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Error Reduction Strategies for the 1998-2005 USAGE Forecast

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ABSTRACT

This paper examines methods aimed at improving baseline economic forecasts using a dynamic CGE model. Forecasting can be used to test the validity of such models, as well as to highlight possible improvements, by investigating the discrepancies between the forecast and actual outcomes. The model employed here is USAGE – a recursive dynamic, 500-industry CGE model of the U.S. USAGE generates baseline forecasts by incorporating expert forecasts for certain macro variables and extrapolating historical trends in technology, consumer preferences, positions of foreign demand curves for U.S. products, and numerous other naturally exogenous variables. In instances where important trends either dissipate or reverse, large forecast errors can arise. This paper seeks to provide explanations and guidance as to whether these various trends from the period 1992 to 1998 would continue for the 1998 to 2005 USAGE forecast. The twenty largest errors on a relative and/or absolute basis are examined. It is found that for some commodities, had all publicly available information by 1998 been appropriately utilised, certain important trends should not have been expected to continue. Hence, a better forecast could have been generated had the projection of certain trends been nullified. More generally, the findings suggest that there is a case to be argued against projecting forward large values relating to import-domestic preference twist factors in particular. It is also shown that for commodities in the trade-exposed textile, clothing and footwear industries moderately better results could have been produced by implementing import price forecasts in a way that is more in line with historical trade policy. This was achieved by projecting forward real basic import prices. However, the key drivers behind these errors were usually the significant underestimation of the impact of import-domestic preference twist factors, as well as the overestimation of factor input cost savings. In relation to forecasts for commodities in the oil and mining sectors as well as industries that service these cyclical industries, it is concluded that these typically could not have been improved in the absence of strong convictions (by 1998) about an impending mining "super-cycle" or extended boom. For the construction-related commodities demand was fuelled by virtually unprecedented low borrowing costs. In these instances, it is difficult to conclusively argue that the modeller could have produced a better forecast. Moreover, while large improvements in forecast accuracy can be obtained for some industries and sectors, the overall economy-wide forecast error does not fall greatly due to the sheer volume of commodities. While it is disappointing that the error is not very reducible, it is also reassuring because it implies that the default implementation of the model is quite powerful. In all about 4% of all commodities were specifically examined to assess the potential for error reduction. After due consideration about 7.5% of commodities were in some way directly re-projected. To generate a large reduction in the forecast error would require an extensive amount of work and probably call for the input of numerous industry specialists.

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SECTION 1 – The Size and Source of Forecast Errors

Trends: will they continue?

Economic forecasting is a difficult pursuit and inaccurate predictions seem to be a relatively common occurrence. Even if a forecast model is correctly specified and is a good representation of the economy, the structure of that economy is unlikely to remain unchanged. Structural shifts can, and do, occur and as time goes by these changes can become more pronounced. It is, therefore, an important consideration to account for the likely future structure of the economy when analysing the impact of potential policy changes. Where structural change is predicted in a baseline forecast the effects of policy changes can widely differ from a *status quo* assumption about the future structure of the economy. This paper examines methods aimed at improving baseline economic forecasts using a dynamic CGE model. Forecasting can be used to test the validity of such models, as well as to highlight possible improvements, by investigating the discrepancies between the forecast and actual outcomes.

USAGE is a recursive dynamic, 500-industry CGE model of the U.S. developed at the Centre of Policy Studies, Monash University, in collaboration with the U.S. International Trade Commission (USITC). USAGE generates baseline forecasts by incorporating expert forecasts for certain macro variables and extrapolating historical trends in technology, consumer preferences, positions of foreign demand curves for U.S. products, and numerous other naturally exogenous variables. In instances where important trends either dissipate or reverse, large forecast errors can arise. This paper seeks to provide explanations and guidance as to whether these various trends from the period 1992 to 1998 would continue for the 1998 to 2005 USAGE forecast. Dixon and Rimmer (2010) note that the importance of the baseline was recognized by the USITC in their 2007 report on import restraints:

> "...in the 2007 report they incorporated an explicit baseline out to 2011 that recognised the secular decline of import-competing industries, such as Textiles, Apparel and Sugar. Thus, in the 2007 report, the USITC avoided exaggerating the likely economy-wide effects in 2011 of reductions in import restraints."[1]

The aim of the paper by Dixon and Rimmer (2010) was to assess the aforementioned method of baseline forecast generation. In particular, using data available up to 1998 the method was applied to generate "pure" forecasts for 1998 to 2005. These forecasts were then compared with the actual outcomes for this period and with alternate forecasts derived as extrapolated trends from 1992 to 1998.[2] In measuring forecast performance, Dixon and Rimmer (2010) calculate the average error (AE) of the forecast as well as a coefficient (*M*) that gives the ratio of average errors between the pure USAGE forecast and the extrapolation-based trend forecast.

AE can be defined as

$$AE = \left(\frac{1}{N}\right) * \sum_{c} \left| f_c - a_c \right| \Big/ \left(1 + \frac{a_c}{100}\right)$$

[1] Peter B. Dixon and Maureen T. Rimmer, "Validating a Detailed, Dynamic CGE Model of the USA", *Economic Record*, 86 (Special Issue), September, 2010, p. 23.
[2] *Ibid*, p. 23.

where

- f_c is the forecast of the percentage change in the output of commodity c between 1998 and 2005;
- a_c is the actual percentage change in the output of commodity c between 1998 and 2005; and
- N is the number of commodities (503 in the present application of USAGE).

The term for commodity c is the gap between the forecast output for commodity c in 2005 and the actual output, expressed a percentage of the actual output. Thus AE is an *unweighted average* across the 503 USAGE commodities in percentage gaps between forecast levels of commodity outputs and actual levels – in the charts further below this is labelled as "AE(uniform)".

M is defined as

$$M = \frac{\sum_c \left| f_c - a_c \right| \Big/ \left(1 + \frac{a_c}{100} \right)}{\sum_c \left| h_c - a_c \right| \Big/ \left(1 + \frac{a_c}{100} \right)}$$

where

- h_c is the percentage change in the output of commodity c across the historical period, 1992 to 1998, extrapolated to make it apply for a seven-year period rather than a six-year period.

If *M* = 1, then the USAGE-based forecast has the same level of accuracy as a non-model-based forecast generated by trends. Alternatively, if *M* = 0.7, then the USAGE model has eliminated 30 percent of the error involved in simply relying on historical trends.[3] In this case, *M* is the ratio of the *unweighted* average errors, with the weights for each commodity equal to 1/503. Hence, this is labelled "M(uniform)" in the charts that appear further below. According to Dixon and Rimmer (2010), USAGE forecasts incorporate trend assumptions for nearly all technology, preference and trade-shift variables; and movements in these variables are major determinants of changes in the commodity composition of U.S. output.[4] There are three reasons explaining how USAGE can outperform (or underperform) trend forecasts:

> "The first is that USAGE forecasts for commodity outputs are driven by macro and energy forecasts that deviate from trends. Second, the starting point for the USAGE forecasts is different from the starting point for the historical trends. Sales structures for each commodity and rates of return and cost structures for each industry in 1998 differ from those in 1992. These differences mean that trends imposed with 1998 being the starting point can have different effects from similar trends imposed in 1992. For example, a given trend in foreign demand for commodity *i* will have a different effect on output depending on the share of exports in sales of commodity *i*. Third, USAGE recognises detailed demand linkages. Thus, for example, if the USAGE forecast for output or investment in industry *i* differs from the trend forecast and output of *j*

[3] *Ibid,* p. 28.
[4] *Ibid,* p. 30.

depends heavily on sales to either output or investment in *i*, then the USAGE forecast for output of *j* is likely to differ from the trend forecast."[5]

In instances where important trends either dissipate or reverse, large forecast errors can arise. This paper provides explanations and guidance as to whether these various trends would continue for the 1998 to 2005 USAGE forecast. It is found that for some commodities, certain important trends should not have been expected to continue, and hence a better forecast could have been generated had all publicly available information at 31 December 1998 (the end of the base year of the forecast) been appropriately utilised. In examining the largest commodity forecast errors, macro and industry-specific commentary was included. With regard to magnitude there are essentially two types of USAGE forecast errors. The first is where the USAGE error is large from an absolute value perspective; and the second is where the USAGE error is large relative to the error attributable to the extrapolated trend. The *M* coefficient is always adversely affected by the second of these two errors. When using extrapolated trend as the benchmark the forecast performance of USAGE is enhanced whenever USAGE is closer to the mark (actual growth in the forecast period) irrespective of sign. Whilst it is useful to gain a better understanding of what went wrong in cases where the trend outperformed, there were many instances where the USAGE error was very large but was eclipsed by the forecast trend error. These USAGE errors warrant investigation in their own right as they detract from the overall quality and usefulness of the forecast. Ultimately, the best forecasts are the ones that are right and achieve this for the right reasons rather than by mere coincidence.

Table A is divided into two sections; the top section contains commodities for which the USAGE error is relatively large versus trend error and is sorted as such (last column); the bottom section sorts those commodities that incurred the largest USAGE errors (third column). The commodities *AsbestosPrd* (Asbestos Products) and *BootCutStock* (Boot and Shoe Cut Stock and Findings) have large enough errors to merit appearing in both sections. In all, these are the twenty worst performers from an error perspective and warrant further analysis. *AsbestosPrd* provided the largest USAGE error *and* was also the largest error relative to the trend forecast. The nature of the error for this commodity was explained in Dixon and Rimmer (2010) and will not be revisited here.[6] Table A shows that for *AsbestosPrd* the USAGE pure forecast error was 151%, calculated as $\left|f_c - a_c\right| / \left(1 + a_c/100\right)$, while the trend error was 43%, calculated as $\left|h_c - a_c\right| / \left(1 + a_c/100\right)$. If these percentage errors are taken as "co-ordinates" the forecast performance of each commodity can be plotted. This is illustrated in Figure A for each of the commodities listed in Table A.

From Table A it can be observed that for *ComFishing* (Commercial Fishing) actual growth was -13% over the 1998-2005 period. This followed a 19% decline from 1992 to 1998 – the extrapolated trend was therefore -22% – yet USAGE forecast 36% growth. The USAGE error was 56% whilst the forecast trend missed by just 10%. The difference between these two figures determines the distance from the 45-degree line in Figure A. If both forecasts were spot-on target then the data point would coincide with the origin. If they were both wrong by precisely the same (absolute) percentage then the data point would sit somewhere on the 45-degree line; the larger the error, the further from the origin.

[5] *Ibid*, p. 30.
[6] *Ibid*, pp. 31-32.

COMMODITY *i*	USAGE F'CAST 1998-2005	USAGE ERROR %	ACTUAL GROWTH 1998-2005	HISTORICAL 1992-1998	TREND F'CAST 1998-2005	TREND ERROR %	45° LINE above/(below)
233 AsbestosPrd	**51**	**151**	**-40**	**-12**	**-14**	**43**	**108**
18 ComFishing	36	56	-13	-19	-22	10	**46**
387 Dolls	-31	51	40	16	19	15	**35**
451 Theatres	44	35	7	7	8	1	**33**
40 AccStrucSMD	-13	39	41	29	34	5	**33**
39 PetNgExplor	-18	42	42	46	55	9	**33**
206 BootCutStock	**45**	**108**	**-30**	**19**	**22**	**75**	**32**
38 PetNgDrill	-15	41	44	50	60	11	**29**
23 Nonferrores	9	75	-38	-5	-5	52	**23**
22 Copperore	5	29	-18	-11	-13	7	**22**
231 CutStone	-14	24	13	14	16	3	**21**
345 ElectronTube	114	**149**	-14	148	189	236	(87)
115 Knitfabric	24	**139**	-48	33	40	169	(30)
210 Luggage	-12	**131**	-62	10	12	193	(63)
114 Hosierynec	19	**122**	-46	30	36	153	(31)
116 Apparel	16	**121**	-48	25	30	148	(26)
205 LeatherTan	-5	**119**	-56	-2	-2	124	(5)
209 Leathrgloves	-17	**114**	-61	3	4	166	(52)
211 WmnsHandbag	19	**107**	-42	23	27	121	(14)
351 Recordmedia	42	**101**	-30	29	35	91	10

Table A: The twenty worst errors on a relative and/or absolute basis

Where *ElectronTube* (Electron Tubes) is concerned both the USAGE forecast and extrapolation yielded high errors. Following a period of strong growth from 1992 to 1998 output of this commodity contracted by 14% in the forecast period of 1998 to 2005. However, the USAGE model forecast a further 114% growth while the trend was extrapolating 189% growth. The USAGE error of 149% was eclipsed by the trend error of 236% and so this made a helpful contribution to the *M* coefficient. As a result USAGE clearly outperformed the simple extrapolation technique. With an absolute difference of -87 this placed *ElectronTube* well below the 45-degree line. (These "vertical displacement" figures appear in the last column of Table A.) There were only six other commodities that were situated even further below the 45-degree line (i.e., easily outperformed the trend forecast); one of these being *RailroadEq* (Railroad Equipment), which is discussed in Dixon and Rimmer (2010) and will not be revisited here.[7]

Figure B shows that the unweighted AE is 18.9% in the pure forecast. In other words, the forecast error for a typical industry is 18.9%. At first glance the result for the AE seems large, especially when the simulation result for real GDP growth over the period was about 21.64% (not shown). According to Dixon and Rimmer (2010):

> "This would be a disastrously large average error if all industries had actual growth rates in a tight band around 21.64. But they did not. The actual growth rates were spread over the range -66 (for slippers) to 218 (for computer peripheral equipment). Only 151

[7] *Ibid*, p. 31.

out of the 503 USAGE commodities exhibited output growth within 10 percentage points of the average. The *M* coefficient gives a more optimistic view of the USAGE forecasts than that obtained from AE. When every commodity is treated as equally important the M coefficient indicates that USAGE reduces the forecast error by 42 percent (*M* = 0.58) relative to a simple non-modelling extrapolation approach..."[8]

As can be seen in Figure B, the bulk of the points lie below the 45-degree line, hence from an *M* perspective the USAGE forecasts have comfortably outperformed a simple trend forecast. This is reflected by the *M* coefficient taking a value well below 1.

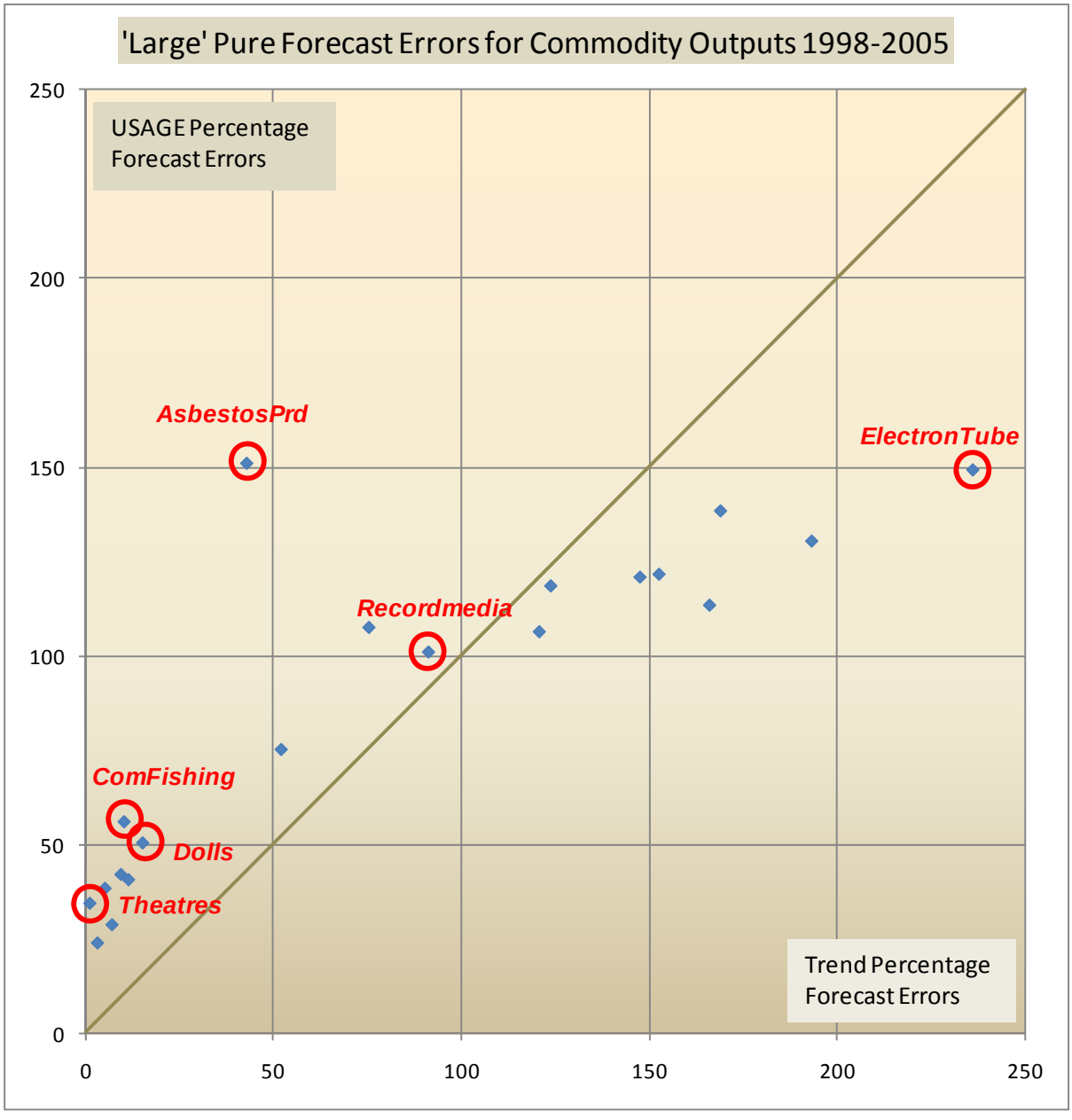

Figure A: Percentage forecast errors for 'large error' commodity outputs 1998-2005 – extrapolated 1992-1998 trend forecast versus the original USAGE pure forecast

[8] *Ibid*, p.p. 28-29.

