs than from recent wool tariffs. This is exactly what is observed.

Earlier we defined the percentage change in real GDP (*qgdp*) from the income side as a function of the change in the use of resources in the economy (*qva*) and the change in the efficiency with which resources are used in the economy (*qnit*), i.e.,

$$qgdp = SVAqva + SNITqnit \; ; \qquad (6.7)$$

where *qva* and *qnit* are the percentage changes in real value added and the quantity base upon which net (of subsidies) indirect taxes are levied, and *SVA* and *SNIT* are the shares of value added and net indirect taxes in GDP.

As only capital is variable in the long run, any change in *qva* will be due to a change in capital. The tariff changes cause *qva* to fall in all regions except China (table 6.11, row 4) and this is due to a fall in the use of capital (row 5). The changes in *qva* move in the same way as *qgdp* and by a similar amount in all regions except China; this explains why *qgdp* expands in China and falls in all other regions.

We noted earlier that where the composition of sectoral outputs and sales do not change, *qnit* and *qva* will also move together, as *qnit* is the weighted sum of sales and *qva* is the weighted sum of (net) industry outputs. But the tariff changes induce a change in each economy's production and sales structure. The compositional changes cause *qva* and *qnit* to diverge in all regions (cf. rows 4 and 6), but the differences are small for Japan and Australia indicating small changes in the composition of sectoral outputs and sales. China is the only region where *qgdp* (0.048%) exceeds *qva* (0.014%) and the excess represents a significant allocative efficiency gain (0.203%) from changing the composition of the economy in favour of activities that were discouraged (relative to optimum) in the pre-shock tax regime. A similar compositional change occurs in the UK, USA and ROW where *qnit* also rises. For France, Germany, Italy, Japan and Australia, allocative efficiency falls; so in these regions the tariff changes lead to compositional changes that favour activities that were encouraged (relative to optimum) in the pre-shock tax regime. This is analysed in more detail in section 6.4.2.

6.4.1.1 The capital stock response

Unlike the effects of recent wool tariffs, current wool tariffs cause a consistent pattern of effects upon regional capital stocks (table 6.12, row 1); capital stocks fall everywhere except China. This reflects a rise in the relative price of capital everywhere except China as a response to the tariff reductions (row 2c). A rise in the relative price of capital reflects the contractionary initial effect of the tariff changes, i.e., a contraction in domestic industries (due to substitution of imported wool products for domestic wool products) that, in turn, reduces the demand for primary factors in the economy. This favours the fixed factors (land and labour) and discriminates against the variable factor (capital); the relative price of capital will rise and industries will substitute land and labour for capital. This is what happens in most regions.

Table 6.12 Effects on regional capital stocks and relative primary factor prices of the complete removal of 2005 wool tariff barriers (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW	**World**
1. Capital stock	-0.095	-0.154	-0.148	-0.044	-0.123	-0.051	0.038	-0.080	-0.075	**-0.091**
2. Relative prices										
2a. Land[a]	-0.038	-0.050	-0.026	-0.022	-0.030	-0.002	-0.134	0.089	-0.036	**-0.002**
2b. Labour[a]	-0.035	-0.047	-0.057	-0.009	-0.031	-0.015	0.035	-0.028	-0.034	**-0.030**
2c. Capital[a]	0.035	0.060	0.048	0.016	0.051	0.024	-0.025	0.028	0.042	**0.040**

[a] These are relative prices, i.e., the price of the primary factor deflated by the average price of all primary factors. Here all prices are purchaser's prices.

For China, the contractionary effect of the tariff changes is outweighed by the expansionary effect, i.e., the increase in demand for a region's exports where tariff barriers faced by those exports are lowered. Domestic industries (in the exporting region) will expand in response to increased export demand. In general, expanding domestic industries will increase the demand for primary factors in the economy. *Ceteris paribus*, this will favour the variable factor (capital) and discriminate against the fixed factors (land and capital); the relative price of capital will fall and industries will substitute capital for land and labour. This is what occurs in China.

Thus for most regions the contractionary effect from cheaper imports is greater than the expansionary effect from increased export demand. For China, the contractionary effect is more than offset by the expansionary effect, the relative price of capital falls and the capital stock expands.

6.4.1.2 The trade response

Similar to the effects of recent wool tariffs, the complete removal of current wool tariffs leads to increased imports in all regions (table 6.13, row 2). A rise in imports must be offset by a rise in exports (row 1) as the trade balance to GDP ratio is assumed fixed in all regions. The more that the terms of trade improve (row 3), the less that exports must rise to maintain the trade balance to GDP ratio. The terms of trade improve for France (0.007%), Germany (0.028%), the UK (0.046%), China (0.128%) and Australia (0.083%). For France, the UK and China, exports rise by less than imports due to the terms of trade improvement; for Germany and Australia, the terms of trade of trade improvement is so strong and the increase in imports (0.004% and 0.064%) so small that exports (–0.027% and –0.006%) are able to fall and the initial trade balance to GDP ratio is maintained. The terms of trade deteriorate for Italy (–0.086%), the USA (–0.011%), Japan (–0.073%) and the ROW (–0.001%); thus exports rise by more than imports in all these regions.

Table 6.13 Regional trade effects of the complete removal of 2005 wool tariffs (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
1. Exports	0.013	-0.027	0.338	0.034	0.244	0.162	0.756	-0.006	0.153
2. Imports	0.027	0.004	0.302	0.076	0.188	0.130	0.960	0.064	0.151
3. Terms of trade	0.007	0.028	-0.086	0.046	-0.011	-0.073	0.128	0.083	-0.001
3a. Export price	0.043	0.059	-0.032	0.087	0.029	-0.017	0.158	0.131	0.047
3b. Import price	0.036	0.031	0.054	0.041	0.040	0.056	0.029	0.048	0.048
4. Export tariff[a]	-0.318	-0.748	-4.311	-0.197	-0.071	-0.032	-1.725	-0.193	-0.849
5. GNE	-0.042	-0.055	-0.095	0.001	-0.038	-0.026	0.085	-0.019	-0.024
6. GNE in export destinations[b]	-0.031	-0.028	-0.027	-0.033	-0.023	-0.018	-0.031	-0.022	-0.028
7. Price of value added	0.046	0.067	-0.034	0.092	0.048	-0.025	0.299	0.072	0.081

[a] Tariff rate faced by exports weighted by share of exports in GDP. [b] For a given region, this is GNE in destination regions weighted by export shares.

Similar to the effects of recent wool tariffs, import prices rise in all regions (row 3b, table 6.13) due to substitution of cheaper imported goods for domestic goods. But just like the effects of recent wool tariffs, the variation in import prices across regions is small; from 0.029% (China) to 0.056% (Japan). Export prices also rise in all regions (row 3a) except Italy (–0.032%) and Japan (–0.017%). For all other regions the variation in export prices is larger than that observed for import prices; that is, from 0.029% (USA) to 0.158% (China). This was also observed with recent wool tariffs; so, as before, the differences in terms of trade changes across regions are largely due to the differences in the prices of exports.

The differences in export prices partly reflect the degree to which demand expands for the exports of each region. This is largely a function of the degree to which tariff barriers faced by each region fall (row 4, table 6.13); Germany, Italy, China and the ROW experience the largest such reductions. The differences in export prices also partly reflect the degree to which demand conditions (GNE; row 5) in a region's export destinations (row 6) interact with lower domestic costs (row 7) in the exporting region. So, export prices for Italy and Japan fall due to a combination of reduced GNE in export destinations and lower domestic costs, despite the reductions in tariff barriers faced by their exports; all other regions experience higher domestic costs. The fall in Italy's export prices (–0.032%) is twice that of Japan's (–0.017%) as GNE in export destinations and domestic costs fall by more in Italy that in Japan.

For China, the strong export price rise (0.158%) reflects a strong rise in domestic costs (0.299%), more than three times that of any other region. Similar to recent wool tariffs, Australia experiences the second largest export price rise (0.131%). Australia experiences a small fall in export barriers (–0.193%) relative to other regions, a noticeable rise in domestic costs (0.072%), and a relatively weak fall in GNE in export destinations (0.022%) due to a strong trade orientation China, which experiences the only noticeable rise in GNE (0.085%).