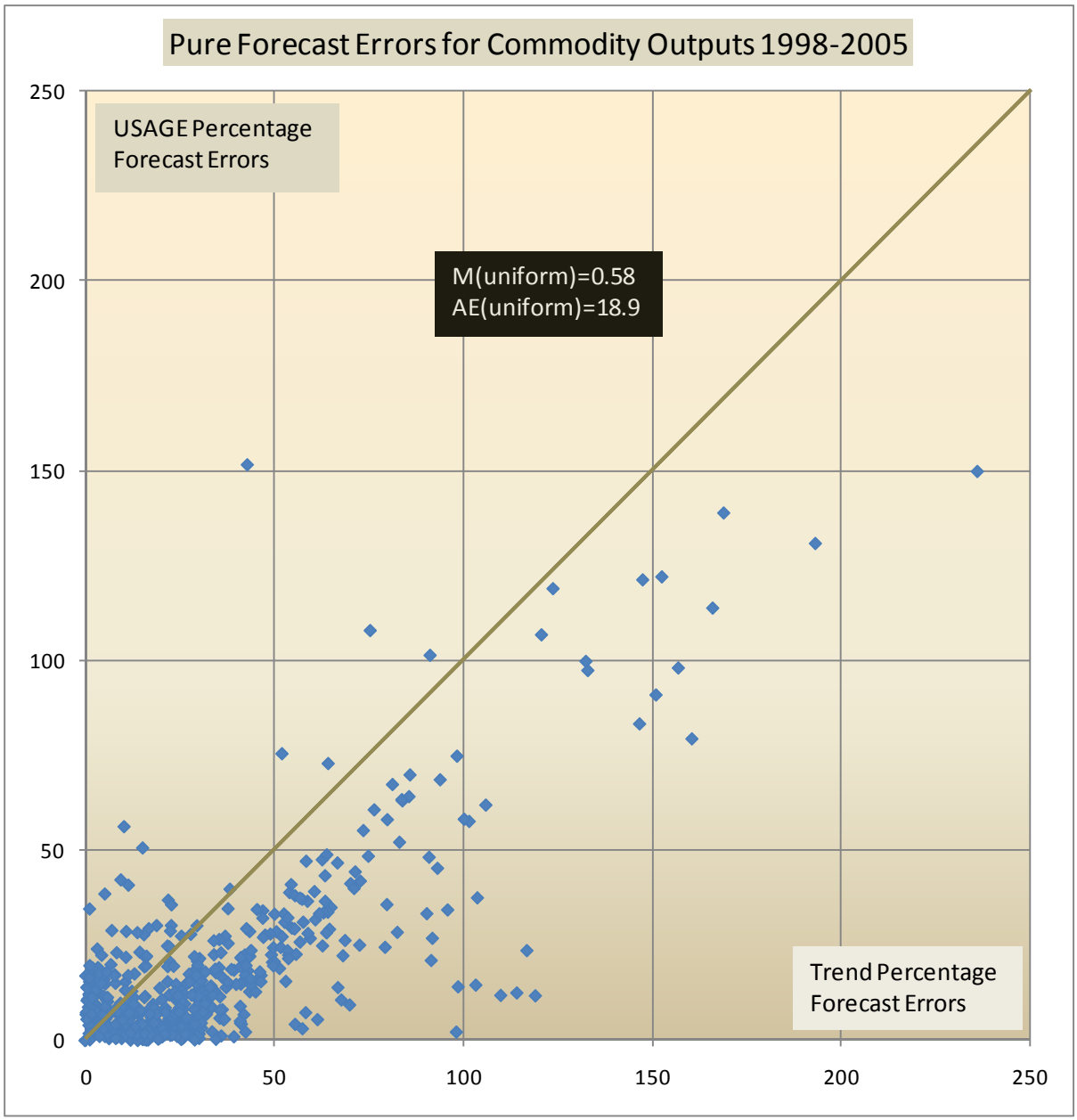

Figure B: Percentage forecast errors for all commodity outputs 1998-2005 – extrapolated 1992-1998 trend forecast versus the original USAGE pure forecast

The Origin of some Large Forecast Errors more generally

In examining the more sizable errors the approach taken was both 'big picture' macro and nitty gritty 'model specific' reasoning. In relation to the latter, it was discovered that where large import-domestic *twist factors* were projected forward during the forecast run, this entrenched patterns that were perhaps only *temporary* phenomena. Twist factors provide a degree of freedom in the model to generate known variables in historical (or pre-forecast) mode, such as for imports. An import twist is said to describe the change in tastes between imported and domestic commodities. Twists do not affect the overall quantity used in a particular good. In the USAGE model there are different types of import twists. For example, there is a:

1. twist that applies overall (*twist_src*);
2. twist effect (*twist_eff)* – the direction of which depends on whether the industry is growing faster or slower than real GDP. In the former case, this will produce a positive sign on this variable that favours imports; and
3. shifter variable (*ftwist_src)*, which relates only to domestic sales of domestically produced commodities – and the impact of this is measured by *impftwist*.[9]

Both *impftwist* and *ftwist_src* apply to domestic demands, but *not* export demand, which depends on foreign preferences. Over the 1990s it was noticed that most twists had been favouring imports, perhaps as people became more aware of the availability of these goods, e.g., through the Internet. More broadly, an interesting finding was that where twists were present, they most often experienced a change of sign or became stronger across simulations towards imports. For commodities where the model performed less well, this seemed to coincide with a change in sign across simulation periods of *impftwist*, e.g., *BootCutStock, Dolls, ComFishing,* and *AsbestosPrd*. Under these circumstances, the model extrapolated the historical value of *impftwist* into the forecast – and where *impftwist* was large this would typically overwhelm other factors affecting the projection, resulting in large errors in absolute terms.

Table B shows a subset of the commodities in Table A where actual estimated *impftwist* changed sign across simulations *and* was ≥|25%| in at least one of the simulation periods. For these commodities the table reveals that USAGE often underperformed trend (this is indicated by a positive figure in the last column). Because the impact of import-domestic *twist factors* is extrapolated into the forecast assumptions in USAGE, this has the effect of reinforcing historical preference patterns that might only be temporary in nature. Without detailed industry analysis it is difficult to predict when import twist factors are about to move sharply against historical trend. Indeed, even with a full industry analysis such moves may not be expected.

[9] *impftwist* helps to explain changes in domestic sales of U.S.-produced commodities that cannot be fully explained by relative price movements between the domestic good and its imported equivalent, and by growth in the U.S. market for those commodities. In these instances, the model infers that there must have been a change in preferences towards (away from) the domestically produced good and away from (towards) imports. This is referred to as an *import/domestic twist*. The impact of this twist on output is projected forward, resulting in a boost (reduction) to domestic production in the forecast.

Commodity *i*	*impftwist* 1992-1998 %	*impftwist* 1998-2005 %	Above/(Below) 45° Line
233 AsbestosPrd	25	-49	108
18 ComFishing	99	-68	46
387 Dolls	-53	39	35
206 BootCutStock	-62	110	32
351 Recordmedia	31	-46	10
211 WmnsHandbag	17	-85	(14)
345 ElectronTube	27	-2	(87)

Table B: Large-error commodities where actual estimated *impftwist* changed sign across simulations and whose impact was ≥|25%| in at least one of the periods

Therefore, some of the largest forecast errors (in both an absolute and relative sense) occurred when the impact of large import-domestic *twist factors* was extrapolated into the forecast assumptions. This had the effect of reinforcing historical preference patterns that were perhaps only temporary in nature. Even with detailed industry analysis, it is still difficult to predict when import twist factors are about to move sharply against historical trend.

RESULTS SUMMARY FOR 'LARGE-ERROR' COMMODITIES			
Commodity/Sector	**Cause of Error**	**Industry Conditions**	**Modelling Strategy**
***ComFishing* - Commercial Fishing** Growth: 1998-2005 Forecast: +36.4% Actual : -12.8% USAGE error = 56% [|36.4 – -12.8|/ (1 + -12.8/100) = 56%]	From 1992 to 1998 the increase in domestic sales of U.S.-produced *ComFishing* could not be fully explained by relative price movements between the domestic good and its imported equivalent, and by growth in the U.S. *ComFishing* market. This led the model to infer that there must have been a change in preferences towards the domestically produced good and away from imports. This is referred to as an *import/domestic twist*. The impact of this twist on output was projected forward, resulting in a strong boost to domestic production in the forecast. In reality, these import-domestic twist factors sharply reversed. Also, the observed sharp decline in the export demand function that occurred from 1992-1998 was extrapolated in the forecast; when, in reality, foreign preferences barely changed. This had a negating impact on growth, thereby preventing a larger forecast error.	A rudimentary examination of the industry in 1998 would have revealed that a restrictive regulatory regime had been imposed just two years earlier on commercial fishing activities. The Sustainable Fisheries Act (1996) marked a significant strengthening in the requirements to prevent overfishing and rebuild overfished fisheries. This would likely have resulted in lower catches (output) going forward, as well as relatively strong upward pressure on prices of the domestic product versus the imported commodity. This suggests that any shortage could only have been met by higher imports, which is in fact what happened, and had started happening in the period from 1992-1998.	Based on industry conditions between 1992 and 1998 a better forecast for *ComFishing* could have been produced. Given the restrictive nature of the regulations it is unlikely that output would have expanded. Knowing this, the strategy in re-running the simulation was to fix output growth at zero and endogenise export volumes (as there was no clear view on likely foreign demand). Furthermore, the model was prevented from projecting forward the impact on domestic production of the import/domestic preference twist. By setting this to zero, this prevented the unlikely large boost to domestic sales of U.S.-produced output versus imports. By forcing zero output growth the USAGE error fell from 56% to 15%. Post simulation it is conjectured that very large shifts in foreign preferences should be closely investigated, in terms of likely sustainability, rather than be automatically projected forward.

***ElectronTube* - Electron Tubes** Growth: 1998-2005 Forecast: +114.3% Actual : -14.3% USAGE error = 149%	From 1992-1998 there was a preference shift towards the greater use of *ElectronTube* as a production input. The contribution to output of this so-called *ElectronTube*-using technical and taste change was projected forward. *ElectronTube* derives its demand from the demand for "other" goods, such as televisions, that were subject to rapid changes in technology that did not require any *ElectronTube* input. The new technologies gained strong momentum from 1998-2005 and this coincided with negative *ElectronTube*-using technical and taste change. Also, analogous to *ComFishing,* the model inferred a preference twist towards the domestically produced good and away from imports. The impact of this twist on output was projected forward, resulting in a boost to domestic production in the forecast – but this did not eventuate. Finally, the observed sharp rise in the export demand function that occurred from 1992-1998 was extrapolated in the forecast; however from 1998-2005 foreign preferences moved sharply away from *ElectronTube*.	By 1998, non-*ElectronTube*-using flat panel technology (such as TFT LCD) was already being used in notebook computers. In 1992, Fujitsu introduced the world's first 21-inch full-colour plasma display. As early as 1990, projections were readily available that showed expected global sales of LCD technology would exceed *ElectronTube*-using CRTs before 2000. In light of the rising competitive pressure from flat panel technology, and with the U.S. generally regarded as an early adopter of high-tech audio visual products, falling prices during period from 1992 to 1998 signalled the decline of the CRT technology used in the Electron Tubes industry.	As sleeker, larger screen replacements had already started to appear on the market, it is plausible that a substantial growth slowdown in *ElectronTube* could have been expected to occur during the 1998-2005 period; and at the very least, output more than doubling (as was the case in the original forecast) would have been seen to be a most unlikely scenario. In the historical simulation, a large upward shift in the export demand curve for *ElectronTube* was observed; as well as a strong twist trend impact on domestic sales of U.S.-produced *ElectronTube*; and *ElectronTube*-using technological change. Given rapidly changing industry conditions, it is clear that these factors ought not to have been projected forward, thereby allowing for an improved forecast. As a result, the strategy was to zero out contributions to output from: *ElectronTube*-using taste changes, foreign preference changes, and import/domestic preference twists. This simulation resulted in output growth of 23.3% and markedly reduced the USAGE error from 149% to 17%.

Dolls – **Dolls & Stuffed Toys** Growth: 1998-2005 Forecast: -30.8% Actual : +40.4% USAGE error = 51%	From 1992 to 1998 overall domestic output was boosted by a large increase in inventories. At the same time there was a decrease in domestic sales of U.S.-produced *Dolls* that could not be fully explained by relative price movements between the domestic good and its imported equivalent, and by growth in the U.S. *Dolls* market. This led the model to infer that there must have been a change in preferences away from the domestically produced good and towards imports. The impact of this preference twist on output was projected forward, resulting in significant damage to domestic production in the forecast; and easily outweighing the expansionary effect of other aspects of the model. In reality, these import-domestic twist factors sharply reversed. Furthermore by 1998 there was more than 90% import penetration, making it difficult to accurately forecast domestic output given that it would move off a low base. In this instance, the model does a better job at predicting the commodity's overall absorption, i.e., all U.S. sales of the commodity irrespective of source.	The doll market is segmented between play dolls and collectible dolls; each characterised by totally different sales distributions. Consumers are by far the largest users of dolls, with gifting by parents and grandparents to young girls being the key driver behind purchases. As a result of competition from computer and electronic games targeted to girls, manufacturers brought out more interactive dolls and updated their current products. Moreover, by late 1997 there was evidence than the collectibles market was growing very strongly as an increasing number of baby boomers entered the market; and 88 percent of the nation's dolls retailers had pointed to new collectors as the top industry trend destined to impact store sales over the next five years. By 1998, total sales (domestic and imported) in the U.S. market for Dolls & Stuffed Toys valued at purchases prices was $7.9b (up from $4.8b in 1992). Collectibles was about 22% of the market, and growing strongly.	U.S. producers were well positioned to meet growing demand and were already making more innovative products. If inventory changes are excluded, households accounted for more than two thirds of sales of domestically produced *Dolls*, with most of the remainder exported. Given the dynamics in the fast-growing collectibles market, a sharp decline in forecast would have seemed unlikely. In light of this, a better forecast for *Dolls* could have been produced. For this to materialise, the strategy in re-running the simulation was to prevent the model from projecting forward the negative impact on domestic production of the import/domestic preference twist. By setting this to zero, this barred the unlikely large contraction to domestic sales of U.S.-produced output versus imports. This resulted in an improved forecast for output growth of 11.0% and reduced the USAGE error from 51% to 21%.

***Theatres* – Motion Pictures (excludes Video Rentals)** <u>Growth: 1998-2005</u> Forecast: +43.5% Actual : +6.5% USAGE error = 35%	Domestic sales of the U.S. produced commodity increased modestly between 1992 and 1998 despite a materially unfavourable change in relative prices. This arose because household tastes moved strongly in favour of *Theatres* between 1992 and 1998, i.e., by 1998 consumers preferred to purchase far more *Theatres* at any given set of prices and per capita income than was the case in 1992. Given insignificant imports, this drove prices sharply higher for the domestically produced commodity. The price rise hurt export volumes. However, as was the case for U.S. households, foreigners increased their liking to the commodity at any given price, thereby preventing a larger fall in exports. By 1998 the industry was beginning to experience the impact of piracy and other negative dynamics such as rising costs. The forward projection of additional strongly positive preference and taste changes for households and foreigners resulted in an exaggerated strong growth forecast.	By 1998, sales of U.S. entertainment both domestically and abroad were expected to depend in part on how new technologies were to be used for the delivery of entertainment and the barriers that U.S. companies were likely to encounter in foreign markets. New technologies at the time included: the internet; DVD and satellite delivery systems for programming. Many industry observers believed that within a decade the Internet would play a major role in delivering filmed entertainment to homes. In 1998 music piracy was a common feature of the internet. However, with the rise in broadband internet connections beginning around 1998, higher quality movies began to see widespread distribution – and ISO images copied directly from the original DVDs were slowly becoming a feasible distribution method. Where faster broadband connections were available (e.g., universities, businesses, and government departments, etc.) the downloading of television shows and movies was not unusual.	Based on the way that the music industry had reacted to piracy it is clear that growth in *Theatres* could have been blunted by growing movie piracy during the forecast period. It must have seemed highly likely at the time that movie piracy would have a strong negative impact on household and foreign demand parameters. (The model calculated a taste shift away from *Theatres* in the actual results for 1998-2005. It is quite conceivable that this is the impact of movie piracy.) Based on these industry conditions a better forecast for *Theatres* could have been produced. In re-running the simulation, the strategy was to prevent any extrapolation of foreign and domestic taste/preference variables on the basis of negative industry dynamics and the likely impact of piracy. This resulted in a vastly improved forecast for output growth of 3.5% and reduced the USAGE error from 35% to just 3%.

***Recordmedia* – Magnetic and Optical Recording Media** Growth: 1998-2005 Forecast: +41.7% Actual : -29.8% USAGE error = 101%	From 1992 to 1998 the increase in domestic sales of U.S.-produced *Recordmedia* could not be fully explained by relative price movements between the domestic good and its imported equivalent, and by growth in the U.S. *Recordmedia* market. This led the model to infer that there must have been a change in preferences towards the domestically produced good and away from imports. This is referred to as an *import/domestic twist*. The impact of this twist on output was projected forward, resulting in a strong boost to domestic production in the forecast. In reality, these import-domestic twist factors sharply reversed. Also, the observed sharp rise in the export demand function that occurred from 1992-1998 was extrapolated in the forecast, further boosting growth. However, in reality, foreign preferences also moved strongly in reverse.	Blank tape technologies (such as VHS and Mini-DV) were jostling for market share in the mid 1990s. However, in November of 1996, Sanyo-Verbatim CD Company announced the onset of Digital Versatile Disc (DVD) production in the first quarter of 1997. DVD had the potential to store seven times the capacity of a CD-ROM. In 1998 the unit shipments of all types of blank tapes were in decline except 8mm videotapes, which increased in 1997. Part of this was due to mounting foreign competition, particularly from China. Although Chinese products using old technology were of inferior quality they had the impact of blunting industry prices. Also, their inferior quality might have explained the strong twist against imports during this period. In relation to exports, by 1998 these comprised 32% of total sales of domestic output. However, from the trade data it was clear that exports were trending downward after peaking in 1996.	Given the advent of new competing technologies and falling export volumes after 1996 it ought to have been realised that domestic output was unlikely to surge in forecast. As China began to export CDs and DVDs (which are technically more *generic* than the technologies these superseded), quality attributes became more difficult to distinguish – perhaps explaining the twist towards imports during the 1998-2005 period. This provided sufficient confidence that the forecast could be considerably improved. The strategy in re-running the simulation was to prevent the model from projecting forward the impact on domestic production of the import/domestic preference twist. By setting this to zero, this averted the unlikely large boost to domestic sales of U.S.-produced output versus imports. It was also determined that export growth opportunities would be limited and the foreign demand curve was held constant; thwarting an unlikely rise in exports. The resultant output forecast was for a 2.8% contraction, and reduced the USAGE error from 101% to 38%.

***Knitfabric* – Knit Fabric Mills** Growth: 1998-2005 Forecast: +23.8% Actual : -48.4% USAGE error = 139%	The original forecast error arose mainly from three sources. First, the forecast underestimated the impact of import/domestic preference twists (the nature of this effect has been described previously). Second, relative prices were expected to strongly favour domestic producers, when in fact they moved in favour of importers. To elaborate, there are different types of prices in the model but output changes are partly driven by changes in relative basic prices such as the landed duty-paid import price for a commodity. This is a function of the foreign currency price, the exchange rate, and any tariffs on the commodity. From 1992 to 1998 the foreign currency price of *Knitfabric* increased, and the main driver of this was projected forward. This strongly contributed to a higher basic price of imported *Knitfabric* than turned out to be the case (in fact, the basic import price fell). Finally, the sharp factor input cost reductions that occurred from 1992 to 1998 were also projected forward; but instead of maintaining their growth rate they largely failed to materialise.	The major domestic players in the industry had embarked on an aggressive expansion and acquisition program during the mid to late 1990s. In the lace & warp knit fabric space rising import competition was a key concern. Throughout the mid-1990s domestic manufacturers remained competitive by introducing new specialty fabrics. During the mid-1990s the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT) opened new markets for the textile industry, but also increased foreign competition (as was evident in the trade data). As a result, a number of companies decided to move operations outside of the U.S. A sharp slowdown in import growth was seen in the 1998 trade data. Most of *Knitfabric's* sales were to the *Apparel* industry. *Apparel* registered 25.0% growth during the historical simulation along with strong and persistent import growth.	Following strong increases in 1996 and 1997 growth in *Knitfabric* imports paused in 1998. It would have been difficult for the modeller to confidently assert that imports would continue to surge and decimate *Knitfabric*. It is also unlikely the modeller would have seen cause to adjust domestic-import twist factors, or even to sensibly estimate the magnitude of any such adjustment. However, it is clear that improvements could have been made to the import price forecasts. Basic import prices for commodities in this sector were heavily tied to policy. From 1992 to 1998 the (nominal) landed duty-paid import price for *Knitfabric* fell slightly; but fell considerably in real terms. It is sensible to assume that policy-makers would allow real basic import prices to continue to fall at the same annual rate. (Compare this to a highly unlikely rise in nominal basic import prices; being driven by also unlikely rising foreign currency import prices.) In re-running the simulation, import price forecasts were generated by extrapolating the *real* price change from 1992 to 1998. This was done for all textile, clothing and footwear (TCF)

			industries, resulting in more realistic import price projections and less erroneous domestic-import relative (basic) price movements. For *Knitfabric* this produced an improved forecast for output growth of 7.1% and reduced the USAGE error from 139% to 106%. The absolute size of the error remained quite large due to the ongoing underestimation of *impftwist*, and the projection of the impact on output for even higher factor input cost reductions. The latter is discussed further below.
	After running the improved simulation some more thought was given to the large reductions seen (from 1992-1998) in total primary factor input costs. In USAGE this term is referred to as "all factor augmenting technical change" and can be interpreted as follows: the industry could *potentially* produce the same output in 1998 as it did in 1992 with less primary factor inputs and the same other inputs. It is potential because actual output will also depend on other factors such as relative price changes. The large falls, sector wide, in all-factor augmenting technical change were having a significant impact in terms of output contributions (by stifling domestic basic prices thereby improving competitiveness). In forecast this impact on output is projected forward. It became clear that for the TCF sector this ought not to be baked in to the forecast. Why? Because the share of total primary factor input costs to total costs was declining significantly throughout these industries. In this relatively labour-intensive sector, output-boosting cost savings from shedding workers (in particular) were likely to be getting smaller; and this effect could be reinforced by possibly higher unit labour costs that might arise from increased labour scarcity (especially as companies were shifting operations abroad). To see how this would pan out the improved forecast simulation was rerun (denoted as improved forecast: *version 2*) with the single change of no additional potentially output-boosting primary factor cost savings for the TCF commodities. The results were very promising, e.g., for *Knitfabric* output contracted 35.4% on the back of rising costs, and its USAGE error fell significantly, to 24%.		

***Apparel* – Apparel Made From Purchased Materials** Growth: 1998-2005 Forecast: +15.8% Actual : -47.6% USAGE error = 121%	Once more, the source of the forecast error was multifaceted. The model extrapolated household preferences from the historical run resulting in tastes moving further in favour of *Apparel*. There was a large share of sales to consumers and this projection proved very inaccurate. More important was the model's underestimation of the impact of import/domestic preference twists (the nature of this effect has been described previously). Furthermore, as was the case for all TCF commodities, the foreign currency price increase of imported *Apparel* that occurred between 1992 and 1998 was projected forward. This strongly contributed to a higher basic price of imported *Apparel* than turned out to be the case (in fact, the basic import price fell sharply). This impacted relative basic prices in a way that was incorrectly favourable to domestic producers. Finally, the impact on output of the sharp cost reductions relating to primary factor input that occurred from 1992 to 1998 were also projected forward; but instead of these intensifying they failed to materialise.	The Uruguay Round of multilateral trade negotiations (MTN) was implemented over the period 1995-2000 for developed countries. As part of this the U.S. lowered tariffs and commenced the phaseout of quotas but reserved the right to impose safeguards once the phaseout was complete. However, the U.S. refused to agree to accelerated quota growth and tariff reductions. Furthermore under the terms of the Uruguay Round agreement, developing countries were afforded much higher tariff rates than developed countries, potentially hurting some export markets. In addition, reduced protection coincided with the increasing emergence of China and India as super-cheap producers and exporters of *Apparel.* This was clearly reflected in the trade data.	By late 1998 it was not clear that consumer tastes would begin to sour overall, whilst taking an increased liking to imports – well beyond that which could be explained by changes in relative prices. Furthermore, the modeller could not have been sure that reductions in protection would not subsequently be reversed. However, as was the case for all TCF commodities, improvements could have been made to the import price forecasts because basic import prices were heavily tied to policy. As a result (as explained earlier) real basic import prices were projected forward, generating more realistic relative basic price changes. For *Apparel* this produced an improved forecast for output growth of 3.8% and reduced the USAGE error from 121% to 98%. A subsequent simulation differing only by the additional forecast of no further primary factor cost savings (i.e., no further all factor augmenting technical change) gave better results. (See earlier comments for elaboration.) In this case, higher costs meant that output contracted 24.7% and the USAGE error improved to 44%.

***Luggage* – Luggage** Growth: 1998-2005 Forecast: -12.1% Actual : -61.9% USAGE error = 131%	There were several factors contributing to the erroneous forecast. On the supply side, primary factors comprised about half of total input costs. The material cost savings that occurred from 1992 to 1998 were projected to continue. In reality, this efficiency measure sharply deteriorated, and its contribution to total input costs rose significantly. On the demand side, households were responsible for about two thirds of sales of domestically produced *Luggage*. For the period from 1992 to 1998 the model deduced that household tastes had shifted towards the consumption of more *Luggage* at any given set of prices and per capita income. This was projected to continue when, in reality, household tastes towards *Luggage* soured considerably. An analogous outcome occurred with foreign demand preferences, though the impact was much less significant. In addition, import twist factors worked overwhelmingly against the domestic commodity in the period from 1998 to 2005 – well beyond that which was projected.	An external forecast was found, dated February 1995, which reported that the U.S. luggage market experienced improved growth trends over the 1990s due to sharper gains in personal income and favourable demographics. Demand was also stimulated by the introduction of more innovative products and casual luggage lines, and the growing need for lifestyle products such as backpacks, sports bags, and computer cases. Stronger growth, higher labour productivity and moderating material costs resulted in expanded profit margins. Furthermore, U.S. manufacturers were able to boost plant profit margins despite rising competition from foreign-sourced products and relatively weak product price gains. The external forecast was for stronger growth through to the end of the decade as the key baby boomer market moved through its prime luggage buying years. Turning to the trade data, it was clear that overall imports were growing strongly from 1992 to 1998. Exports also grew strongly as foreign markets became more open, but this growth was off a relatively low base.	*Luggage* output increased modestly over the period from 1992 to 1998. (The bullish external forecast may well have changed by 1998, but any further reports could not be located.) *Luggage* is an example of a commodity with a very large import share. This makes it especially difficult to accurately forecast domestic output in the absence of specialised knowledge. By late 1998 it was not clear that consumer tastes would begin to sour overall, whilst taking an increased liking to imports – well beyond that which could be explained by changes in relative prices. However, as was the case for all TCF commodities, knowing that basic import prices were heavily tied to policy an improved forecast could have been produced by projecting real basic import prices. This generated more realistic relative basic price changes, resulting in a 19.1% contraction in forecast output. The USAGE error fell from 131% to 112%. A subsequent simulation differing only by the additional forecast of no further primary factor cost savings saw forecast output contract 38.4% and the USAGE error improved to 62%.

***BootCutStock* – Boot and Shoe Cut Stock and Findings** Growth: 1998-2005 Forecast: +44.7% Actual : -30.6% USAGE error = 108%	Exports were by far the largest share of domestic output. Hence, the accuracy of the forecast for output hinged on the foreign demand forecast. In simplified terms, USAGE relates foreign demand for a commodity to overseas activity; foreign currency prices; and to several autonomous variables that determine the position of the export demand curve. From 1992 to 1998 the export demand curve moved considerably higher. This upward shift in foreign demand was projected forward, which had a highly expansionary impact on forecast output. However, this proved to be a vast overestimation because in reality a very sharp downward shift occurred. The collapse in foreign preferences dominated any offsetting effects from a reduction in export prices. Hence the expected strong increase in export volumes did not turn out to be true – instead export volumes virtually halved. On the supply side, the material primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these did not materialise.	By 1996 U.S. manufacturers began to shift operations to lower cost countries. Many of the footwear plants that remained eventually closed, and plant openings slowed to a trickle by the late 1990s. Pricing was under intense pressure due to competition from imported shoes. The drop in domestically produced footwear depressed the business of companies that supply shoe manufacturers. Leather sole makers also had to contend with a shift by consumers to more casual footwear and the rising cost of leather. While there remained a market for fine leather shoes, many Americans no longer required several pairs of dress shoes. During the recession of the early 1990s, the repair trade picked up more slowly than in previous downturns (consumers have traditionally mended old shoes during difficult times). There was also concern about longer term trends in the repair market. The trade data showed a cyclical pattern for imports, but strong growth in exports until 1997. Export growth peaked in 1996 at around 50%, and exceeded 10% in 1997. In 1998 exports fell by about 10%.	Whilst there was some evidence that exports of *BootCutStock* were beginning to slow, the modeller is unlikely to have imagined that export volumes would halve over the forecast period. Industry conditions were getting tougher as evidenced by a slowdown of plant openings in the late 1990s; the "offshoring" of the industry; and rising competition from low wage nations more generally. This could have indicated that further expansion would be unlikely. This is an instance where the modeller, on balance, probably would have made *ad hoc* changes to the forecast parameters, such as by nullifying export demand shifts and/or domestic output – though this was not implemented. Rather, the TCF industries were treated with a broad brush by projecting real basic import prices. This generated more realistic relative basic price changes, resulting in 24.7% output growth. The USAGE error fell from 108% to 79%. A subsequent simulation differing only by the forecast of no further primary factor cost savings saw forecast output contract 27.0% and the USAGE error improve to just 5%.

***LeatherTan* – Leather Tanning and Finishing** Growth: 1998-2005 Forecast: -4.6% Actual : -56.4% USAGE error = 119%	Several factors contributed to the erroneous forecast. The main buyers of the commodity were other TCF industries. As was seen earlier, these industries generally underperformed forecasts in the period from 1998 to 2005. Furthermore, there was a larger than expected preference shift away from use of *LeatherTan* in production. In addition, the USAGE prediction for foreign preferences was also off the mark. Given foreign preferences from 1992 to 1998 the export demand curve was forecast to shift slightly upward; when it in fact shifted strongly downward. As has been the norm in these industries, import twist factors worked overwhelmingly against the domestic commodity. In particular, the impact of these twists did significantly more damage to the domestic producers than was anticipated. On the supply side, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these were reversed over the seven years from 1998 to 2005.	In the U.S., automotive upholstery and casual footwear make up most of the leather market. The number of companies engaged in leather tanning and finishing had declined since the 1980s, as a result of takeover activity. The number of U.S. tanning and finishing establishments was also decreasing, albeit slowly. Competition from overseas leather tanners, especially in developing nations, had adversely affected the industry in the U.S. Leather tanning in the U.S. is primarily the work of privately held companies, where the vast majority of the leather processed is cattle hide. So-called specialty leathers – including deer, calf, pig, goat, sheep, lamb, kangaroo, and various reptiles – comprised only about 5%. Turning to the trade data the rebound in exports that occurred in the mid 1990s had stalled by 1998. Overall, the growth patterns for both imports and exports seemed cyclical but fairly sharp and out of sync. This created a degree of volatility that made it difficult pinpoint any long term trend.	Great volatility was evident in the trade data, so there seemed to be no convincing argument that overall trade volumes would fall away. With no *a priori* view that the TCF sector was facing a gloomy period ahead, the modeller is unlikely to have imagined that output would more than halve. However, an improved forecast could be generated by treating the TCF industries with a broad brush – by projecting real basic import prices. This typically generated more realistic relative price changes – though this wasn't the case for *LeatherTan*. However, the larger divergence in relative prices placed more pressure on sales and choked off exports, thereby muting output. The resultant 15.3% contraction in forecast output saw the USAGE error fall to 94%. The error remained large due to the overestimation of foreign demand and underestimation of domestic-import twist factors. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 31.9% and the USAGE error improve markedly, to 56%.