6.4.1.3 Welfare effects

The welfare effects of recent tariff changes generally diverged from the real GDP effects. For current wool tariffs, this pattern is reversed; real household income (row 5, table 6.14) moves in the same direction as real GDP effect (row 6) in all regions except the UK. Nevertheless, the real income gain in the UK (0.002%) is only slightly positive compared with the 0.012% fall in real GDP. Not only do the signs of the welfare effects reflect the real GDP effects for most regions, but the sizes of the changes are also similar for all regions except Italy, China and ROW. For Italy and China, the absolute size of the welfare effect is larger (–0.109% and 0.099%) than the absolute size of the real GDP effect (–0.076% and 0.048%). For the ROW, the welfare effect (–0.013%) is half that of the real GDP effect (–0.026%).

Table 6.14 Regional welfare effects of the complete removal of 2005 wool tariffs (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
1. Factor income[a]	-0.001	-0.001	-0.114	0.077	0.002	-0.045	0.313	0.036	0.047
1a. Land inc[a]	0.016	0.022	-0.060	0.072	0.011	-0.026	0.164	0.173	0.044
1b. Labour inc[a]	0.011	0.020	-0.091	0.084	0.017	-0.040	0.334	0.044	0.047
1c. Capital inc[a]	-0.014	-0.027	-0.134	0.065	-0.023	-0.052	0.311	0.020	0.048
2. Income tax rate	0.086	0.078	0.079	0.113	0.207	0.123	2.790	0.175	0.354
3. Disp income[b]	-0.037	-0.058	-0.146	0.049	-0.051	-0.057	0.263	0.002	-0.009
4. CPI	0.014	0.017	-0.037	0.047	-0.011	-0.033	0.163	0.035	0.004
5. Real income[c]	-0.051	-0.075	-0.109	0.002	-0.040	-0.024	0.099	-0.033	-0.013
5a. US$ million	-431	-800	-778	15	-2549	-796	746	-102	-937
6. Real GDP	-0.046	-0.064	-0.076	-0.012	-0.040	-0.020	0.048	-0.035	-0.026

[a] These are pre-tax nominal variables. [b] This is post-tax nominal household factor income. [c] This is post-tax nominal household factor income (row 3) minus the consumer price index (row 4).

The income tax rate (row 2, table 6.14) rises in all regions in response to the complete removal of 2005 wool tariffs. The largest rises are in regions where there is a large fall in the indirect tax rate (weighted by the share of indirect taxes in GDP) (row 1, table 6.11) and the direct tax base is relatively small.[8] For instance, the USA, China and ROW all experience similar reductions in the (weighted) indirect tax rate (–0.037%, –0.043% and –0.04%), but the income tax rate rises least in the USA (0.207%) and most in China and ROW (2.79% and 0.354%). And this is in spite of the fact that the economy (real GDP) shrinks by more in the US (–0.4%) than in ROW (–0.026%) and grows in China (0.048%). China and ROW, like most developing regions, have a smaller direct tax base upon which to replace the indirect revenue lost due to the tariff reductions, e.g., the share of direct taxes in GDP is 2% for China and 12% for ROW. In contrast, the same share is 20% for the USA.

[8] Note that the government budget position is fixed and the income tax rate is variable in the long run; therefore any pressure on government revenue from lower import taxes is accommodated by the income tax rate adjusting upwards.

The rise in income tax rates is large enough to reduce nominal household disposable income (row 3) in all but three regions: the UK (0.049%), China (0.263%) and Australia (0.002%). The consumer price index (row 4) rises in all these regions but by less than disposable income in the UK and China so that real household income rises by 0.002% and 0.099%, whereas in Australia the consumer price index rises significantly (0.035%) thus reducing real income by 0.033%. Consequently, the UK and China are the only gainers from the complete removal of 2005 wool tariffs; the gains are worth $15 and $746 million annually in 1997 US dollars. Both of these regions also gain from changes in recent wool tariffs. The single biggest loser from the removal of current wool tariffs is Italy, which suffers a real income decline of 0.109% or $US 778 million annually. This contrasts strongly with a gain of 0.094% or $US 672 million from changes in recent wool tariffs.

6.4.2 Microeconomic effects

The complete removal of 2005 wool tariffs provides two countervailing forces on a given industry's output. One, the contractionary effect from the degree to which the price of competing imports falls due to lower tariffs; this depends on the size of the initial import tariff [panel (a), table 6.15].[9] Two, the expansionary effect from the degree to which the tariff barriers it faces in export markets fall [panel (b)].[10]

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[9] These are the actual rates from the model database *after* the changes in wool tariffs between 1997 and 2005 have been imposed. At the level of aggregation presented in table 6.15, these rates differ from the 2005 rates presented in table 6.3 in two ways. First, the regional import shares used to calculate the averages in table 6.15 are based on the 2005 (post-shock) model database, whereas those in table 6.3 are based on the 1997 (pre-shock) model database. The two sets of shares differ due to the effects of the changes in wool tariffs between 1997 and 2005. Regardless, at the 56 commodity level the rates in table 6.15 correspond exactly with those in table 6.3. Second, the rates for raw wool (i.e., greasy wool, scoured wool, carbonised wool, worsted tops, and noils) by China in table 6.15 are the same as the 1997 rates presented in table 6.3, as the increases calculated between 1997 and 2005 have not been imposed, see p. 215.

[10] In Section 6.3.2 we also mentioned that changes in the relative price of the primary factor used most intensively as influencing changes in industry output. As was observed for changes in wool tariffs between 1997 and 2005, the changes in relative prices from 2005 wool tariffs do not cause large changes in relative primary factor prices. Thus, we do not discuss these changes here.

Table 6.15 2005 wool import and export tariff barriers (per cent)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
					(a) Import tariff barriers				
Greasy wools	0	0	0	0	18.7	0	9.0	0	1.2
Scourd wools	0	0	0	0	18.7	0	9.0	0	1.2
Carbon wools	1.9	1.6	2.0	1.1	6.9	0	10.0	0	3.7
Worsted tops	1.9	1.7	1.5	1.1	6.9	0	10.0	0	3.7
Noils	1.8	1.2	1.8	1.9	6.9	0	10.0	0	3.7
Wool yarns	0.6	1.0	0.7	0.6	6.0	2.7	5.0	5.0	10.1
Wool fabrics	0.6	0.9	2.8	1.7	25.0	0	10.0	0	14.7
Wool garms	7.9	8.6	10.7	8.3	25.1	10.6	15.6	17.5	24.2
					(b) Export tariff barriers				
Greasy wools	0	9.0	11.6	7.5	0	0	0.7	2.7	3.8
Scourd wools	0.3	0.0	0.0	0.2	0	0	0.9	1.5	0.4
Carbon wools	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.1	2.1
Worsted tops	0.2	0.5	0.3	0.7	2.0	3.1	2.6	2.4	2.1
Noils	0.0	0.0	0	4.8	2.0	2.0	2.0	2.0	1.9
Wool yarns	2.5	5.6	4.8	4.2	0	0	6.9	0	5.0
Wool fabrics	10.6	11.8	14.5	14.2	13.4	12.1	16.7	0	14.5
Wool garms	17.2	19.3	14.7	19.6	21.9	17.1	16.9	19.8	20.4

The changes in industry output [panel (b), table 6.16] show a general pattern; wool industries in China either expand or are largely unaffected whereas wool industries everywhere else generally contract. This contrasts with the effects of changes in wool tariffs between 1997 and 2005 that showed extreme and divergent changes in industry output across regions. Except for the sheep and wool garments industries, all wool industries in China expand by between 35% and 62%. The sheep industry contracts slightly by –0.5% and the wool garments industries expand by 9%. Wool industries generally contract in other regions but there are exceptions; significant exceptions are the carbonising industries in France (19%), the UK wool garments industries (24%), and the scoured wools (64%) and worsted tops (343%) industries in the US.

The general expansion in wool industries in China represents a unique interaction between the effects of cheaper imported wool inputs due to the removal of tariffs and increased export sales due to lower export barriers. This is reflected in the fact that domestic sales, imports and exports expand for most of the wool industries in China; thus, scale effects drive the expansions in these industries. Tariffs on raw wool in China are reduced from an initial rate of around 10%;[11] thus imports of all types of raw wool except noils expand strongly by between 117% and 202%. At the same time, domestic sales of all types of raw wool except greasy wools also increase by between 25% and 50%. Thus, imports improve their market shares as substitution of imported for domestic raw wool occurs. At the same time, exports of all forms of raw wool also expand strongly by between 42% and 223%; but this is not a reflection of the removal of significant exports barriers as they only range between 0.7% and 2.6%.

Increased raw wool exports from China reflects lower domestic prices due to cheaper imported wool inputs. Thus, the prices of all raw wool products in China fall relative to most other regions [panel (a), table 6.16]. Although increased exports helps drive the expansion in output by the raw wool industries in China, it is not the dominant effect as these industries are not, in general, export oriented. The main contributor to increased output is higher domestic sales to upstream industries, that is, wool yarns, fabrics and garments, which expand by 36%, 47% and 9%. The expansion in these industries is purely due to increased exports of 66%, 78% and 22%, reflecting lower domestic prices relative to most other regions. The wool yarns, fabrics and garments industries in China are heavily export oriented, exporting 59%, 77% and 46% of their output. These industries benefit from cheaper domestic and imported wool inputs due to the removal of import tariffs. They also benefit from the removal of significant export barriers, e.g., 7% for wool yarns and 17% for wool fabrics and garments.

[11] That is, greasy, scoured and carbonised wool, worsted tops, and noils.

Table 6.16 Selected industry and commodity effects due to the complete removal of 2005 wool tariff barriers (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
(a) Commodity price[a]									
Sheep meat	0.02	0.01	-0.03	0.06	0.05	0.01	0.30	-0.06	-0.08
Greasy wools	-1.42	5.31	5.71	2.70	-7.62	-1.73	-1.09	0.73	2.45
Scoured wools	0.29	0.74	0.53	1.22	-10.96	0.42	-4.74	0.48	2.04
Carbon wools	-3.05	0.73	3.10	1.81	-4.84	0.10	-3.83	1.36	2.21
Worsted tops	-0.96	0.97	0.41	-5.26	-12.54	-1.09	-5.18	-1.47	-0.89
Noils	-0.20	9.73	1.94	10.23	-10.61	18.49	-1.45	7.92	1.95
Wool yarns	-1.60	-0.51	0.16	-0.40	-2.50	2.58	-2.29	0.94	-0.80
Wool fabrics	-0.68	-0.98	-0.23	-0.12	-0.97	0.43	-2.66	0.01	-3.25
Wool garms	-0.38	-0.54	-0.48	-0.28	-3.98	0.06	-2.01	0.06	-2.84
Synth textiles	0.07	0.08	0.02	0.08	0.06	0.05	0.17	0.08	0.08
Other goods	0.05	0.06	-0.02	0.09	0.05	-0.02	0.24	0.07	0.07
(b) Industry output									
Sheep	-0.23	-0.20	0.02	-0.14	-0.12	0.04	-0.51	0.69	0.50
Scoured wools	-33.86	-43.01	-39.37	-13.19	63.60	-33.14	62.65	-3.91	-7.51
Carbon wools	19.25	-49.06	-11.50	-4.57	-71.62	-11.68	54.54	0.46	-2.56
Worsted tops	-34.65	-38.40	-40.03	-29.88	343.38	-46.50	48.36	-8.39	7.21
Wool yarns	6.45	5.16	-1.21	0.62	-58.93	-18.75	35.95	-15.71	6.26
Wool fabrics	-5.77	5.80	5.02	6.97	-57.71	-5.54	47.43	-3.16	-19.82
Wool garms	-16.13	-11.98	-10.21	24.38	0.72	-4.65	9.33	-2.90	7.27
Other indust	-0.04	-0.06	-0.04	-0.03	-0.04	0.00	-0.06	-0.03	-0.05
(c) Domestic sales									
Sheep meat	-0.06	-0.08	0.02	-0.11	-0.09	0.04	-0.02	-0.01	0.02
Greasy wools	-2.21	0	0	2.84	-11.26	0	-6.93	-3.58	-8.42
Scoured wools	-38.95	-43.01	-39.36	-7.48	39.41	-33.14	50.44	-3.16	-2.25
Carbon wools	12.49	-49.27	-11.48	3.85	-73.18	-11.68	37.23	-28.44	-16.82
Worsted tops	-41.13	-39.00	-39.37	-35.64	99.02	-47.36	25.78	0	-5.18
Noils	-27.79	-36.93	-42.12	-34.26	-61.06	-47.62	37.20	0	-4.34
Wool yarns	-13.33	-0.29	-3.11	-7.55	-58.93	-18.75	-6.61	-15.71	-75.33
Wool fabrics	-36.54	-45.70	-24.43	-15.40	-95.64	-7.16	-56.08	-3.16	-74.48
Wool garms	-35.21	-8.52	-14.24	-7.72	-7.01	-4.62	-1.91	-6.17	-5.82
Synth textiles	0.00	-0.02	-0.03	-0.03	-0.02	0.07	-0.11	-0.03	-0.03
Other goods	-0.04	-0.06	-0.07	-0.02	-0.05	-0.01	-0.04	-0.03	-0.04
(d) Imports									
Sheep meat	1.11	0.82	-0.48	1.75	2.16	-0.29	6.99	-0.67	-1.29
Greasy wools	-33.91	-43.00	-39.37	-18.91	256.98	-33.07	116.68	0	-4.64
Scoured wools	-16.82	-33.41	-11.45	-15.72	277.93	15.50	141.48	0	21.36
Carbon wools	30.50	11.28	6.67	19.38	-82.04	11.35	202.44	15.41	97.36
Worsted tops	7.73	13.36	0.44	9.34	22.10	-48.98	135.88	-72.30	69.58
Noils	24.77	109.23	3.06	2.24	-74.55	80.01	-22.84	-16.56	19.39
Wool yarns	-16.28	9.65	9.65	-0.20	76.85	55.04	42.15	107.23	8.66
Wool fabrics	-11.43	-11.21	34.83	32.21	25.09	0	24.08	0	36.67
Wool garms	21.52	10.69	187.49	6.89	21.32	38.57	22.24	19.22	22.23
Synth textiles	-0.06	0.01	-0.46	0.00	-0.19	-0.38	0.65	-0.07	-0.07
Other goods	-0.09	-0.09	-0.25	0.02	-0.09	-0.21	0.33	-0.04	-0.01
(e) Exports									
Sheep meat	-1.27	-1.46	-0.49	-1.97	-1.76	0.49	-6.58	-0.49	1.46
Greasy wools	0	7.18	8.02	196.53	250.89	-2.36	42.48	9.23	30.69
Scoured wools	107.40	-44.40	-44.82	-41.70	151.00	-44.40	189.11	-5.24	-18.70
Carbon wools	24.44	5.12	-16.76	-17.41	131.76	15.22	223.32	0.85	9.92
Worsted tops	-33.47	-24.39	-41.85	-18.89	555.58	-2.32	157.69	-9.02	11.71
Noils	-34.57	-12.99	-26.76	-37.04	354.80	-89.50	61.96	-7.72	4.54
Wool yarns	11.61	5.91	8.12	1.05	0	0	65.71	0	31.55
Wool fabrics	7.24	14.14	11.63	9.32	53.03	17.52	77.69	0	101.81
Wool garms	16.76	-23.64	-5.99	247.14	133.51	-7.48	22.36	169.99	29.74
Synth textiles	0.01	-0.04	0.42	-0.06	0.10	0.37	-0.79	0.01	-0.03
Other goods	-0.01	-0.04	0.16	-0.10	0.01	0.15	-0.30	-0.05	-0.05

[a] This is the supply (or basic) price in each region.

In percentage-change terms, the largest changes in wool industry output are observed in the USA; this is similar to what is observed for the changes in wool tariffs over 1997–2005. Most US wool industries contract significantly from the complete removal of 2005 wool tariffs as the initial tariffs are significant for all wool industries: 19% for greasy and scoured wools; 7% for carbonised wools, worsted tops and noils; 6% for yarns; 25% for wool fabrics and garments. Thus, large increases in imports and large decreases in domestic sales are observed for most wool products. On the export side, the only significant barriers are those on wool fabrics (13%) and wool garments (22%) and the removal of these increases exports by 53% and 134%. Nevertheless, the wool fabrics and garments industries are not export oriented and hence the large increases in exports do not offset the fall in domestic sales: –96% for wool fabrics and –7% for wool garments. The result is a 58% contraction in the output of the wool fabrics industries and a 0.7% expansion in the output of the wool garments industries.