***Hosierynec* – Hosiery, Not Elsewhere Classified** Growth: 1998-2005 Forecast: +19.3% Actual : -46.1% USAGE error = 122%	There were several drivers behind the erroneous forecast. Firstly, the model projected a change in relative prices favouring the domestically-produced commodity, when in reality, there was an unfavourable move. There was a high degree of substitutability between domestic and imported *Hosierynec*. The significant fall in import prices and a much larger than forecast preference twist towards the imported commodity drove the spike in imports. Given that imports held just 22% of the U.S. *Hosierynec* market there was plenty of room for these to grow. The error would have been larger if not for an unforeseen swing away in consumer tastes from *Hosierynec.* Households were by far the largest buyer. Exports were much weaker than forecast, however these comprised a relatively minor segment of production and were not as an important determinant of the results. Finally, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these prevailed only in part in the seven years from 1998 to 2005.	The biggest impact on the commodity's lamentable performance over the 1998-2005 period was the replacement of domestic production by surging imports. While other countries such as Taiwan and South Korea were already exerting pressure on domestic production, the entry of China into the WTO in 2001 and phasing out of the MFA quotas by 2005 amplified these pressures. The Multifibre Agreement, or Agreement on Textiles and Clothing, covered the period 1974-2004, replacing earlier agreements. The phase-out of import quotas took place over ten years (1995-2005) in four phases. At each stage, the percentage of goods not limited by quotas increased, while the quotas for goods still protected also increased. However, as mentioned previously, the U.S. had recourse to special safeguard provisions in the case that imports from China caused or threatened to cause market disruptions to local industry. The trade data from 1992 to 1998 showed strong growth in both imports and exports.	Even with the strong growth in imports and the impact of trade reform, it is unlikely that the modeller could have imagined that output would almost halve over the forecast period. The import favouring twists and the household preference shift away from *Hosierynec* also could not have been predicted. However, an improved forecast could be generated by treating the TCF industries with a broad brush – by projecting real basic import prices. This produced more realistic relative price changes for *Hosierynec* that placed more pressure on sales of the domestically produced commodity. The resultant 11.3% output growth in forecast output saw the USAGE error fall to 107% from 122%. The error remained large due to the ongoing underestimation of domestic-import twist factors and overestimation of cost savings from primary factor inputs. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 21.0% and the USAGE error improve markedly, to 47%.

***Leathrgloves* – Leather Gloves & Mittens** Growth: 1998-2005 Forecast: -16.7% Actual : -61.0% USAGE error = 114%	There were several key drivers behind the erroneous forecast. Firstly, from 1992 to 1998 there was a strong preference twist towards the imported commodity as the reduction in output could not be explained by changes in relative prices. The forecast projected this forward but grossly underestimated the actual impact of this phenomenon. Partly offsetting this, the forecast also underestimated the extent that the change in relative prices favoured the domestic commodity. Furthermore, consumers were by far the largest buyer of *Leathrgloves* and overall household demand rose by less than was predicted. This arose because the USAGE forecast failed to account for a large swing away in consumer tastes from *Leathrgloves.* In fact, USAGE projected forward the slightly favourable preference/taste shift that occurred from 1992 to 1998. Finally, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these actually reversed in the seven years from 1998 to 2005.	This is a very small industry which has been squeezed by cheaper imports since WWII. Historical data shows that the domestic industry was relatively stagnant between 1992 and 1998. Any growth in demand was met typically by rising imports. This strength in imports is also consistent with the solid growth in absorption in the historical period. Other than commentary around rising import penetration and a chronological history of industry consolidation, it was difficult to source external forecasts around 1998 that were specifically for the U.S.	The import favouring taste twist and the household preference shift away from *Leathrgloves* could not have been predicted. However, an improved forecast could be generated by treating the TCF industries with a broad brush – by projecting real basic import prices. This typically produced more realistic relative price changes – though this wasn't the case for *Leathrgloves*. However, the inaccurate relative price forecast had the impact of placing more pressure on total sales of the domestically produced commodity, thereby further negating output growth. The resultant 17.5% contraction in forecast output saw the USAGE error fall only slightly, to 112%. The error remained large mostly due to the ongoing mis-estimation of the change away from the commodity in household tastes and preferences and the underestimation of domestic-import twist factors. A subsequent simulation that included the forecast of no further primary factor input cost savings saw forecast output contract 26.6% and the USAGE error improve to 88%.

***WmnsHandbag* – Women's Handbags** Growth: 1998-2005 Forecast: +18.9% Actual : -42.2% USAGE error = 107%	From 1992 to 1998 the increase in domestic sales of U.S.-produced *WmnsHandbag* could not be fully explained by relative price movements between the domestic good and its imported equivalent, and by growth in the U.S. *WmnsHandbag* market. This led the model to infer that there must have been a change in preferences towards the domestically produced good and away from imports. This is referred to as an *import/domestic twist*. The impact of this twist on output was projected forward, resulting in a strong boost to domestic production in the forecast. In reality, these import-domestic twist factors sharply reversed. This depressed output. If not for a foreign demand driven rise in exports and a positive taste move by households domestic output would have fallen by even more. On the supply side, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these sharply reversed over the seven years from 1998 to 2005.	What distinguishes *WmnsHandbag* from the other TCF sectors that were examined above is that in the period from 1992 to 1998 the quantity of sales into the U.S. market of the domestically produced commodity grew faster than the imported equivalent. The trade data showed that imports peaked in 1996, and that sales growth of the local product was rapid enough for domestic producers to increase their market share from 1992 to 1998. However, similar to many of the TCF industries, *WmnsHandbag* experienced significant outsourcing of manufacturing to China. An example of this is the high-end American label "Coach", which outsourced and shifted production to lower cost markets. In 1998, only around 25% of "Coach" products were produced by independent manufacturers; two years later, around 80% of the products were made by outsourcers. Thus, "Coach" retains responsibility for design and marketing, but no longer manufacture *per se*.	Given than domestic producers gained market share over the period from 1992 to 1998, and that imports appeared to have peaked in 1996, it is unlikely that the modeller could have imagined that output would slump over the forecast period – even though outsourcing of the commodity was already taking place. However, an improved forecast could be generated by treating the TCF industries with a broad brush – by projecting real basic import prices. This generated more realistic relative price changes for *WmnsHandbag* that placed additional pressure on sales. The resultant 14.3% output growth in forecast output saw the USAGE error fall from 107% to 99%. The error remained large due to the ongoing mis-estimation of domestic-import twist factors and overestimation of cost savings from primary factor inputs. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 8.7% and the USAGE error improve rather markedly, to 59%.

***AccStrucSMD* – Access Structures for Solid Mineral Development** Growth: 1998-2005 Forecast: -13.1% Actual : +41.5% USAGE error = 39%	*AccStrucSMD* derives its demand exclusively from investment demand by industries in the resource sector, in particular, from the coal industry (*Coal*). To understand the key driver behind the erroneous forecast there must be an examination of *Coal's* expected rate of return and its subsequent investment. Over the period 1992-1998 investment in *Coal* increased strongly. This drove the solid rise in *AccStrucSMD* output during that period. By 1998, the capital-weighted average expected rate of return for all industries was more than double what it was for *Coal*. With only modest growth predicted for the coal industry, USAGE translated the low rate of return into what turned out to be relatively weak investment. On this basis the model forecast a double digit contraction in output for *AccStrucSMD*. In reality, there was a strong increase in coal prices, which led to surging investment in *Coal*. This made the single largest contribution to output growth in *AccStrucSMD*, overwhelming the demand reductions from the various other using industries.	The general commentary emerging from this sector in the late 1990s was that there was an increase of mining services as an industry in its own right largely due to cost-cutting measures on the part of the mining industry. With specific services contracted out, firms could avoid a large commitment of capital investment. In January 1997, the outlook for the coal industry according to the Energy Information Administration (EIA) included a discussion about long term price pressures and the increasing emergence of renewable energy sources. By December 1998, the outlook had been revised very sharply downward. This seemed to be congruent with the trade data for *Coal*. International trade was dominated by exports, and these were clearly falling from the mid-1990s. Meanwhile, overall *Coal* output rose modestly during the period.	Whilst the resources sector is highly cyclical by nature, it probably would have been too tough for the modeller to form a reliable long term view without taking in external forecasts. In 1998, could the modeller have predicted the gloom of 2002, and the sharp surge from 2004? *AccStrucSMD* provides inputs to capital creation in *Coal*. As seen in the EIA outlook statements from that time, alternative energy sources to coal were being touted, so the forecast for moderate growth is unlikely to have appeared unreasonable. In reality there was overall strong demand for the coal industry, due mostly to the resources boom that occurred during the latter part of the forecast period. In concluding, it would be unlikely that the modeller could have produced a better forecast.

***PetNgExplor* – Petroleum, Natural Gas, and Solid Mineral Exploration** Growth: 1998-2005 Forecast: -18.0% Actual : +43.4% USAGE error = 42%	*PetNgExplor* derives its demand soley from investment demand by industries in the resource sector – mainly Natural Gas (*NatGas*) and Crude Petroleum (*Crude*). Over the period 1992-1998 investment in *NatGas* more than doubled, while in *Crude* it grew solidly. This drove the strong rise in *PetNgExplor* output. In 1998, the capital-weighted average expected rate of return for all industries was considerably higher than for *NatGas* and *Crude*. With only modest growth predicted for *NatGas* and a decline in *Crude*, USAGE translated the low expected rates of return into a vast slowdown in investment overall across those industries. In fact, investment was predicted to be negative in *Crude*. On this basis the model forecast an 18.0% contraction in output for *PetNgExplor*. In reality, there was a huge spike in natural gas prices. This led to stronger than expected investment in *NatGas*. Crude petroleum prices rose stronger still, which led to an acceleration in investment demand growth as opposed to the predicted modest contraction.	Much of the discussion relating to *AccStructSMD* applies here, except the focus is on exploration rather than development. The EIA's Annual Energy Outlook for 1998 (published December 1997), showed that total U.S. energy consumption was projected to increase just 26 percent by 2020 from its 1996 level, with world average crude oil prices rising (in the reference case) to $22.32 per barrel (1996 dollars) in 2020. As expected, growing demand and falling production would be met by rising net imports. The forecasts were then updated in the Annual Energy Outlook for 1999 (published December 1998) and again did not predict an impending surge in energy prices. The trade data for the main users of *PetNgDrill* showed falling import demand for Natural Gas and Crude Petroleum. Separately, it was noted that crude oil prices were trending downward throughout 1997 and 1998 and prior to this had traded within a relatively narrow band.	As previously noted, it is not easy to forecast commodity cycles without the expertise of dedicated outlook providers. Even then it is no guarantee the forecast will be accurate. On balance, it is likely that the modeller would have been satisfied with a weak forecast for the commodity as there was nothing to suggest good prospects. A cursory glance at oil prices post-1998 shows the sudden, sharp reversal that occurred. In the case of natural gas prices, there was a huge spike post-1998, perhaps as the industry began to benefit from market deregulation in the early 1990s. Again, this would have been difficult to predict. Overall, it would be unlikely that the modeller could have produced a better forecast.

***PetNgDrill* – Petroleum & Natural Gas Well Drilling** <u>Growth: 1998-2005</u> Forecast: -14.9% Actual : +45.3% USAGE error = 41%	*PetNgDrill* derives its demand soley from investment demand by industries in the resource sector – mainly Natural Gas (*NatGas*) and Crude Petroleum (*Crude*). Over the period 1992-1998 investment in *NatGas* more than doubled, while in *Crude* it grew solidly. This drove the strong rise in *PetNgDrill* output. In 1998, the capital-weighted average expected rate of return for all industries was considerably higher than for *NatGas* and *Crude*. With only modest growth predicted for *NatGas* and a decline in *Crude*, USAGE translated the low expected rates of return into a vast slowdown in investment overall across those industries. In fact, investment was predicted to be negative in *Crude*. On this basis the model forecast a 14.9% contraction in output for *PetNgDrill*. In reality, there was a huge spike in natural gas prices. This led to stronger than expected investment in *NatGas*. Crude petroleum prices rose stronger still, which led to an acceleration in investment demand growth as opposed to the predicted modest contraction.	Much of the discussion relating to *PetNgExplor* and *AccStructSMD* applies here, except the focus is on oil & gas well drilling rather than exploration and development, respectively. Again turning to the EIA's Annual Energy Outlook for 1998 (published December 1997), it is found that total U.S. energy consumption was projected to increase just 26 percent by 2020 from its 1996 level, with world average crude oil prices rising (in the reference case) to $22.32 per barrel (1996 dollars) in 2020. As expected, growing demand and falling production would be met by rising net imports. The forecasts were then updated in the Annual Energy Outlook for 1999 (published December 1998) and again did not predict an impending surge in energy prices. The trade data for the main users of *PetNgExplor* showed falling import demand for Natural Gas and Crude Petroleum. Separately, it was noted that crude oil prices were trending downward throughout 1997 and 1998 and prior to this had traded within a relatively narrow band.	It is reiterated that it is not easy to forecast commodity cycles without the expertise of dedicated outlook providers. Even then it is no guarantee the forecast will be accurate. On balance, it is likely that the modeller would have been satisfied with a weak forecast for the commodity as there was nothing to suggest good prospects. A cursory glance at oil prices post-1998 shows the sudden, sharp reversal that occurred. In the case of natural gas prices, there was a huge spike post-1998, perhaps as the industry began to benefit from market deregulation in the early 1990s. Again, this would have been difficult to predict. Overall, it would be unlikely that the modeller could have produced a better forecast.

***Nonferrores* – Nonferrous Metal Ores, except Copper** Growth: 1998-2005 Forecast: +9.2% Actual : -38.0% USAGE error = 75%	Despite a larger than projected outward shift of the export demand curve, strong production-efficiency related cost rises translated into a surge in export prices (which more than double what was predicted). This had an overwhelmingly negative impact on export volumes. Furthermore, the intermediate use of *Nonferrores* (i.e., as an input into production of other commodities) was much lower than expected. With import penetration only minimal, overall intermediate demand fell by almost one third as rising costs helped drive prices substantially higher for the domestic commodity. The *Nonferrores* industry purchased a significant portion of its own output and saw its demand slump, versus the USAGE prediction for modest growth.	At noted in previous discussions, metals and mining-related commodities exhibit volatile cyclical demand patterns. This was certainly the case from 1992 to 1998 for *Nonfoerrores* as evidenced by the behaviour of gold and silver prices. Gold had been trending downwards from about 1996, whereas silver, exhibited a sharp price spike in early 1998. Gold prices moved sharply higher in the forecast period. It is not surprising that this sort of volatility was also reflected in the trade data, with very large movements observed in the annual growth rate of exports from 1992 to 1998.	This is another example of where the modeller is unlikely to have been able to do much better in forecast. As mentioned previously, the modeller would have been hard pressed to predict the resources boom that had a very big impact on the tail end of the forecast. Furthermore, exports were the largest share of domestic output. The value of exports for the commodity often moved quite dramatically during the period from 1992 to 1998.
***Copperore* – Copper Ores** Growth: 1998-2005 Forecast: +5.2% Actual : -18.7% USAGE error = 29%	Most of the sales of this commodity were to copper manufacturers and chemical producers. In 1992, exports comprised 15% of sales. Between 1992 and 1998 exports slumped by 90%. In the USAGE simulation for 1992-1998, there was a significant inward movement of the foreign demand curve, and this was accompanied by rising export prices. At	A decade ago, the U.S. was the world's second largest copper producer and a net importer of copper, obtaining 37 percent of refined copper from abroad at the turn of the twenty-first century. Global demand for copper has grown steadily since the late 1970s, but in the late 1990s copper producers, including many located in Chile, the world's largest	The longevity of falling prices and the higher stockpiles might have indicated to the modeller that *Copperore* faced a bleak outlook. The USAGE forecast of 5.2% growth was perhaps bullish. Given the way copper prices were trending in the late 1990s it is not clear why demand would shift so strongly away from copper – particularly given that price reductions

	the same time there was strong growth in imports, albeit off a low base. Output of the commodity between 1992 and 1998 fell by 11%. However, with strong import growth and apparent diversion of exports back to the domestic market, the USAGE simulation for 1992-1998 showed weak growth in supplies on the domestic market relative to demands by the using industries. In these circumstances, the model implied that during the period 1992 to 1998 there was *Copperore*-using technical change in the using industries. In the forecast for 1998 to 2005, this *Copperore*-using technical change was projected forward. The inward movement in the export demand curve was also projected forward, but with exports in 1998 at very low levels, this did not significantly affect the forecast output for *Copperore*. The *Copperore*-using industries in the 1998-2005 forecast showed moderate contractions. This provided some offset to the projected *Copperore*-using technical change, but not enough to predict a contraction in the USAGE forecasts.	copper-producing country, ramped up new mining capacity faster than the market could absorb their production. The economic weakness in Asia and Latin America in the late 1990s left global demand growth at a slower pace than some producers anticipated. The downward trend in copper prices from the mid-1990s started to translate into rising stockpiles by the end of the decade. It is also noteworthy that in 1998 the U.S. went from being a net exporter to a net importer. However, by 1998 exports became a relatively insignificant component of total sales of domestic output.	were being driven by boosted mining capacity. The most obvious copper substitutes are aluminium, plastics and fibre. The Primary aluminium industry was also facing a bleak outlook with USAGE predicting a steady decline in output of that commodity. The various plastics and fibre commodities in USAGE all exhibited relatively modest outlooks. On balance it is reasonably arguable that the modeller could have done better. However, in all likelihood any strategy would have revolved around setting domestic output growth to zero. Hence, the gains from such an exercise would have been minimal.