For the four European regions, the complete removal of current wool tariffs generally leads to contractions in wool industries. Comparing 2005 import tariffs with export barriers (table 6.15) we see that import tariffs are larger than export barriers from most types of raw wool. Thus, the industries producing these products (sheep, scouring, carbonising and worsted tops) tend to contract [table 6.16, panel (b)]. For industries in this set that are domestically oriented (e.g., sheep and scoured wools in France, all raw wool producing industries in Germany, Italy and the UK), lower output is driven mainly by lower domestic sales [panel (c)] that tend to be replaced by increased imports [panel (d)]. For industries in this set that are export oriented, the export response dominates the output response: carbonised wools industries in France export 24% more and output increases by 19%, worsted tops industries in France export around 34% less and output falls by 34%.

Most European wool fabrics and yarns industries experience small output expansions. They benefit from increased exports but lose from lower domestic sales that are replaced by imports. Almost all industries in this set are export oriented and the removal of significant export barriers benefits them more than the removal of less significant import tariffs. The relative significance of import and export barriers for the wool garments industries in Europe is similar to that for wool fabrics; export barriers are much more significant than import barriers. But, surprisingly, all of these industries experience significant contractions except in the UK. The removal of import tariffs decreases domestic sales and increases imports. All of these industries are domestically oriented and reduced domestic sales drives output lower for all of them except in the UK. Exports of wool garments from the UK rise by 247% and this huge increase leads to an output expansion of 24%. Exports of wool garments from Germany and Italy fall (24% and 6%) and rise from France (17%).

The divergent response of exports of wool garments across the European regions reflects divergent export responses across the 12 individual garment types (table 6.17). The export response of wool garments by these regions is dominated by men's woollen woven garments (rows 7 and 9). Regardless of the enormous increase in exports of these two garment types from all four European regions, the overall effect on total wool garments exports is negative for Germany and Italy and positive for France and the UK. For France and the UK, these two garment types represent 27% and 22% of total wool garments exports; for Germany and Italy, these two garment types represent less than 1% of total wool garments exports.

Table 6.17 Export effects on European regions due to the complete removal of 2005 wool tariff barriers (percentage change)

	France	Germ	Italy	UK
1. Men's worsted blend woven garments	-28.49	-27.73	-31.52	-29.74
2. Women's worsted blend woven garments	-29.73	-29.68	-31.05	-31.31
3. Men's worsted pure woven garments	-36.66	-33.45	-34.71	-35.02
4. Women's worsted pure woven garments	-17.74	-15.63	-15.38	-17.69
5. Men's worsted knitted garments	0.00	18.74	6.68	4.30
6. Women's worsted knitted garments	-9.64	-13.35	-12.90	-21.34
7. Men's woollen blend woven garments	1145.60	497.60	1635.02	1189.74
8. Women's woollen blend woven garments	-7.31	-2.58	-16.19	-5.10
9. Men's woollen pure woven garments	1101.11	483.68	1858.58	1168.20
10. Women's woollen pure woven garments	-13.22	-12.48	-8.58	-12.72
11. Woollen knitted blend garments	-8.33	-6.67	-14.55	-9.33
12. Woollen knitted pure garments	-12.01	-12.81	-19.41	-13.60

The export response observed for men's woollen woven garments in the European regions is reflective of the export response in other regions; this is driven, in the main, by the huge increase in imports of these goods by the USA and the ROW. The US places specific as well as *ad valorem* duties on men's wool garments (see Chapter 4, Section 4.3.2.1), thus the total *ad valorem* rate is much higher than for other wool garments. The complete removal of wool import tariffs reduces the relative price of imports of men's wool garments by much more than for other wool garments. Further, men's woollen woven garments are predominantly produced domestically in most regions. So the complete removal of existing wool tariffs places little downward pressure on the domestic price of these products and leads to a large fall in the relative price of imports; a large substitution effect results. Although the large expansion in imports of men's woollen woven garments by the USA and ROW explains the divergent export responses for wool garments across the European regions, the increased imports by all regions is on a small initial flow and is therefore not significant.

6.4.2.1 Allocative efficiency losses in France, Germany, Italy, Japan and Australia

The reduction in recent wool tariffs improves the efficiency with which resources are used in the economies of all regions except Australia. The complete removal of current wool tariffs reduces allocative efficiency in four regions: France, Germany, Italy, Japan and Australia (see table 6.11, row 6). In section 6.3.2.1 we decomposed the allocative efficiency variable *qnit* into commodity and industry effects; the results of the decomposition for the complete removal of current tariff barriers are presented in table 6.18.

Table 6.18 Industry and commodity allocative efficiency effects of the complete removal of 2005 wool tariff barriers (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
					(a) Commodity tax base: $qnit_i^{COM}$				
Sheep meat	0.01	1.18	0.22	1.64	0.12	-0.32	7.44	-0.47	-0.75
Greasy wools	0	0	0	0	187.55	-2.36	116.64	12.98	26.74
Scoured wools	0	0	0	0	-234.06	-44.40	142.89	-22.11	-13.24
Carbon wools	32.12	12.34	6.74	46.62	-82.05	15.22	202.46	0.85	23.82
Worsted tops	9.52	24.22	10.03	63.37	22.26	-2.32	136.13	-9.02	31.07
Noils	30.04	226.98	5.43	3.13	-74.62	-89.51	-22.56	-7.72	13.72
Wool yarns	12.55	48.99	53.15	44.85	77.28	54.69	68.57	107.25	8.36
Wool fabrics	198.77	179.67	159.73	214.35	25.43	17.52	49.53	0	40.12
Wool garms	15.21	9.22	12.26	33.51	11.59	6.86	11.72	17.91	12.28
Synth textiles	-0.04	0.00	-0.37	0.00	-0.13	-0.20	0.41	-0.12	-0.07
Other goods	-0.06	-0.06	-0.09	-0.01	-0.02	-0.05	0.29	-0.03	-0.03
Total: $qnit^{COM}$	-0.02	-0.02	-0.02	0.06	0.11	-0.01	0.89	-0.01	0.07
					(b) Industry tax base: $qnit_j^{IND}$				
Sheep	0.25	0.24	0.00	0.15	0.09	-0.05	-0.61	-0.44	-4.85
Scoured wools	-39.12	-51.49	-39.47	15.79	-50.10	-408.71	116.70	3.52	-10.40
Carbon wools	-17.43	-1.17	-11.82	1.71	55.52	13.49	70.89	-1.70	-4.62
Worsted tops	-34.41	-32.44	-42.95	23.89	469.56	-54.63	48.90	-7.37	2.47
Wool yarns	11.36	17.77	-0.20	-0.51	169.74	-18.53	36.47	-16.15	-414.36
Wool fabrics	-5.72	78.61	5.31	6.79	-72.82	-5.58	47.22	-3.28	-20.61
Wool garms	-16.52	-40.57	-10.44	23.98	-46.55	-4.66	11.02	-2.91	7.64
Other indust	-0.04	-0.10	0.03	-0.03	0.01	0.00	-0.06	-0.03	-0.05
Total: $qnit^{IND}$	-0.08	-0.59	0.14	-0.02	-0.09	-0.03	0.02	-0.07	-0.03

For Australia, the allocative efficiency effects of changes in industry output from current wool tariffs are almost a mirror image of the effects from recent wool tariffs; allocative efficiency from industry output falls (–0.07%) in Australia because most of the industries that contract are already smaller than optimum and all the industries that expand (i.e., sheep and carbonised wools) are already larger than optimum. Nevertheless, allocative efficiency from commodity sales also falls marginally by –0.01%. Allocative efficiency improves from increased exports of greasy wools and increased imports of wool garments (both taxed commodities). But these gains are more than offset by reduced domestic and overseas sales of scoured wools, reduced exports of noils and reduced sales of the other goods composite due to the general contraction in economic activity in Australia.

The allocative efficiency losses in France, Germany and Japan are driven by a pattern similar to that observed for Australia; allocative efficiency falls from both commodity sales and industry output but the effects of industry output dominate. In France, the fall in efficiency is mainly due to large reductions in industries that a relatively highly taxed – worsted tops, wool garments and other industries – and are relatively large. In Germany, the loss is due to the 38% contraction in the worsted tops industries and the small contraction (–0.06%) in the other industries. For Japan, the loss is driven in large part by the contraction (–4.7%) in the wool garments industries that, although relatively lightly taxed, represent the largest wool industries in Japan.

The allocative efficiency loss in Italy is unique in that it is purely driven by the change in the composition of commodity sales. Wool garments are the most highly taxed imports in Italy and increase by 188% when 2005 wool tariffs are completely removed. This significantly improves efficiency (12%). But this improvement is more than offset by reduced sales of other goods (–0.06%) – this figure includes imports as well domestically-produced other goods. In overall terms, other goods are the most highly taxed goods in Italy and the contraction of sales strongly reduces efficiency as sales of these goods are already smaller than optimum.

6.5 Sensitivity analysis

It is appropriate to investigate the sensitivity of the model results with respect to key parameters so as to assess the robustness of the results. There are many endogenous variables upon which we could focus the sensitivity analysis. To keep the analysis manageable, we focus on regional welfare as it summarises the overall effect for each region. The sensitivity analysis consists of calculating means and standard deviations for the welfare effects with respect to five key parameters (elasticities): factor substitution, intermediate input substitution, import-domestic substitution, import source substitution, and output transformation. This is done using the systematic sensitivity analysis facility available in GEMPACK (Arndt and Pearson 1996).

Table 6.19 presents the mean and standard deviations for regional welfare with respect to systematic variation in parameters. In calculating means and standard deviations, the industry/commodity dimension of each parameter value is varied together whereas the regional dimension is varied independently.[12] So the results concentrate on the sensitivity of the assumed parameter values across regions, providing information on the true range of regional welfare effects.

For recent wool tariffs (panel a), the welfare effects are robust for four regions: Italy, UK, China and Australia. For these regions, the standard deviations are small relative to the mean indicating that (i) the sign of welfare estimate is not sensitive to variations in parameter values, and (ii) the size of the welfare estimate is only slightly sensitive to variations in parameter values. Thus, we can be highly confident in the estimated welfare effects for these regions; i.e., we can be highly confident that Italy and China are the

[12] So, for instance, in testing the sensitivity of the factor substitution elasticities (table 6.19, column 2), we vary the parameter values together for all industries in a given region by ± 50% while maintaining the size of the same values in all other regions. This requires running 18 (=2x9 regions) simulations.

biggest winners from changes in recent wool tariffs, the UK is a small gainer and that Australia is the biggest loser.

Table 6.19 Mean and standard deviation of regional welfare with respect to various model parameters (percentage change)

	Mean	Factor substitution	Intermediate input substitution	Import-domestic substitution	Import source substitution	Output transformation
	(1)	(2)	(3)	(4)	(5)	(6)
			(a) Change in recent wool tariffs: 1997–2005			
France	0.000	0.001	0.001	0.002	0.002	0.000
Germany	0.003	0.003	0.001	0.002	0.002	0.000
Italy	0.094	0.009	0.007	0.017	0.017	0.001
UK	0.017	0.001	0.000	0.001	0.001	0.000
USA	-0.016	0.007	0.000	0.004	0.004	0.000
Japan	0.002	0.001	0.000	0.001	0.001	0.000
China	0.092	0.000	0.001	0.012	0.012	0.001
Australia	-0.040	0.006	0.001	0.011	0.011	0.003
ROW	-0.005	0.003	0.000	0.002	0.002	0.000
			(b) Complete removal of 2005 wool tariffs			
France	-0.051	0.009	0.000	0.003	0.003	0.000
Germany	-0.075	0.034	0.000	0.001	0.001	0.000
Italy	-0.109	0.012	0.001	0.019	0.019	0.000
UK	0.002	0.003	0.000	0.005	0.005	0.000
USA	-0.040	0.009	0.000	0.003	0.003	0.000
Japan	-0.024	0.005	0.000	0.001	0.001	0.000
China	0.099	0.002	0.000	0.004	0.004	0.000
Australia	-0.051	0.007	0.001	0.005	0.005	0.001
ROW	-0.075	0.008	0.000	0.002	0.002	0.000

The standard deviations for France, Germany and Japan indicate that the sign of the estimated welfare effects are not robust; the welfare effects could be either negative or positive depending on the chosen parameter values. Nevertheless, the mean welfare effects for these regions are close to zero and the size of the standard deviations confirm that variations in parameter values would still provide welfare estimates of close to zero. For the USA and ROW, the welfare estimates are somewhat robust; the welfare effects for these regions are sensitive to factor substitution and Armington parameters but insensitive to other elasticities.

For 2005 wool tariffs [panel (b), table 6.19], the size and sign of the 0.1% welfare gain for China is robust, i.e., we can be highly confident that China is the biggest gainer from the complete removal of 2005 wool tariffs. The sign of the welfare effect for Italy is robust but the size is less so; the –0.1% loss for Italy is somewhat sensitive to factor substitution and Armington parameter values. The other major losers from the removal of 2005 wool tariffs, Germany and ROW (–0.08%), have varying sensitivities to parameter values. Germany's welfare loss is very sensitive to factor substitution elasticities but invariant to other elasticities, whereas the ROW's welfare loss is insensitive to all elasticity values. The sensitivity results for Italy, Germany and Japan suggest that we can highly confident that these regions are the largest losers from the removal of 2005 wool tariffs, and that the individual losses are highly likely to be similar.

For the UK, the standard deviations indicate that the small welfare gain (0.002%) predicted by the benchmark scenario is not robust and could be negative, depending on the chosen parameter values. Regardless, the size of the welfare effect is insensitive to parameter choices. For the other losing regions – France, USA, Japan and Australia – the standard deviations indicate that while the size of the loss may be sensitive to parameter values, the sign is insensitive and these regions would likely lose under a wide range of parameter values.

6.6 Discussion

Our estimates of the effects tariffs on wool products indicate that, in general, the economy-wide effects are small (see rows 1 and 4, table 6.20). But for some regions the real income effects are comparable to recent estimates of the real income effects of an OECD-based trade agreement including agriculture, manufacturing and services (Francois et al. 2005).[13] The largest real income effects of our simulations approach 0.1% in absolute terms (rows 2 and 5); i.e., Italy and China for recent wool tariffs and Germany, Italy and China for current wool tariffs. For China, the absolute size of our estimates are comparable to those by Francois et al. (2005) for an OECD-based trade round estimate where China is expected to suffer a real income loss in the order of 0.1% (see table 9, p.374). Francois et al. (2005) also estimate a gain of 0.5% for Germany and 0.4% for the 'Rest of EU 15' (a region including Italy). Our estimates indicate that wool tariffs have between one-quarter and one-fifth of the effect on real income of an OECD-based trade round for these regions.

Table 6.20 Various regional effects of wool tariff liberalisation scenarios (percentage change)

	France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
	(a) Change in recent wool tariffs: 1997–2005								
1. Real GDP	-0.001	-0.000	0.065	0.006	-0.015	-0.001	0.062	-0.029	-0.003
2. Real income	0.000	0.003	0.094	0.017	-0.016	0.002	0.092	-0.040	-0.005
3. Value added									
3a. Wool inds	-2.355	-0.990	3.264	3.141	-6.194	-1.147	0.960	-1.157	-0.499
3b. Other inds	0.000	-0.004	0.026	-0.003	-0.019	0.002	-0.006	-0.024	-0.013
	(b) Complete removal of 2005 wool tariffs								
4. Real GDP	-0.046	-0.064	-0.076	-0.012	-0.040	-0.020	0.048	-0.035	-0.026
5. Real income	-0.051	-0.075	-0.109	0.002	-0.040	-0.024	0.099	-0.033	-0.013
6. Value added									
6a. Wool inds	-5.450	-5.039	-4.383	5.823	-0.674	-5.564	12.818	-0.495	3.575
6b. Other inds	-0.038	-0.061	-0.040	-0.027	-0.045	-0.003	-0.064	-0.032	-0.046

An interesting feature of the effects of recent wool tariffs is that there is no general pattern to the effects on the wool and nonwool economies (rows 3a and 3b, table 6.20) in each region. For Italy, the wool and nonwool economies expand; for China, the wool economy expands but the nonwool economy contracts; for Germany, the USA, Australia and the ROW, both the wool and nonwool economies contract; for France and Japan, the nonwool economy expands at the expense of the wool economy. In contrast, current wool

[13] This experiment is regarded as realistic by the authors. It involves no actual liberalisation by developing countries and only involves a 50% reduction in all trade protection measures for agriculture, manufactures and services by OECD countries (see pp. 366–7).

tariffs reduce the size of both the wool and nonwool economies in most regions (rows 6a and 6b). The exceptions are the UK, China and the ROW where the wool economies expand at the expense of the nonwool economies.