***CutStone* – Cut Stone and Stone Products** <u>Growth: 1998-2005</u> Forecast: -14.3% Actual : +12.2% USAGE error = 24%	From 1992 to 1998 growth in domestic demand for *CutStone* was driven by households. Intermediate input demand for the domestically produced commodity was relatively flat during this period, reflecting low growth in outputs by purchasing industries. USAGE calculated modest rises in the taste and preference indicators for households and producers, which were projected forward. In the case of households, USAGE predicted household demand for domestically produced *CutStone* to rise at a modest pace. However, the model vastly underestimated producer demand in the four largest intermediate purchasers of *CutStone*. Given that production demand was the larger share of output, the model forecast an overall reduction in *CutStone* output. The actual output that eventuated was largely driven by a strong increase in tastes for *CutStone* by producers and households. Finally, the primary factor input cost savings that occurred from 1992 to 1998 were projected to continue. However, these reversed throughout 1998 to 2005, thereby preventing a larger USAGE error.	Any forward looking comments that were sourced from the 1990s were reasonably cautious, and generally emphasised a lacklustre long-term industry outlook. There were limited opportunities for further productivity gains, and rising foreign competition was expected to hurt the construction sector. Superior synthetic substitutes continued to make inroads into the U.S. construction market. Due to the strength of the construction industry in the late 1990s the cut stone industry experienced steady growth in 1997 and 1998, as evidenced by a rise in shipments. Because of stone's weight-to-value ratio opportunities for export growth were limited to niche specialty stones. A bright spot for the industry was the expected continued surge in historical restoration projects that require considerable amounts of stone to replace damaged pieces from the original construction. However this seemed to comprise a relatively small part of total output.	The modeller may have viewed this overall cautious outlook as being consistent with the downbeat USAGE forecast for the commodity. Moreover, the building and construction boom that occurred mostly during the second half of the forecast period played a key role in the forecast error. Excessive borrowing across many sectors was fuelled by exceptionally low interest rates post the events of "September 11"; lax lending standards; piecemeal regulation; and financial product innovation. The extent and longevity of this boom did not seem to have been expected by industry experts. However, a track record of overly accommodative monetary policy from the mid-1990s and steady industry growth in 1997 and 1998 may have provided some clues that the general outlook was overly guarded. On balance, it is difficult to say, conclusively, that the modeller could have produced a better forecast for *CutStone*. Perhaps, if negative growth was seen to be too pessimistic, a zero growth forecast – at most – might have been worked into the model.

RESULTS SUMMARY OF IMPROVED FORECAST SIMULATIONS

Figure C charts the results of *version 1* of the improved pure USAGE forecast. In this version of the improved forecast *ad hoc* modelling strategies are implemented for *AsbestosPrd, ComFishing, ElectronTube, Dolls, Theatres,* and *Recordmedia.* In addition, a broad strategy of projecting forward real basic import prices is implemented for USAGE's 31 TCF commodities (recall that 8 of these featured among the 20 largest USAGE forecast errors). No change is made to the standard treatment of projecting forward the impact of contributions to output of all-factor augmenting technical change. These modelling strategies are summarised in the table above.

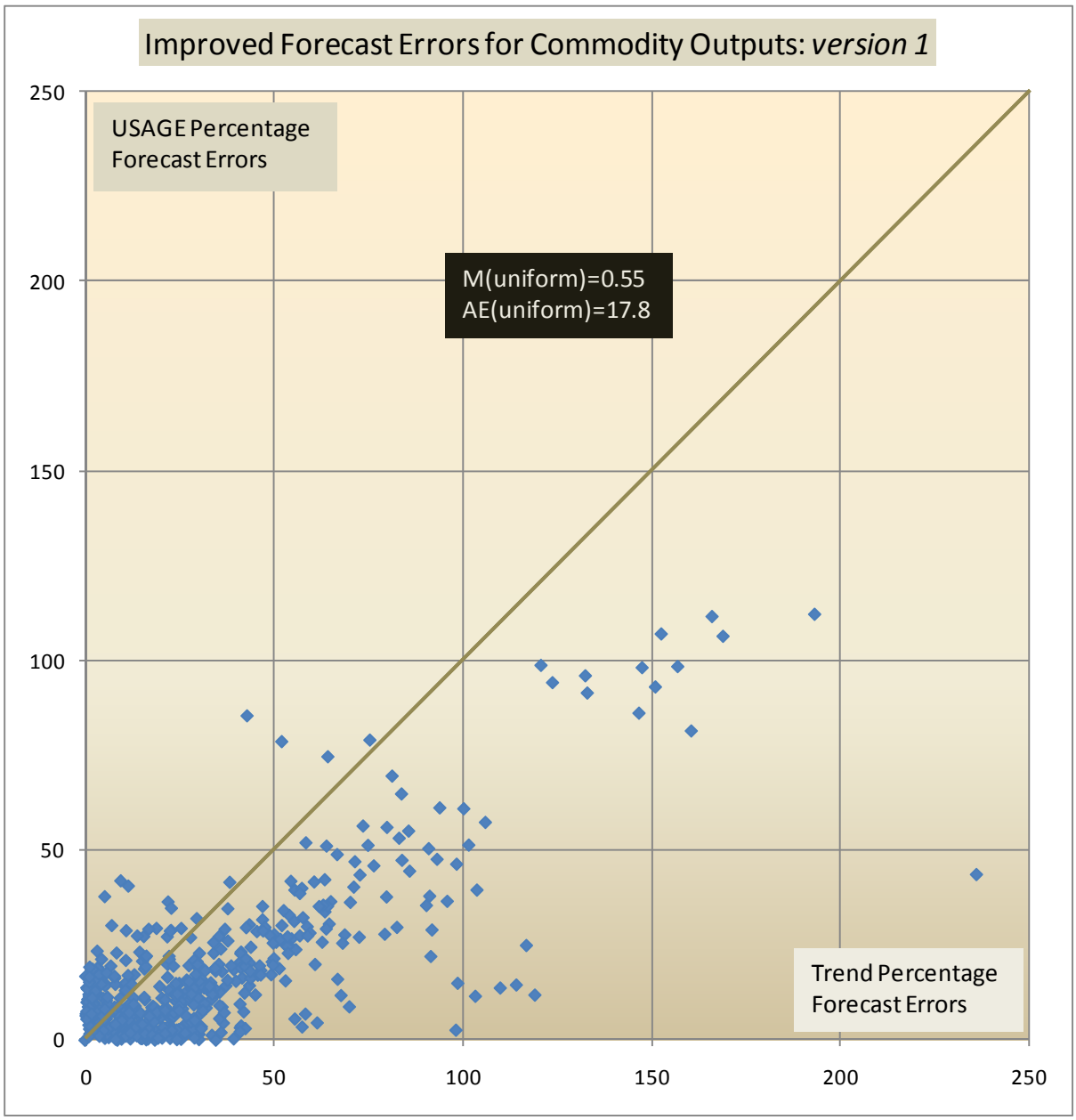

Figure C: Percentage forecast errors for all commodity outputs 1998-2005 – extrapolated 1992-1998 trend forecast versus *version 1* of the improved USAGE pure forecast, which, *inter alia*, assumes the standard treatment of projecting forward the impact of contributions to output of all-factor augmenting technical change

This improved forecast reduces the unweighted average error (AE) to 17.8% from 18.9% in the original USAGE pure forecast. In other words, the forecast error for a typical industry is 17.8% in *version 1* of the improved forecast. With every commodity treated as equally important the ratio of average errors between the pure USAGE forecast and the extrapolation-based trend forecast (denoted by *M*) indicates that USAGE reduces the forecast error by 45% (*M* = 0.55) relative to a simple non-modelling extrapolation approach. This compares favourably to the 42% reduction (*M* = 0.58) in the original USAGE pure forecast.

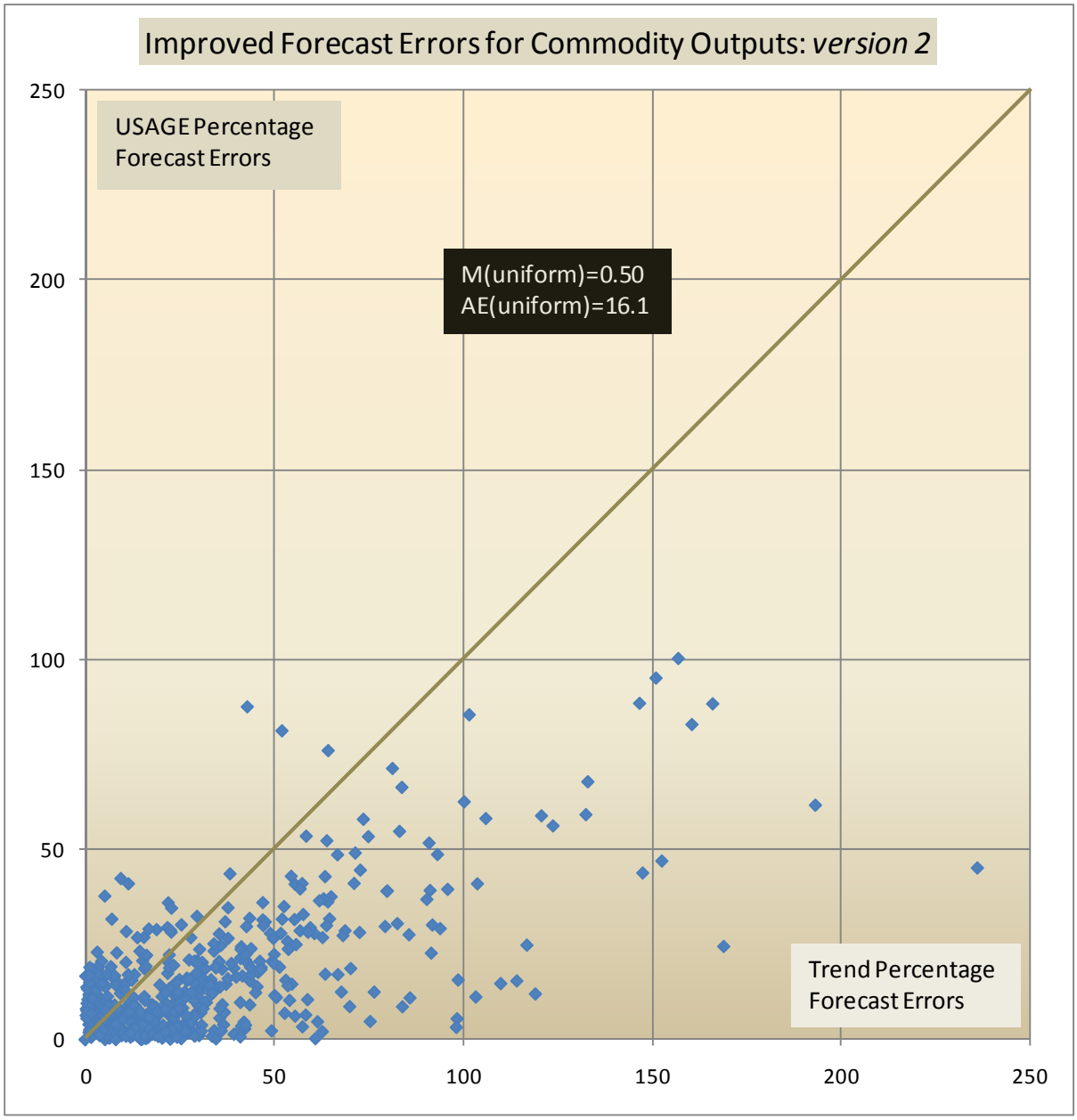

Figure D: Percentage forecast errors for all commodity outputs 1998-2005 – extrapolated 1992-1998 trend forecast versus *version 2* of the improved USAGE pure forecast, which, *inter alia*, does not project forward the impact of contributions to output of all-factor augmenting technical change for all TCF commodities

Figure D charts the results of *version 2* of the improved pure USAGE forecast. As was the case in *version 1* the improved forecast adopts identical *ad hoc* modelling strategies for *AsbestosPrd, ComFishing, ElectronTube, Dolls, Theatres,* and *Recordmedia.* Likewise, the strategy of projecting

forward real basic import prices is implemented for TCF commodities. However, unlike in *version 1* the impact of contributions to output of all-factor augmenting technical change is not projected forward for any of USAGE's 31 TCF commodities. This improved forecast reduces the AE to 16.1% and the *M* coefficient improves to 0.5, indicating that USAGE reduces the forecast error by 50% relative to a simple non-modelling extrapolation approach.

Aggregation	Forecast Type	*M*	AE
Whole economy	Original Forecast	0.58	18.87
	Improved Forecast: *version 1*	0.55	17.79
	Improved Forecast: *version 2*	0.50	16.11
Improvable 'large-error' Commodities ex TCF sector	Original Forecast	1.37	90.54
	Improved Forecast: *version 1*	0.52	34.21
	Improved Forecast: *version 2*	0.53	34.90
TCF sector	Original Forecast	0.74	66.18
	Improved Forecast: *version 1*	0.62	55.40
	Improved Forecast: *version 2*	0.28	25.21
Improvable 'large-error' Commodities inc. TCF sector	Original Forecast	0.82	70.13
	Improved Forecast: *version 1*	0.61	51.97
	Improved Forecast: *version 2*	0.31	26.78
Non-Improvable 'large-error' Commodities	Original Forecast	2.82	41.64
	Improved Forecast: *version 1*	2.85	42.11
	Improved Forecast: *version 2*	2.90	42.76

Table C: *M* coefficients and percentage average errors for the extrapolated 1992-1998 trend forecast versus:
(a) the original USAGE pure forecast;
(b) *version 1* of the improved USAGE pure forecast, which, *inter alia*, assumes the standard treatment of projecting forward the impact of contributions to output of all-factor augmenting technical change;
(c) *version 2* of the improved USAGE pure forecast, which, *inter alia*, does not project forward the impact of contributions to output of all-factor augmenting technical change for all TCF commodities

Table C provides a summary of *M* coefficients and percentage unweighted average errors for the various simulations that were undertaken for this paper. The original USAGE pure forecast outperformed the extrapolated 1992-1998 trend forecast by 42% (1 - *M*) at the macro economy level. The introduction of error-reducing *ad hoc* modelling strategies for *AsbestosPrd, ComFishing, ElectronTube, Dolls, Theatres,* and *Recordmedia*, as well as a broad brush modelling strategy for the 31-commodity TCF sector (where real basic import prices were projected forward) saw the degree of outperformance improve to 45%. The AE was reduced by 108 basis points. This was *version 1* of the improved pure forecast. *Version 2* differed only by the addition of no forward projection of the impact of contributions to output of all-factor augmenting technical change for the TCF sector. This improved the model's outperformance by a further 500 basis points to 50%, and reduced the AE by an additional 168 basis points to 16.11%.