Italy and China experience the largest positive effects on real GDP from recent wool tariffs. For Italy, recent wool tariffs provide almost no initial contractionary effect from lower import tariffs but provide the largest (relative to other regions) initial expansionary effect from lower tariff barriers on exports. The result is a fall in relative price of capital and an expansion in the capital stock. For China, the initial contractionary effect is comparable to the initial expansionary effect so that the capital stock does not change. But the improvement in allocative efficiency from the tariff changes is so large that it increases real GDP by a similar amount to that observed in Italy. The largest reductions in real GDP are observed for Australia and the USA. The USA experiences a large contractionary effect from lower import tariffs and a small expansionary effect from lower tariff barriers on exports, thus the relative price of capital rises and the capital stock falls significantly. Australia is the only region where allocative efficiency falls due to the tariff changes. Allocative efficiency falls because most of the industries that contract due to the tariff changes are already smaller than optimum and all the industries that expand are already larger than optimum.

The set of regions that experience the largest (absolute) real GDP effects from recent wool tariffs are the same set of regions that experience the largest (absolute) real income effects; Italy, China and Australia. But the real income effects are greater in absolute size than the real GDP effects for this set of regions and the reason differs for each region. Italy's expanding economy increases the indirect tax base to such an extent that the government budget position can be maintained with a reduction in the income tax rate; a lower income tax rate means the gain to households, in terms of real income, is greater than that for the economy in general. The reverse occurs in Australia where the allocative efficiency loss reduces the indirect tax base and the income tax rate must rise to maintain a fixed budget position. Households in China gain more than the economy generally as the consumer price index hardly rises due to a large fall in the price of wool garments from the tariff changes; thus, they capture almost all of the increase in factor prices.

All regions except China experience lower real GDP from the complete removal of current (2005) wool tariffs. Comparing the relative sizes of the initial contractionary and expansionary effects of recent wool tariffs with current wool tariffs, China is the only region where the initial contractionary effect is much smaller relative to the initial expansionary effect; for all other regions the initial contractionary effect of current wool tariffs is much larger than the initial expansionary effect. Thus, all regions except China experience smaller real GDP when current wool tariffs are removed.

With the initial contractionary effect being much smaller in China than the initial expansionary effect, the relative price of capital falls and the capital stock expands; the reverse happens in all other regions. China also gains from a significant improvement in allocative efficiency. Despite the complete removal of current wool tariffs, allocative efficiency falls in about half of the regions we model; France, Germany, Italy, Japan and Australia. In Australia allocative efficiency from industry output falls because most of the industries that contract are already smaller than optimum and all the industries that expand are already larger than optimum. Allocative efficiency from commodity sales also falls marginally as sales of lightly-taxed goods expand and sales of highly-taxed goods contract. The allocative efficiency losses in France, Germany and Japan are driven by a pattern similar to that observed for Australia; allocative efficiency falls from both commodity sales and industry output but the effects of industry output dominate.

The pattern of industry effects of recent and current wool tariffs diverge considerably. The effects of changes in wool tariffs between 1997 and 2005 show extreme and divergent changes in industry output across regions with no general pattern. In contrast, the complete removal of 2005 wool tariffs show a general pattern; wool industries in China either expand or are largely unaffected whereas wool industries everywhere else generally contract; these results are similar to those reported in Francois et al. (2005) that show an increased concentration of (all types of) textile and garment production in China from an OECD-based trade liberalisation including agriculture, manufacturing and services (p. 372). In our simulations, the general expansion in wool industries in China represents a unique interaction between the effects of cheaper imported wool inputs due to the removal of tariffs and increased export sales due to lower export barriers. This is reflected by the expansion in domestic sales, imports and exports for most of the wool industries in China; thus, scale effects drive the expansions in these industries. Tariffs on raw wool in China are reduced from an initial rate of around 10%; thus imports of most types of raw wool expand strongly. At the same time, domestic sales of most types of raw wool increase significantly. Thus, imports improve their market shares as substitution of imported for domestic raw wool occurs. At the same time, exports of all forms of raw wool also expand strongly; but this does not reflect the removal of significant exports barriers.

6.7 Concluding comments

This work makes a major contribution to the modelling of wool markets. We apply a model containing a detailed depiction of the multistage wool production system within a broader economy-wide framework to estimate the direct and indirect effects of wool tariff barriers over two periods of interest to trade negotiators, policy makers and producers: 1997–2005 and 2005 and beyond.

The simulation results provide an indication of the degree of discrimination imposed by wool tariffs. Recent (1997–2005) wool tariffs lead to positive welfare effects for most regions. Nevertheless, sensitivity analysis shows that the estimated welfare gains are robust only for three regions: Italy (0.09%), UK (0.017%) and China (0.09%). The welfare gains for Italy and China are significant given the small relative size of the wool industries in these regions. The estimated welfare gain for China is similar, in absolute terms, to that estimated by Francois et al. (2005) for an OECD-based trade round estimate where China is expected to suffer a real income loss in the order of 0.1%.

The gains to Italy and the UK are due to little change in import tariffs but a strong stimulus provided to their exports of wool textiles and garments from lower tariff barriers in export destinations. Tariff barriers on wool textiles and garments fall significantly over 1997–2005 and the pattern of both China's and Italy's exports are more skewed towards these goods than in other regions. China's gain is totally composed of a large allocative efficiency improvement driven by increased sales of late-stage processed goods (i.e., wool yarns, fabrics and garments). Italy also experiences an improvement in allocative efficiency but also gains from an increase in the use of capital due to a fall in its relative price that is driven by the large expansionary effect of the tariff changes.

Australia is predicted to be the biggest loser from recent wool tariffs (–0.04%) and this result is found to be robust. The tariff changes encourage industries that are subsidised to expand (i.e., early-stage processing industries; scoured wools, carbonised wools, and worsted tops) and encourage industries that are taxed (i.e., wool yarns and fabrics, and other industries) to contract. Also, the contractionary effect of the tariff changes dominates the expansionary effect, thus reducing the demand for primary factors and increasing the relative price of capital. The use of capital falls and this adds to the loss for Australia.

For the complete removal of 2005 wool tariffs, China (0.1%) and the UK (0.002%) are estimated to be the only winners; but the welfare gain is only robust for China. The estimated welfare gain for China is 0.1%; as with current wool tariffs, the absolute size of this effect is comparable to the estimated welfare effect on China of an OECD-based trade liberalisation scenario (Francois et al. 2005). The reason for China's gain from 2005 wool tariffs is similar to the reason for its gain from 1997–2005 tariff changes; its exports are skewed towards wool products that have the highest tariff rates in 2005 (i.e., wool fabrics and garments) and their removal benefits China more than any other region. The result is an allocative efficiency improvement and increase in the use of capital due to a rise in the demand for primary factors that reduces the relative price of capital.

For three losing regions – Italy (–0.11%), Germany (0.08%) and Japan (0.024%) – the results are robust and we can be highly confident that these regions are the largest losers from the complete removal of 2005 wool tariffs. The welfare losses are driven by a fall in allocative efficiency due to the changes in composition of sales and output in these economies.

Underlying the welfare effects of recent and current wool tariffs are the effects on individual industries in each region. The results indicate that the nature of both recent and current wool tariffs severely distort the size of wool industries in different regions. For recent wool tariffs, the changes in the output of wool commodities are extreme reflecting the discriminatory nature of the tariffs. Examples include a doubling of carbonised wools output in France whereas in the USA it more than halves. Other extreme reductions also occur in US production of wool yarns (–74%) and wool fabrics (–75%). The results also indicate a relocation of wool garments production away from France, Germany and Italy, largely to China and the ROW region. For 2005 wool tariffs, production effects on wool processing follow a general pattern: large reductions in most regions and large expansions in China. In China the expansions are in the order of 9–50%. There is also a major relocation of wool garments industries away from France, Germany and Italy to the UK, China and the ROW region.

Numerical assessments of the global effects of wider tariff (and other trade) barriers have a long and rich history. Numerical assessments of the effects, global or otherwise, of wool tariff barriers are nonexistent. The work presented here provides a first attempt to present such an assessment. As such, it provides trade negotiators, policy makers and producers with an unprecedented reference point for the effects of wool tariff barriers within the context of wider trade negotiations.

Appendix Detailed results for the change in tariff barriers between 1997–2005

Table A.1 Industry output (percentage change)

		France	Germ	Italy	UK	USA	Japan	China	Aust	ROW
1.	Sheep	0.50	0.41	0.16	0.29	0.07	0.22	-2.13	-2.59	-1.52
2.	Scoured wool <20 microns, <56 millimetres	0	39.68	78.94	0	-78.45	0	-21.01	29.73	-22.04
3.	Scoured wool 20-23 microns, <56 millimetres	100.57	-41.57	-76.63	176.19	-51.68	10.86	-4.31	12.57	-28.76
4.	Scoured wool >23 microns, <56 millimetres	22.54	52.75	57.86	15.26	-84.50	1.47	-23.00	1.21	3.07
5.	Scoured wool <20 microns , 56-65 millimetres	-6.35	-11.69	-36.57	52.44	0	-17.53	-19.55	8.47	-36.50
6.	Scoured wool 20-23 microns, 56-65 millimetres	3.18	-15.74	-8.12	-24.06	-17.89	-20.22	-19.52	-0.86	23.44
7.	Scoured wool >23 microns, 56-65 millimetres	-35.06	-2.63	-26.56	-9.25	-13.11	-13.59	-19.54	-24.28	9.42
8.	Scoured wool <20 microns, >65 millimetres	-15.69	-5.76	-32.33	0	-67.41	-23.78	0	0	3.13
9.	Scoured wool 20-23 microns, >65 millimetres	0	-1.93	-33.21	0	-34.44	-20.23	-25.09	4.65	-11.96
10.	Scoured wool >23 microns, >65 millimetres	0	5.70	-43.82	0	0	0	-34.52	-33.57	12.68
11.	Carbonised wool <20 microns, <56 millimetres	0	30.92	28.78	190.00	-78.45	-1.78	-8.19	31.76	-39.13
12.	Carbonised wool 20-23 microns, <56 millimetres	105.69	-41.59	-64.92	184.69	-70.15	10.46	-17.40	26.55	-35.43
13.	Carbonised wool >23 microns, <56 millimetres	22.41	60.99	52.47	33.92	-83.10	1.47	-23.37	14.58	-11.34
14.	Worsted top <20 microns , 56-65 millimetres	-6.35	-11.44	-36.57	50.75	-76.15	-21.98	-19.36	18.57	-36.50
15.	Worsted top 20-23 microns, 56-65 millimetres	-7.31	6.09	-8.13	-59.83	-21.89	-20.26	-24.79	-14.48	23.02
16.	Worsted top >23 microns, 56-65 millimetres	-35.06	19.85	-26.56	-9.25	-41.58	-17.00	-20.68	-24.05	10.50
17.	Worsted top <20 microns, >65 millimetres	-15.69	-5.76	-32.33	0	-67.41	-23.78	0	0	3.13
18.	Worsted top 20-23 microns, >65 millimetres	0	-1.93	-33.21	0	-34.44	-20.26	-24.95	5.59	-13.20
19.	Worsted top >23 microns, >65 millimetres	0	5.70	-43.83	0	0	0	-34.52	-33.57	12.68
20.	Worsted blend yarn	-6.32	3.81	1.07	-20.81	-87.36	-13.58	-35.16	-68.29	38.80
21.	Worsted pure lightweight yarn	0	-15.73	-32.40	12.17	-67.20	-24.51	-26.72	-79.12	4.68
22.	Worsted pure heavyweight yarn	0.75	10.82	12.61	-18.19	0.32	-28.15	-29.65	-68.18	-8.83
23.	Woollen blend yarn	23.96	4.10	14.15	95.95	-80.87	40.64	-27.19	-4.12	-57.56
24.	Woollen pure yarn	23.20	14.03	36.09	197.66	-74.08	3.77	-28.73	-2.25	-38.77
25.	Worsted blend woven fabric	-13.01	16.39	1.17	1.86	-88.07	-11.90	43.61	-67.84	-30.97
26.	Worsted pure lightweight woven fabric	-14.32	-9.94	-12.61	-19.04	-27.65	-9.04	394.00	-67.95	320.96
27.	Worsted pure heavyweight woven fabric	-1.84	23.54	19.25	11.97	0.87	-10.92	51.74	-67.35	-44.68
28.	Worsted knitted fabric	-2.99	0	1.85	16.63	90.43	-3.79	14.96	-67.48	-14.43
29.	Woollen blend woven fabric	55.97	56.38	43.61	89.22	-83.99	36.89	-8.09	-2.24	-35.18
30.	Woollen pure woven fabric	58.22	82.01	95.22	184.03	-75.28	2.05	-30.87	-1.80	-45.00
31.	Synthetics	-29.66	-28.59	-12.96	-25.67	68.30	-20.16	-25.23	-68.96	17.04
32.	Men’s worsted blend woven garments	-16.03	-23.58	-9.50	-23.50	73.40	-13.63	1.09	-67.09	29.87
33.	Women’s worsted blend woven garments	-38.29	-37.11	-20.64	-30.86	-6.68	-34.30	2.96	-66.70	14.31
34.	Men’s worsted pure woven garments	-13.57	-16.38	-8.80	-19.12	21.43	-12.51	28.50	-67.94	44.40
35.	Women’s worsted pure woven garments	0	3.32	-0.83	-8.60	0.00	-1.38	-46.59	-68.82	41.92
36.	Men’s worsted knitted garments	-23.42	-24.92	-9.64	-19.59	-93.47	-5.23	30.54	-65.86	21.68
37.	Women’s worsted knitted garments	1.85	-0.18	1.06	0.67	-0.29	-0.03	1.57	-1.12	0.30
38.	Men’s woollen blend woven garments	-13.46	-23.03	-5.92	-16.23	-71.58	-16.20	25.04	-65.71	8.12
39.	Womens’ woollen blend woven garments	1.46	-0.34	8.89	5.60	-0.01	-0.01	1.12	-0.89	0.18
40.	Men’s woollen pure woven garments	-20.63	-23.83	-18.25	-18.98	-83.42	-11.23	15.48	-59.67	7.34
41.	Womens’ woollen pure woven garments	-6.96	-10.82	-10.47	-6.85	9.17	9.51	-0.27	-40.40	19.77
42.	Woollen knitted blend garments	-14.57	-14.89	-18.72	-8.91	10.80	-18.32	5.80	-32.00	15.84
43.	Woollen knitted pure garments	0.00	0.00	0.03	0.00	-0.02	0.00	-0.01	-0.02	-0.01
44.	Other goods	0.50	0.41	0.16	0.29	0.07	0.22	-2.13	-2.59	-1.52

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CHAPTER 7

CONCLUSION

The core objective of this thesis is to aid understanding of the economic mechanisms by which the world wool market operates. In doing so, we have analysed two issues – productivity and trade – and their effect on the world wool market and its submarkets. In performing the analysis we have developed a novel analytical framework. The framework combines two long and rich modelling traditions: the partial-equilibrium commodity-specific approach and the computable-general-equilibrium approach. The result is a model that represents the world wool market in detail, tracking the production of greasy wool through five off-farm production stages that end in the production of wool garments. Capturing the multistage nature of the wool production system is a key pillar in this part of the model. At the same time, the rest of the economy, or nonwool economy, is represented through six representative agents: nonwool producers, capital creators, households, exporters, governments and importers.