At the more micro level, for an aggregation of *AsbestosPrd, ComFishing, ElectronTube, Dolls, Theatres,* and *Recordmedia*, the original USAGE pure forecast underperformed the extrapolated 1992-1998 trend forecast by 37%, with AE of 90.54%. *Version 1* of the improved forecast slashed the

AE to 34.21%, driving 48% outperformance. Notice that in *version 2* of the improved forecast the results are slightly worse for this aggregation of commodities despite no direct modelling impact (which was targeted at the TCF sector). This is a general equilibrium model, and as in the real world significant changes in one part of the economy can have broader indirect effects. With the exception of *ComFishing*, where forecast output was exogenously fixed, small changes were felt in areas such as wage-rental rates, capital-labour ratios, etc. In the case of the other 5 commodities in this aggregation the sum of the percentage forecast errors turned out to be slightly larger. For the sake of completeness, *AsbestosPrd, ElectronTube,* and *Recordmedia*, had slightly larger forecast errors (all by less than 2%), while *Dolls* and *Theatres* had slightly smaller forecast errors (both by less than 0.4%).

For the TCF sector aggregation, the original USAGE pure forecast outperformed the extrapolated 1992-1998 trend forecast by 26%. However, this was accompanied by an AE of 66.18%; the size of which reduced the usefulness of this forecast. While the model outperformed trend overall in this 31-commodity sector, 6 of these commodities were among the twenty worst errors listed in Table A. *Version 1* of the improved forecast reduced the AE to 55.40%, driving 38% outperformance. The biggest performance gains were seen in *version 2* of the improved forecast, where the modelling strategy specifically targeted the TCF sector. In this case the AE fell significantly, to 25.21%; while the model's outperformance spiked to 72%. Analogous results are reported for the combined 6-commodity aggregation and TCF sector.

Among the 20 worst errors featured in Table A were 5 commodities that could be described as resources related. These are essentially energy and mining related commodities: *AccStrucSMD, PetNgExplor, PetNgDrill, Nonferrores,* and *Copperore*. Without great foresight it is probably unlikely that a better forecast could have been generated for these commodities or sectors in general. The same is perhaps true for the construction-related commodity, *CutStone*, where it was not clear cut whether an improved forecast could have been generated. Analysis of these commodities generally found that their volatile and cyclical nature would require great faith in even the most well-regarded sector experts for projections extending beyond a couple of years. In 1998 could the modeller have confidently predicted the economic gloom of 2002 and the strength of the rebound from 2004? It seems unlikely. Table C reports that USAGE underperformed trend extrapolation by 182% in the original pure forecast. This was accompanied by an AE of 41.64%. Furthermore, both versions of the improved forecast had slightly deleterious effects on this aggregation of commodities.

Moreover, while large improvements in forecast accuracy can be obtained for some industries and sectors, the overall economy-wide forecast error does not fall greatly due to the sheer volume of commodities. While it is disappointing that the error is not very reducible, it is also reassuring because it implies that the default implementation of the model is quite powerful. In all the twenty worst errors on a relative and/or absolute basis (about 4% of all commodities) were specifically examined to assess the potential for error reduction [20/503]. However, after due consideration about 7.5% of commodities were in some way directly re-projected [37/503]. To generate a large reduction in the forecast error (and hence improvement in model performance) would require an extensive amount of work and probably call for the input of numerous industry specialists.

SECTION 2 – Error Reduction Strategies

Ad Hoc Approach: Specific Knowledge for Specific Commodities

Reductions in the magnitude of forecast errors are attainable for certain commodities where specialist knowledge of industry trends and conditions are implemented into the model. For instance, if close examination of an industry provides clear evidence that prospects are likely to be poor, the modeller ought to be suspicious of a forecast result that opposes this. Among the top 20 errors listed in Table A there were 6 instances where this approach could be sensibly applied. These USAGE commodities were: *AsbestosPrd, ComFishing, ElectronTube, Dolls, Theatres, and Recordmedia.* The approach is *ad hoc* because the response is made on a case-by-case basis. Sometimes it meant nullifying the projection of large values for the impact of import twist factors; other times it required nullification of domestic and foreign preference variables; or some combination of the above.

Figure E shows that the AE for these commodities under the original forecast was 90.5% (AE = 90.5) and that USAGE had underperformed the trend forecast by 37% (M = 1.37). The degree of underperformance would have much greater had the trend forecast *ElectronTube* not been so terrible. Implementation of specific modelling strategies, consistent with all available evidence by 1998, resulted in a dramatic improvement in the baseline forecast for these commodities. The AE fell to 34.2%, and the model delivered 48% outperformance. The arrows in Figure E point to the new position of the percentage error coordinate for each commodity; the longer the arrow, the larger the improvement in the USAGE forecast.

Further below detailed analysis is shown for these commodities (except *AsbestosPrd*). In each instance this is divided into several parts, typically as follows:

- Why the model gave erroneous prospects to the commodity
- Analysis of industry conditions as they were known by December 1998
- Explanation of why the original forecast ought to have been rejected
- Strategy to improve the forecast

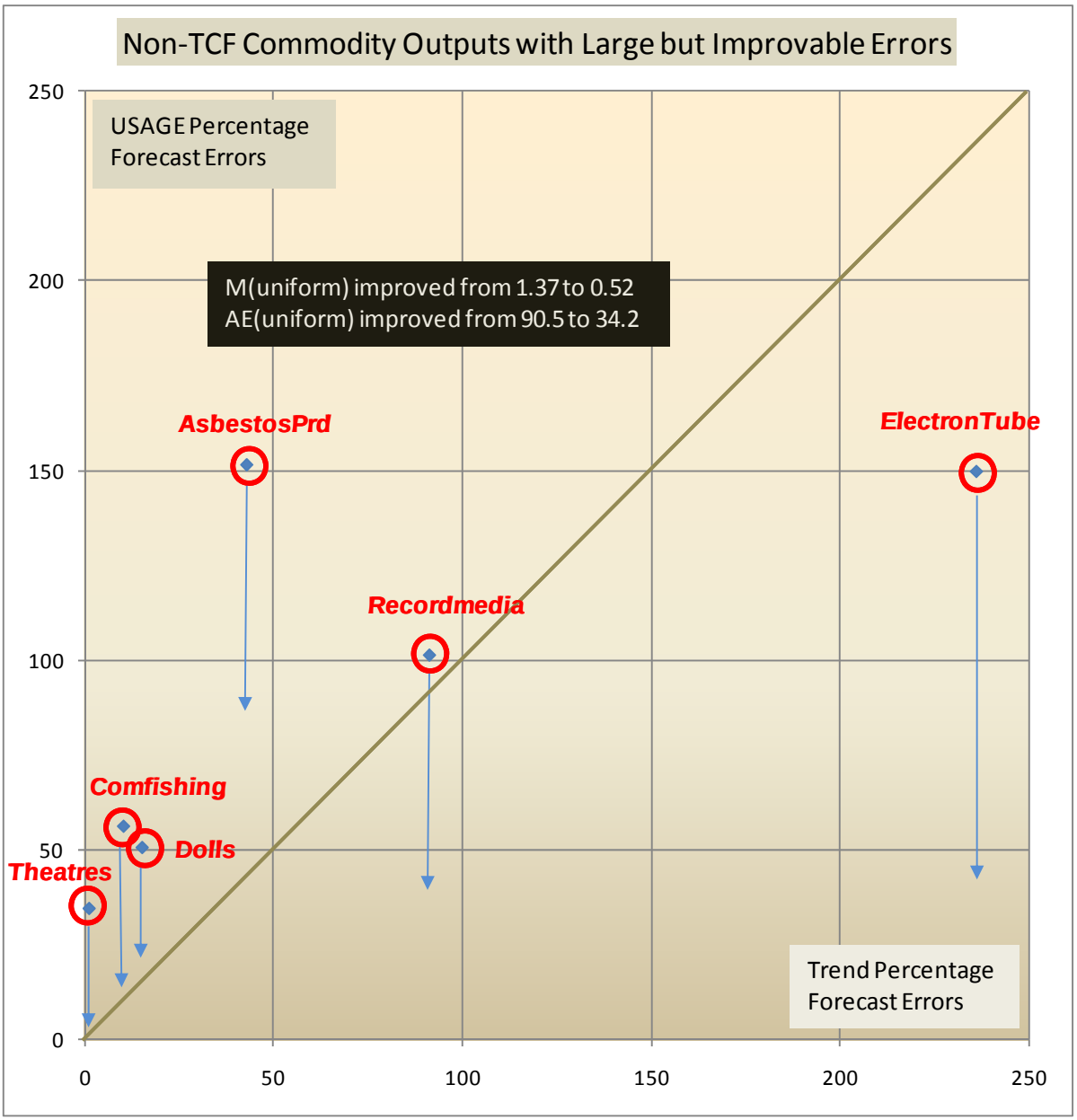

Figure E: Percentage forecast errors for 'large error' commodity outputs 1998-2005 – extrapolated 1992-1998 trend forecast versus the original USAGE pure forecast

ComFishing → Commercial Fishing (Industry Group 091)

This is part of Fishing, hunting, and trapping, and includes establishments primarily engaged in commercial fishing (including crabbing, lobstering, clamming, oystering, and the gathering of sponges and seaweed), and the operation of fish hatcheries and fish and game preserves, in commercial hunting and trapping, and in game propagation.

Industry Group 091: Commercial Fishing

- *0912 Finfish*
- *0913 Shellfish*
- *0919 Miscellaneous Marine Products*

ComFishing - Commercial Fishing	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	0.6	-2.5	7.6	7.5
All factor augmenting technical change	*a1prim*	12.5	14.8	13.0	13.0
Contribution to output of all factor augmenting technical change	*cont_a1prim*	7.8	10.5	9.2	9.2
Combined change in household tastes	*a3com*	9.2	10.2	10.9	10.9
Commodity-using technical and taste change	*ac*	13.7	5.5	13.0	13.0
Contribution to output of commodity-using technical & taste change	*cont_ac*	7.7	3.8	9.0	9.0
Vertical shift of the export demand curve	*cont_fepc*	-21.5	0.6	-24.6	-9.7
Import/domestic twist by commodity	*ftwist_src*	-61.5	274.8	-76.7	0.0
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	98.6	-68.3	122.6	0.0
Twist caused by strong growth	*twist_eff*	-10.2	-8.0	4.3	-3.5
Basic price of domestic goods	*p0dom*	48.3	10.7	40.6	29.2
Basic price of imported goods	*p0imp*	14.6	14.5	30.2	31.7
Ratio of basic prices: domestic to import	*fpdm*	29.7	-3.4	8.2	-1.9
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	29.5	24.8	16.4	17.6
Total supplies of domestic goods	*x0dom*	**-18.9**	**-12.8**	**36.4**	**0.0**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	71.1	-53.9	99.7	7.2
Total supplies of imported goods	*x0imp*	17.8	58.0	-19.8	22.4
Household demands undifferentiated by source	*x3*	28.0	39.4	15.8	17.6
Export volumes	*x4*	-55.9	50.9	-57.3	-9.7
Change in net import share to domestic output	*dtradeshare*	46.4	87.7	-35.2	37.1

Table 1: *ComFishing* results

1. **Why did the model erroneously give good prospects to Commercial Fishing?**

The model predicted 36.4% growth for the 1998-2005 period. This is highlighted in Table 1 and can be seen in the row containing "Total supplies of domestic goods" (*x0dom*), along with several other key results. The actual outcome was a 12.8% decline, which followed an 18.9% decline between 1992 and 1998. In trying to explain these results, it is worth pointing out some characteristics of the initial database as at 1992. The main users, cost structure and other information of interest can be seen in Table 2, which has been divided into 6 sections. The model allows for commodities to be produced in multiple industries. Sections 1 and 2 illustrate the main producers of the commodity, along with the overall output of the industry that is the chief producer of the commodity. In this

case the commodity is only produced by the Commercial Fishing industry (USAGE industry 19: *ComFishing*). Some of the key features of the Commercial Fishing database include the following:

- 71% of production measured at basic prices[10] was exported. This can be seen in the last column of Section 3 in Table 2 [0.71 = 2265/3735].
- The remaining output was sold into the domestic market. Table 2, Section 5 (Market Share) includes these sales and shows them at purchasers' prices, along with the sum of intermediate and final demands. The row referring to "Current Production" indicates that 82% of domestically produced Commercial Fishing sold domestically was purchased for intermediate use. The residual was purchased by domestic households (19%). A small reduction in inventories accounted for -1%.
- 81% of total domestic sales came from imports. This can be seen in the last row of the third column of Section 5 in Table 2 [0.81 = 5469/6753].

During the period 1992-1998 there was a 71.1% increase in domestic sales of domestic production of *ComFishing* (see row containing *x0dom_dom* in Table 1). The spike in domestic sales took place despite a materially unfavourable change in relative prices (see row containing *fpdm* in Table 1). In particular, the basic price of domestic *ComFishing* (see *p0dom* in Table 1) increased 29.7% more than the basic price of its imported equivalent (see *p0imp* in Table 1)[11]. Imported *ComFishing* became relatively more attractive but rose *only* 17.8% (see *x0imp* in Table 1).

On the basis of relative price changes alone, the ratio of imported to domestic *ComFishing* being sold into the domestic market would have increased by 107%.[12] [107% = $1.297^{2.8}$]. Instead it fell 31% [= (1.178/1.711 - 1)*100]. As domestic sales surged 71%, exports declined sharply (*x4* fell 55.9% as shown in Table 1) as these were being diverted into the domestic market; and overall domestic output fell *only* 18.9%.

Given the observed historical values for *ComFishing* from 1992 to 1998 and given the unfavourable change in relative prices, the model inferred that there must have been a large preference twist favouring domestic production. Examining the results listed in Table 1, this can be seen in the form of *impftwist* (up 98.6%). According to the model, there was in essence a twist away from imports that resulted in a 98.6% boost to domestic output sold domestically (*x0dom_dom*). Table 3 shows a back-of-the-envelope estimation to help explain how this is calculated.[13]

[10] Basic prices are prices received by producers. In USAGE, supplies of commodities respond to basic prices while demands for commodities respond to purchasers' prices. Purchasers' prices include sales taxes and various margins including wholesale, retail and transport.

[11] The model reported *fpdm* – the change in the relative price ratio – to be 29.7% for *Comfishing* [p0dom/p0imp = 1.483/1.146 = 29.4%, which is very close to the model's estimation]

[12] The parameters in the model known as the Armington elasticities were set at 2.8. C*eteris paribus,* this indicates a good degree of substitution between the domestically produced commodity and the imported equivalent.

[13] Note the estimation method used in the Microsoft Office Excel excerpt only works if there is only one user in each BAS category (or all users in that BAS use it at the same intensity). So if there are several industries using e.g., *AsbestosProducts* in BAS1 (which there are) and they use it in different ratios then the Excel spreadsheet won't be accurate; whereas *ComFishing* is only used (demanded) as an input in the *ComFishing* industry (as opposed to many industries using it in different ratios, etc).