We first apply the model to analysing the relationship between productivity changes and grower incomes. Here, we examine the relationship between grower incomes and on- and off-farm productivity changes. The analysis indicates that the nature of the assumed supply shift from research is crucial in estimating returns to wool growers from productivity improvements. Assuming a degree of research leakage to foreign producers, a pivotal supply shift will reduce quasi-rents to Australian wool producers for both on- and off-farm research, in both the short and long run; the losses are largest from on-farm research. Again assuming a degree of research leakage to foreign producers, a parallel supply shift will increase quasi-rents to Australian wool producers for both on- and off-farm research, in both the short and long run; the gains are largest from on-farm research.

The results are as predicted by economic theory when it is assumed that the producer faces inelastic demand; our model assumes inelastic demand for sheep meat and wool garments. Extensive sensitivity analysis confirms that the assumed nature of the supply shift is the important determinant of the sign of the welfare effects from research. Previous studies have modelled research as a parallel supply shift, e.g., Freebairn et al. (1982), Mullen et al. (1989), following the argument made by Rose (1980) in favour of using a parallel supply shift as the best approximation. As such, we believe it is appropriate to place more weight on the estimates generated by assuming a parallel supply shift.

Focussing on estimates generated from parallel supply shifts, we find that on-farm research is to be preferred to all other forms of research; on-farm research gives the largest welfare gain to Australian wool producers and off-farm research ranks second. The result is consistent with the only empirical study that has addressed this issue, Mullen et al. (1989). Unlike Mullen et al. (1989), our model is comprehensive enough to assess research in five off-farm production stages; this compares to two off-farm productions stages for Mullen et al. (1989). Our results indicate that, in general, off-farm research that is ‘close’ to the wool producer provides larger benefits than off-farm research that is ‘distant’. This contrasts with the off-farm research findings by Mullen et al. (1989) who find that top processing research provides smaller benefits than textile research. The comprehensive model applied here suggests such a ranking is unlikely when off-farm production stages are modelled as separate industries and research is applied as a technological improvement. The result by Mullen et al. (1989) is driven by modelling textile research as an exogenous increase in demand by the top industry.

Extensive sensitivity analysis indicates that certain assumptions do affect the estimated welfare gains from research. We evaluate the price/income elasticities for final demand, wool/nonwool input substitution, factor substitution by the sheep industry, trade elasticities, and the degree of research leakage from Australia to foreign producers. None of these assumptions are found to alter the ranking of benefits from on- and off-farm research. Nevertheless, some assumptions are found to have a noticeable impact on the estimated research gains. Trade elasticities are most important as they affect the top three ranked forms of research: on-farm, scouring, and carding/combing. Factor substitution by the sheep industry is also important for on-farm research gains, but less so for scouring and carding/combing research. The degree of research leakage is found to be important only for on-farm research gains. Price/income elasticities are also found to be important only for estimating gains from garment-making research. Wool/nonwool input substitution is found to be relatively unimportant for research in all production stages.

Our base case scenario indicates that there are significant benefits to Australian wool producers from on-farm research: a 1% improvement in on-farm productivity increases welfare by around 1.4%. Off-farm research provides smaller benefits: a 1% improvement in scouring productivity increases welfare by around 0.7%, and a 1% improvement in carding/combing productivity increases welfare by around 0.6%. The results suggest a number of policy implications. On-farm levy-funded research is to be preferred by the Australian wool grower over off-farm research. To the extent that off-farm research is undertaken, scouring and carding/combing research is to be preferred to later-stage off-farm research. On-farm research that is specific to Australian conditions is to be preferred, as the less applicable the research is to foreign producers the greater will be the gains to Australian producers.

Next we apply the model to analysing the economic effects of wool tariff changes. Changes in recent wool tariffs (the period 1997–2005) lead to positive welfare effects for most regions. Nevertheless, sensitivity analysis shows that the estimated welfare gains are robust only for three regions: Italy (0.09%), UK (0.017%) and China (0.09%). The welfare gains for Italy and China are significant given the small relative size of the wool industries in these regions.

The gains to Italy and the UK are due to little change in import tariffs but a strong stimulus provided to their exports of wool textiles and garments from lower tariff barriers in export destinations. Tariff barriers on wool textiles and garments fall significantly over 1997–2005 and the pattern of both China's and Italy's exports are more skewed towards these goods than in other regions. China's gain is totally composed of a large allocative efficiency improvement driven by increased sales of late-stage processed goods (i.e., wool yarns, fabrics and garments). Italy also experiences an improvement in allocative efficiency but also gains from an increase in the use of capital due to a fall in its relative price that is driven by the large expansionary effect of the tariff changes.

Australia is predicted to be the biggest loser from recent wool tariffs (–0.04%) and this result is found to be robust. The tariff changes encourage industries that are subsidised to expand (i.e., early-stage processing industries; scoured wool, carbonised wool, and worsted tops) and encourage industries that are taxed (i.e., wool yarns and fabrics, and other industries) to contract. Also, the contractionary effect of the tariff changes dominates the expansionary effect, thus reducing the demand for primary factors and increasing the relative price of capital. The use of capital falls and this adds to the loss for Australia.

For the complete removal of 2005 wool tariffs, China (0.1%) and the UK (0.002%) are estimated to be the only winners; but the welfare gain is only robust for China. The reason for China's gain from 2005 wool tariffs is similar to the reason for its gain from

1997–2005 tariff changes; its exports are skewed towards wool products that have the highest tariff rates in 2005 (i.e., wool fabrics and garments) and their removal benefits China more than any other region. The result is an allocative efficiency improvement and increase in the use of capital due to a rise in the demand for primary factors that reduces the relative price of capital.

For three losing regions – Italy (–0.11%), Germany (–0.08%) and Japan (–0.024%) – the results are robust and we can be highly confident that these regions are the largest losers from the complete removal of 2005 wool tariffs. The welfare losses are driven by a fall in allocative efficiency due to the changes in composition of sales and output in these economies.

Underlying the welfare effects of recent and current wool tariffs are the effects on individual industries in each region. The results indicate that the nature of both recent and current wool tariffs severely distort the size of wool industries across regions. For recent wool tariffs, the changes in the output of wool commodities are extreme reflecting the discriminatory nature of the tariffs. Examples include a doubling of carbonised wools output in France whereas in the USA it more than halves. Other extreme reductions also occur in US production of wool yarns (–74%) and wool fabrics (–75%). The results also indicate a relocation of wool garments production away from France, Germany and Italy, largely to China and the ROW region. For the complete removal of 2005 wool tariffs, production effects on wool processing follow a general pattern: large reductions in most regions and large expansions in China. In China the expansions are in the order of 9–50%. There is also a major relocation of wool garments industries away from France, Germany and Italy to the UK, China and the ROW region.

Numerical assessments of the global effects of wider tariff (and other trade) barriers have a long and rich history. Numerical assessments of the effects, global or otherwise, of wool tariff barriers are nonexistent. The work presented here provides a first attempt to present such an assessment. As such, it provides trade negotiators, policy makers and producers with an unprecedented reference point for the effects of wool tariff barriers within the context of wider trade negotiations.

The overall finding of this work is that a sophisticated analytical framework is necessary for analysing productivity and trade issues in the world wool market. Only a model of this kind can appropriately handle the degree of complexity of interactions between members (domestic and foreign) of the multistage wool production system. Further, including the nonwool economy in the analytical framework allows us to capture the indirect effects of changes in the world wool market and also the effects on the nonwool economy itself. The results from the wool trade liberalisation scenarios indicate no consistent pattern across regions of nonwool economy effects; i.e., sometimes the nonwool economy expands, sometimes it contracts, and the effect is not consistent with changes in economy overall.

The results from the wool trade liberalisation scenarios also show that even though the world wool market is small, both globally and for most regions, the results for some regions may approach the order of magnitude of wider multilateral liberalisation on all goods and services. For instance, the estimated welfare gain for China from recent and current wool tariffs is around 0.1%. The absolute size of this effect is comparable to the estimated welfare effect on China of an OECD-based trade liberalisation scenario (Francois et al. 2005). This result could not be observed using a model that was partial equilibrium and ignored the rest of the economy.

The work here demonstrates the merits of synthesising the partial-equilibrium commodity-specific approach with the computable-general-equilibrium approach in modelling a specific commodity market and its submarkets. As such, consideration should be given to applying such an approach in modelling other commodity markets and that the extra benefit of undertaking such an approach may exceed the extra cost. Ignoring the possible cost-benefit ratio, there are no technical barriers to applying the approach to modelling commodities other than wool and its derivatives.

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