Commercial Fishing (*ComFishing*) - 1992 Database

1. Main Producers of the Commodity at Basic Prices

Industries	19 ComFishing: 3735	**Total: 3735**
Proportion	19 ComFishing: 1.000	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	18 ComFishing: 3735	**Total: 3735**
Proportion	18 ComFishing: 1.000	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	926	3838	4764	**0.25**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	160	665	825	**0.04**
Exports	BAS4	2665	0	2665	**0.71**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	-16	0	-16	**0.00**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**3735**	**4503**	**8238**	
Source/Total		**0.45**	**0.55**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	67 PreparedFish: 484	457 EatDrinkPlce: 296	Rest: 146	Total: 926	**Total: 0.194**
Imported	67 PreparedFish: 2011	457 EatDrinkPlce: 1227	Rest: 600	Total: 3838	**Total: 0.806**
Total	**67 PreparedFish: 2495**	**457 EatDrinkPlce: 1523**	**Rest: 746**	**Total: 4764**	
Proportion	**67 PreparedFish: 0.524**	**457 EatDrinkPlce: 0.320**	**Rest: 0.157**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	1058	4451	5509	**0.82**	**0.16**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	242	1018	1260	**0.19**	**0.04**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	-16	0	-16	**-0.01**	**0.00**
Total	**1284**	**5469**	**6753**		
Source/Total	**0.19**	**0.81**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	1286	**0.34**	LABOUR	1379	**0.58**
Factor	2374	**0.64**	CAPITAL	995	**0.42**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	75	**0.02**	**Total**	**2374**	
Total	**3735**				

Source	c. Intermediate Inputs				Proportion
Domestic	195 LubricatOils: 349	46 OthMRconst: 303	Rest: 578	Total: 1230	**Total: 0.957**
Imported	110 CordageTwine: 36	18 ComFishing: 8	Rest: 12	Total: 56	**Total: 0.043**
Total	**195 LubricatOils: 349**	**46 OthMRconst: 303**	**Rest: 634**	**Total: 1286**	
Proportion	**195 LubricatOils: 0.271**	**46 OthMRconst: 0.236**	**Rest: 0.493**		

Table 2: The key attributes of *ComFishing* in 1992

As can be seen in Table 3 *ComFishing* is only used by *BAS1* (production) and *BAS3* (households) and in the same proportion by source (import-domestic). It can also be seen that the share of sales at basic prices of domestically produced *ComFishing* in 1992 was 19.4%[14]. Given the model inferred an import-domestic twist (*ftwist_src*) of -61.52% as shown in Table 1 and the top left corner of Table 3, *ceteris paribus*, this would have had the impact of growing domestic market share from 19.4% to 38.5% by 1998. In other words, the contribution of the shifter on the twist (*impftwist*) was in the order of 98% [= 38.5/19.4].

ftwist_src	-61.52%	*ComFishing* : 1992-1998 (Historical Simulation)				
		start		**end**		
Import	3838	80.57	2.60	61.47	1.60	
Domestic	926	19.43		38.53	1.60	98.28
Total	**4764**	**= BAS1**				
		start		**end**		
Import	0	0	0	0	0	
Domestic	0	0		0	0	0.00
Total	**0**	**= BAS2**				
		start		**end**		
Import	665	80.56	2.59	61.46	1.59	
Domestic	160	19.44		38.54	1.59	98.25
Total	**825**	**= BAS3**				
				Weighted Average =		**98.28**
Sales	**5588**			**versus USAGE *impftwist***		**98.58**
The difference is due to b.o.t.e. estimation error						

Table 3: 1992-1998 – The impact of the shifter on the import preference twist on *ComFishing*

However, unfavourable changes in relative prices and rising costs stifled the rise in forecast market share, instead growing to 30.9% rather than 38.5% as shown in Table 3.[15] In fact, the strong domestic-production-boosting *impftwist* was projected forward (at 122.6% in the forecast run as can be seen in Table 1).[16] Given high import penetration there was lots of room for domestic output to grow and replace imports. This outcome was reflected in the forecast for 1998-2005. The result was twist factors contributed a 122.6% boost to the domestic sales of domestically produced *ComFishing (x0dom_dom* spiked by 99.7%) in forecast. This is the key reason for the erroneous forecast of a 36.4% increase in domestically produced *ComFishing*.

2. Given industry conditions it ought to have been realised that domestic output is *unlikely* to have expanded

A rudimentary examination of the industry in 1998 would have revealed that a restrictive regulatory regime had been imposed just two years earlier on commercial fishing activities; and that this would likely have resulted in lower catches (output) going forward, as well as relatively strong upward pressure on prices of the domestic product (*p0dom*) versus the imported commodity (*p0imp*).

The NOAA (National Oceanic & Atmostpheric Administration) is charged with protecting and preserving the nation's living marine resources through scientific research, fisheries management,

[14] This can also be found in Table 2 Section 4 (Sales of Commodity to Domestic Users) in the last column along the "domestic" row.
[15] 30.9% is not shown, but was reflected by the post-simulation values of *BAS1* and *BAS3* for *Comfishing*.
[16] The extrapolation was as follows: $1.986^{7/6}$ = 222.6 or 122.6%.

enforcement and habitat conservation. NOAA's National Marine Fisheries Service (NOAA Fisheries) is the lead federal agency responsible for the stewardship of the nation's offshore living marine resources and their habitat. NOAA Fisheries manages, conserves and protects fish, whales, dolphins, sea turtles and other living creatures in the ocean. NOAA Fisheries works within the Magnuson-Stevens Act, the Marine Mammal Protection Act and the Endangered Species Act to fulfill its mission of promoting healthy ecosystems. (http://www.noaa.gov/fisheries.html)

On October 11, 1996 the Sustainable Fisheries Act (SFA) became law. This marked a significant change in the requirements to prevent overfishing and rebuild overfished fisheries. The SFA amended the Magnuson Fishery Conservation and Management Act (renamed the Magnuson-Stevens Fishery Conservation and Management Act). SFA amendments and changes to the Magnuson Act include numerous provisions requiring science, management and conservation action by the National Marine Fisheries Service (NMFS). (http://www.nmfs.noaa.gov/sfa/)

The 'SFA Update' was published periodically from June 1997 to April/May 1998 by the National Marine Fisheries Service (NMFS) Office of Sustainable Fisheries. It contained information on actions taken by NMFS to implement Sustainable Fisheries Act amendments to the Magnuson-Stevens Fishery Conservation and Management Act. (http://www.nmfs.noaa.gov/sfa/update.html). In the June 1997 'SFA Update' page 1 states:

> "Some key provisions of the Sustainable Fisheries Act include:
>
> - Preventing overfishing, and ending overfishing of currently depressed stocks;
> - Rebuilding depleted stocks;
> - Reducing bycatch and minimizing the mortality of unavoidable bycatch;
> - Designating and conserving essential fish habitat;
> - Reforming the approval process for Fishery Management Plans and regulations;
> - Reducing conflict-of interest on Regional Councils; and
> - Establishing user fees"

This seems to make it fairly clear that several measures would be implemented that would likely impede growth in the *ComFishing* sector. It seems that armed with this knowledge it would have been difficult to foresee industry expansion during the forecast horizon.

> "In the half dozen years prior to passage of the SFA [this would include the 1992-1998 run], the councils and NOAA Fisheries developed and implemented several individual transferable quota (ITQ) programs. ITQs were established in the surf clam/ocean quahog fishery in the Mid-Atlantic, the wreckfish fishery in the South Atlantic, and the fixed gear halibut and sablefish fisheries in the North Pacific ... The movement toward ITQs prompted a heated debate and, responding to concerns about consolidation of quota ownership and other social impacts, Congress changed the name of this program from ITQ to individual fishing quotas (IFQ) and included a four-year (1996 - 2000) moratorium on new IFQs in Section 303(d) of the SFA (later extended to September 30, 2002). " (page26, http://www.nmfs.noaa.gov/sfa/SFA-Report-FINAL7_1.pdf)

The moratorium lapsed in 2002 and old rules again applied (and it seems to great effect).

3. Conclusion

In concluding, the crucial factor for *ComFishing* was the domestic production boost via *impftwist*, which was projected forward. This overwhelmed the impact of the lower foreign demand because by 1998 producers and households had a 60% of total output (up from 29% in 1992). Meanwhile, the share of exports in total out had fallen to 39% from the 71% share in 1992. Had the model been tweaked to account for the impact of industry-impeding legislative change in the mid to late 1990s it seems likely that a more accurate forecast would have emerged. For instance, in these circumstances a modeler would find it hard to believe that any projected domestic expansion would be so large as to squeeze out or replace such a large volume of imports. This is because the regulatory/environmental restrictions would have suggested a shortage that could only be met by higher imports, which is in fact what appears to have happened, and had started happening in the 1992-1998 period. The relatively fast rising domestic-import price ratio was a symptom of when the bans started to apply more widely and when the regulatory change started to gather pace.

Overall, there is little doubt that in these types of situations the modeler should apply a specialised strategy to avoid projecting forward the domestic market share impact of *large* import twists. It appears that a similar idea should apply to exports as it is notoriously difficult to predict foreign demand. Perhaps very large shifts in foreign preferences should be closely investigated, in terms of likely sustainability, rather than be automatically projected forward. Given that the focus of the forecasts is on commodity output, it would be preferable to further examine the expected trade balance for an industry (and in turn, absorption) and treat exports as a residual, i.e., rather than try to explain trade at the gross level, report the net level.

4. Strategy to improve the forecast

Based on industry conditions between 1992 and 1998 a better forecast for *ComFishing* could have been produced. Given the restrictive nature of the regulations it is unlikely that output would have expanded. Knowing this, the strategy in re-running the simulation was to fix output growth at zero and endogenise export volumes (as no clear view could be formed on likely changes to foreign demand). The model was prevented from projecting forward the impact on domestic production of the import/domestic preference twist. By setting this to zero, this prevented the unlikely large boost to domestic sales of U.S.-produced output versus imports. By forcing zero output growth the USAGE error fell from 56% to 15%.

The result more generally is shown in the last column of Table 1. The model-imposed constraint on overall domestic output meant that a domestic commodity favouring 1.9% change in forecast relative prices could not fully filter through into local sales of domestically produced *ComFishing*. With strong demand from households and producers there was a 22.4% rise in imports. Despite the overall *ComFishing* output growth constraint, *x0dom_dom* rose 7.2% as exports (down 9.7%) were diverted back into the domestic market. This compares favourably to the 99.7% rise in the original forecast. Actual *x0dom_dom* was a 53.9% decrease due to strong import penetration on the back of a sharp reversal of *impftwist* that resulted in significant damage to domestic sales of domestically produced *ComFishing*. Absorption rose 17.6% versus 16.4% in the original forecast – the actual result was a 24.8% increase driven by very strong import growth. In terms of *net* trade, net imports as a proportion of domestic output rose 37.1% (*dtradeshare*) versus a 35.2% reduction in the original forecast. The actual result was an 87.7% increase due to the surge in imported *ComFishing*.

ElectronTube → Electron Tubes (SIC 3671)

Establishments primarily engaged in manufacturing electron tubes and tube parts. Not x-ray tubes. Includes cathode ray tubes, light sensing and emitting tubes, and television tubes.

ElectronTube - Electron Tubes	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-20.3	-20.8	-19.0	-21.0
All factor augmenting technical change	*a1prim*	-55.4	-16.8	-67.9	-67.9
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-23.6	-5.0	-26.9	-26.9
Combined change in household tastes	*a3com*	57.2	35.4	69.5	69.5
Commodity-using technical and taste change	*ac*	12.4	-8.9	17.3	0.0
Contribution to output of commodity-using technical & taste change	*cont_ac*	10.2	-6.4	12.0	0.0
Vertical shift of the export demand curve	*cont_fepc*	41.5	-31.7	49.9	0.0
Import/domestic twist by commodity	*ftwist_src*	-76.3	16.3	-94.5	0.0
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	26.8	-2.0	31.9	0.0
Twist caused by strong growth	*twist_eff*	19.4	-8.4	17.2	1.7
Basic price of domestic goods	*p0dom*	-19.3	-19.5	-11.8	-14.4
Basic price of imported goods	*p0imp*	-30.7	-27.8	-25.4	-24.5
Ratio of basic prices: domestic to import	*fpdm*	16.2	11.2	18.0	13.2
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	92.8	14.0	91.4	60.0
Total supplies of domestic goods	*x0dom*	148.0	-14.3	114.3	23.3
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	112.6	14.4	119.3	51.8
Total supplies of imported goods	*x0imp*	40.2	15.2	-39.3	104.2
Household demands undifferentiated by source	*x3*	98.4	75.7	102.2	102.3
Export volumes	*x4*	282.3	-72.4	106.8	-33.0
Change in net import share to domestic output	*dtradeshare*	-28.1	24.8	-10.0	21.8
HldAudioVid - Household Audio & Video Equipment	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-2.8	0.0	-3.0	
All factor augmenting technical change	*a1prim*	-32.6	-18.4	-40.1	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-6.7	-3.2	-7.7	
Combined change in household tastes	*a3com*	18.2	45.9	21.5	
Commodity-using technical and taste change	*ac*	-25.6	-6.5	-32.5	
Contribution to output of commodity-using technical & taste change	*cont_ac*	-4.0	-0.8	-4.6	
Vertical shift of the export demand curve	*cont_fepc*	12.4	-14.5	14.6	
Import/domestic twist by commodity	*ftwist_src*	-23.9	118.3	-28.2	
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	21.0	-46.0	24.9	
Twist caused by strong growth	*twist_eff*	7.7	-4.8	9.9	N/A
Basic price of domestic goods	*p0dom*	-5.8	-2.8	-1.8	
Basic price of imported goods	*p0imp*	-5.1	0.6	7.7	
Ratio of basic prices: domestic to import	*fpdm*	-0.7	-3.4	-8.8	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	41.3	80.0	33.8	
Total supplies of domestic goods	*x0dom*	66.3	0.1	67.0	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	64.3	5.5	52.8	
Total supplies of imported goods	*x0imp*	34.6	105.0	25.2	
Household demands undifferentiated by source	*x3*	44.3	88.1	37.6	
Export volumes	*x4*	90.2	-9.5	96.8	
Change in net import share to domestic output	*dtradeshare*	-44.0	191.2	-37.4	

Table 4: *ElectronTube* & *HldAudioVid* results

ElectronTube had a USAGE error of 149%. However it was situated well below the 45 degree line due to the extremely erroneous trend forecast – the forecast trend error was 236%. Actual growth was a 14.3% decline over the 1998-2005 period, which has been highlighted in the top section of Table 4. This followed a 148.0% rise from 1992-1998 – the extrapolated trend was therefore 189%, versus the USAGE forecast of 114% growth.

1. **Why did the model predict 114.0% growth for 1998-2005 when the true outcome was a 14.3% decline?**

Following the protocols used in the section on *ComFishing,* key results appear in Table 4, while certain characteristics of the 1992 database (such as main users, cost structure, market share, etc.) appear in Table 5. These include the following:

- This is a multi-industry commodity, mostly produced by the Electron Tubes industry (USAGE industry 355: *ElectronTube*). This industry also produces other commodities. These observations can be confirmed in Sections 1 and 2 of Table 5.
- 78% that was sold into the domestic market and all of this was to producers. 21% of production was exported. These observations can be confirmed in Section 3 of Table 5.
- The Household Audio & Video Equipment industry was the main buyer of Electron Tubes. This is USAGE industry 351: *HldAudioVid* and appears in Section 4 of Table 5.
- About 27% of total domestic sales came from imports, which can be seen in Section 5 of Table 5.

There were several contributing factors to the erroneous forecast. Perhaps the main reason was the poor forecast for the main purchaser of Electron Tubes – *HldAudioVid*. Indeed, there were a number of similarities in the results for *ElectronTube* and *HldAudioVid* that can be seen in Table 4, such as:

1. The large upward shift in the export demand curve, which was projected forward thereby overestimating foreign demand (see results for *cont_fepc* in Table 4).
2. The strong twist trend impact on domestic sales of U.S. output was projected forward, when it in fact moved sharply in the opposite direction (see results for *impftwist* in Table 4).
3. The above factors combined to generate growth well above the rate of real GDP. This resulted in an additional import-favouring twist effect, thereby preventing even higher forecast domestic output (see results for *twist_eff)* in Table 4).

With overall domestic market supplies growing faster than demands by the main users of the commodity, the model implied fairly strong *ElectronTube*-using technical change (*ac*), and the contribution to output of this term was projected forward (*cont_ac*). To see this, start by looking in Table 4, from 1992-1998, at the row entitled "Quantity of sales of domestically produced in U.S." (*x0dom_dom*). For *ElectronTube* this shows growth of 112.6%. However, in results not shown here demand for inputs of domestically-sourced *ElectronTube* for current production by *HldAudioVid* (the main user) grew by only 97.7%.

Electron Tubes (*ElectronTube*) - 1992 Database

1. Main Producers of the Commodity at Basic Prices

Industries	355 ElectronTube: 2970	351 HldAudioVid: 292	Rest: 218	**Total: 3480**
Proportion	355 ElectronTube: 0.853	351 HldAudioVid: 0.084	Rest: 0.063	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	345 ElectronTube: 2970	347 OthElectronC: 72	Rest: 68	**Total: 3110**
Proportion	345 ElectronTube: 0.955	347 OthElectronC: 0.023	Rest: 0.022	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	2715	1015	3730	**0.78**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	736	0	736	**0.21**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	29	0	29	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**3480**	**1015**	**4495**	
Source/Total		**0.77**	**0.23**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	351 HldAudioVid: 1505	494 FGCEnatdef: 203	Rest: 1007	Total: 2715	**Total: 0.728**
Imported	351 HldAudioVid: 442	355 ElectronTube: 285	Rest: 289	Total: 1015	**Total: 0.272**
Total	**351 HldAudioVid: 1947**	**355 ElectronTube: 350**	**Rest: 1434**	**Total: 3730**	
Proportion	**351 HldAudioVid: 0.522**	**355 ElectronTube: 0.094**	**Rest: 0.384**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	2976	1129	4105	**0.99**	**0.72**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	29	0	29	**0.01**	**0.01**
Total	**3005**	**1129**	**4134**		
Source/Total	**0.73**	**0.27**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	2027	**0.65**	LABOUR	1004	**0.95**
Factor	1057	**0.34**	CAPITAL	53	**0.05**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	26	**0.01**	**Total**	**1057**	
Total	**3110**				

Source	c. Intermediate Inputs				Proportion
Domestic	214 Glass: 593	262 SheetMtlWork: 129	Rest: 761	Total: 1483	**Total: 0.731**
Imported	345 ElectronTube: 318	214 Glass: 170	Rest: 57	Total: 545	**Total: 0.269**
Total	**214 Glass: 763**	**345 ElectronTube: 389**	**Rest: 875**	**Total: 2027**	
Proportion	**214 Glass: 0.376**	**345 ElectronTube: 0.192**	**Rest: 0.432**		

Table 5: The key attributes of *ElectronTube* in 1992

As can be seen in Section 5 of Table 5, *ElectronTube* derives its demand from the demand for "other" goods, such as televisions, which is an important component of *HldAudioVid.* Furthermore, these "other" goods were subject to rapid changes in technology that did not require any *ElectronTube* input. Sales of domestically produced *ElectronTube* were forecast to more than double and to replace imports (see *x0dom_dom* in Table 4), even as relative price changes favoured imports. The basic price of imported *ElectronTube* was expected to fall by 25.4%, while the basic price of domestically-produced *ElectronTube* was expected to fall by just 11.8%. In light of this, and given that sales of domestically produced *ElectronTube* (*x0dom_dom*) comprised the lion's share of the U.S. market, *impftwist* must have had an enormous influence on the projection of total production (*x0dom*). In forecast, the 18.0% import-favouring move in relative prices (*fpdm*) implied, *ceteris paribus*, that the import-domestic ratio should have increased 59.0% [$=1.18^{2.8}$]; but it in fact *fell* 72.3% [=0.607/2.193] due to:

- the 31.9% boost to sales of domestically produced *ElectronTube,* which already dominated the U.S. market (see *impftwist* in Table 4);
- strong commodity-using technical change that made a 12% contribution to domestic output of *ElectronTube* (see *cont_ac* in Table 4); and
- the reinforcing effect of another strong rise in the export demand function – this was extrapolated in the forecast as a 49.9% upward shift in the export demand curve (see *cont_fepc* in Table 4). This produced the dubious and material impact of a further doubling (+106.8%) in export volumes, having almost quadrupled (+282.3%) during the period from 1992-1998.

2. Given industry dynamics it ought to have been realised that domestic output was *unlikely* to expand

Direct view cathode ray tubes (CRTs) and rear projection tubes, whilst improving in functionality, suffered from the major disadvantage of their overall size in that they occupied large parts of a room (floor space), or desk space in the case of a computer monitor. These products dominated the television and monitor (display) market during the 1992-1998 period and falling prices (a process that was accelerated by the arrival of Chinese imports), as well as the strong uptake of computers and the internet, resulted in a surge in demand. However, during the 1998-2005 period the increased penetration of newer technologies (such as plasma and LCD flat panels) in the television and 'visual' industry more generally, revolutionised the type of television or monitor that people could view.

It is worth noting that these types of flat panels (called TFT LCD) were already being used in notebook computers. The key question here is: in 1998 would the modeller have been sufficiently aware of this revolution? If so, then it would be difficult to believe that *ElectronTube* could continue to grow as strongly as in the historical period. In 1992, Fujitsu introduced the world's first 21-inch (53 cm) full-colour plasma display.[17] In December 1994, the International Technology Research Institute at Loyola College in Maryland, produced a publication on display technologies that included

[17] http://en.wikipedia.org/wiki/Plasma_display visited 2 August 2009

an insightful appendix: “World View Of Liquid Crystal Flat Panel Displays” by Dr Patricia E. Cladis.[18] As can be viewed at wtec.org, Dr Cladis wrote:

> “In TFT LCDs, 16.7 million colors are now possible (shown, for example, by the Sharp Corporation at the 1992 Japan Electronics Show in Osaka, Japan).
>
> Once a true color display is seen, multicolor and monochrome displays are unacceptable to many customers in the same way black-and-white TV is unacceptable to viewers of color television. A brightly-colored display is cheerful and friendly. Product enhancement from a color display can outsell an equivalent monochrome product in the consumer market.
>
> About 90% of the world supply of LCDs (and virtually 100% of TFT LCDs) are manufactured by Japanese leaders in the semiconductor industry. According to a Nikkei Microdevices survey, since 1989 LCD production of both passive and active LCDs has grown in Japan at a staggering 35% annual rate (in yen) to about $3.5 billion (435.5 billion yen) in 1991. In 1992, the total LCD growth rate slowed somewhat to a still phenomenal 20%, reaching $4.7 billion (516.5 billion yen), with the TFT LCD sector reporting an outstanding 161% growth (to $1.2 billion or 132.2 billion yen) (Nikkei 1992). According to NEC and Sharp executives, "Nothing has changed the outlook for a 1 trillion yen liquid crystal market (in Japan) by 1995" (Nikkei 1992).
>
> Indeed, Figure F.1 [shown in Figure 1] shows that Asada (a Sharp vice-president) was right on track (Asada 1990) for the LCD world market, where the 1 trillion yen mark [about US$8.5b at the time] is expected by the turn of the century.”

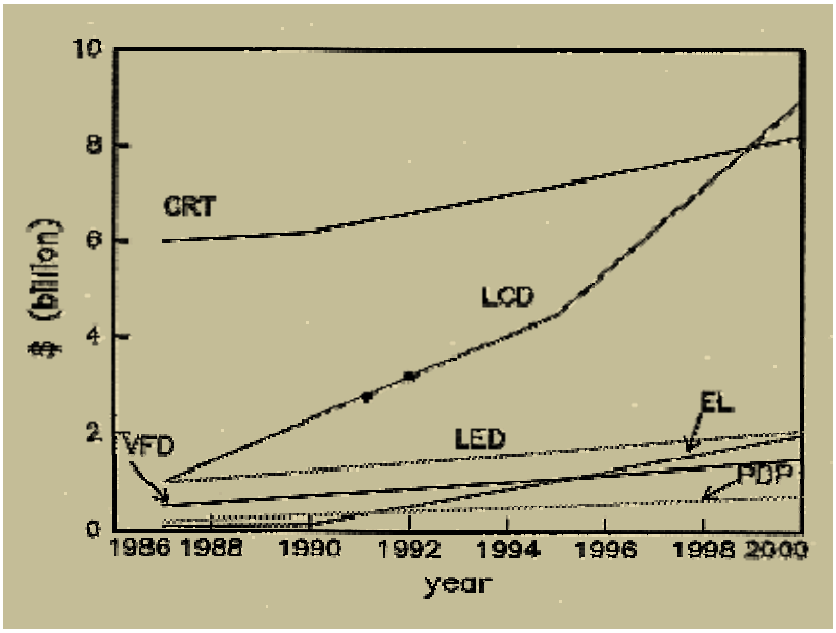

Figure 1: Early projections for the LCD world market

[18] http://www.wtec.org/loyola/displays/af_world.htm visited 2 August 2009. Further references of interest in this article are: Asada, Atsushi. 1990. "Electronic Displays: A Revealing Look at the Latest in LCDs." Display Devices Dempa Publications, Inc. Jul.:30. Also: Nikkei Microdevices. 1992. Flat Panel Display 1993. Dec. 10.

Hence, as early as 1990 projections were readily available that showed expected global sales of LCD technology would exceed CRTs before 2000. Furthermore, a concise summary of the state of global LCD manufacturing in 1994 could be found at: http://www.wtec.org/loyola/displays/c3_s1.htm.

In 1998 flat panel displays were relatively expensive versus a tube television. Though, it appears that by 2002 the price of a plasma display had fallen by enough to allow for increased market penetration.[19] According to Wikipedia:

> "In 1997, Fujitsu introduced the first 42-inch (107 cm) plasma display; it had 852x480 resolution and was progressively scanned. Also in 1997, Philips introduced a 42-inch (107 cm) display, with 852x480 resolution. It was the only plasma to be displayed to the retail public in 4 Sears locations in the U.S. The price was 14 999 US$ and included in-home installation. Later in 1997, Pioneer started selling their first plasma television to the public."[20]

That information from Wikipedia was referenced from a website that was in existence pre-1998: www.tech-notes.tv. Upon visiting the webpage the following commentary was noted from one of the site's owners (Jim Mendrala: J.Mendrala@ieee.org) dated 15 June 1997 (the bolding is mine):

> "...It is **estimated** that by the year 2000, large wide screen TVs will account for one third of the total television market and plasma displays for 10% of that market, or 303 million sets annually. Fujitsu Plasma Displays are already in use at airports, stock exchanges, and other locations worldwide ... Sony says it will have an HDTV receiver using the 42 inch diagonal Plasma Display from Fujitsu available here in the U.S. around the last quarter of 1998. It will have a starting list price of $2,500 but that price is expected to drop rapidly as sales increase."[21]

This then raises the questions of: "who" made that estimation and how widely known was this; and was this subsequently updated by the end of 1998? As seen above there were others making such estimates. It seems there were some expecting CRTs to continue to dominate for some time yet, at least in the computer monitor market as indicated by the following quote from an online tech publication in 1998 (the bolding is mine):

> "CRT monitors will continue to dominate the data display market for the next seven years, despite **"mounting competitive pressure" from flat panel displays.** Worldwide CRT sales will produce $17 billion revenues from 90.5 million units, according to research firm Stanford Resources. By 2004, the worldwide CRT monitor market will reach 134.7 million units, but market value will edge up only slightly to $18.9 billion, as average selling prices continue to decline, Stanford forecasts in the twelfth edition of Monitor Market Trends. The 19-inch CRT monitor is the fastest growing screen size, with expected shipments of 2.4 million units leaping to 23.2 million units in 2004. "With the introduction of new CRTs featuring flatter faceplates, shorter necks, and larger viewing area, CRT-based monitors continue to offer the best price/performance

[19] http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=01002519 see pdf "Scanning the Issue: Special Issue on Flat-Panel Display Technology" out of PROCEEDINGS OF THE IEEE, VOL. 90, NO. 4, APRIL 2002
[20] http://en.wikipedia.org/wiki/Plasma_Display visited 24 July 2009
[21] http://www.tech-notes.tv/Archive/tech_notes_004.htm visited 24 July 2009

> equation for computer applications," Stanford Resources analyst Rhoda Alexander said. Both 17- and 19-inch CRTs are the focal point for growth in the CRT monitor industry into the next decade, while formerly price-prohibitive 20- and 21-inch monitor markets are now becoming increasingly affordable for general computer users," Alexander said."[22]

Stanford Resources produced a publication called Monitor Market Trends. This focused on computer monitors rather than televisions (the difference being that monitors do not have an integrated tuner and are typically much smaller). The reader should notice the strong focus on size. This is in line with the bigger is better motto and was indicative of how consumers had a strong preference for larger viewable areas.

According to the data (in nominal dollars) from the International Trade Administration in Figure 2, the value of imports of *ElectronTube* had started to decline in the mid 1990s. This was also borne out in the trade data for *HldAudioVid*, and was driven by sharp price falls in the basic prices of imports. At the same time the value of exports was rising even as f.o.b. export prices fell. In terms of volumes, these were rising across the board. However, domestic output grew much more strongly than the imported equivalent. This was reflected by the rise in the domestic-import supply ratio in both industries, which can be seen in Table 4 by comparing growth rates of *x0dom* and *x0imp*.

In light of the rising competitive pressure from flat panel technology, and with the U.S. generally regarded as an early adopter of high-tech audio visual products, falling prices was a sign of the old technology making way. It is a regular occurrence for new product release strategies to focus on launching in the world's largest economy, where virtually all of the world's largest companies have a presence. In relation to new technologies, the annual International Consumer Electronics Show in Las Vegas is often the centrepiece for product releases and previews.[23] According to Wikipedia, a notable product introduction at the January 1998 show was High Definition Television (HDTV). The natural implication of this was that 'big' televisions would ultimately display high resolution images.

[22] "CRTs beat back flat panel challenge" By a staffer; Posted in Business, 21st October 1998 12:50 GMT; http://www.theregister.co.uk/1998/10/21/crts_beat_back_flat_panel/. The Register began publishing online daily in 1998.

[23] http://en.wikipedia.org/wiki/Consumer_Electronics_Show page visited 2 August 2009.

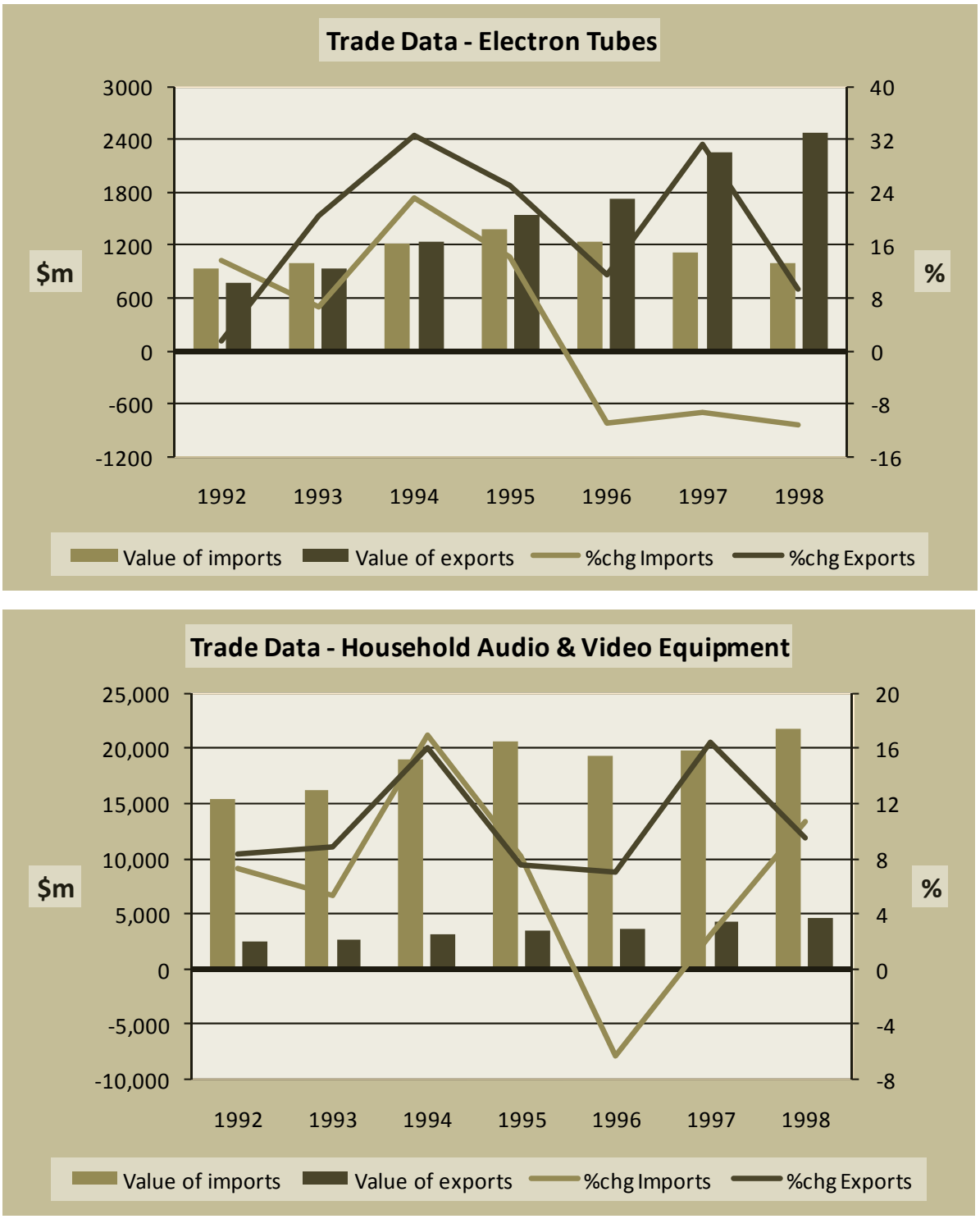

Figure 2: 1992-1998 – U.S. trade by the Electron Tubes and Household Audio & Video Equipment industries

3. Conclusion

Flat panel technology (such as TFT LCD) was already being used in notebook computers. In 1992, Fujitsu introduced the world's first 21-inch full-colour plasma display. As early as 1990, projections were readily available that showed expected global sales of LCD technology would exceed CRTs

before 2000. In light of the rising competitive pressure from flat panel technology, and with the U.S. generally regarded as an early adopter of high-tech audio visual products, falling prices during period from 1992 to 1998 signalled the decline of the CRT technology used in the Electron Tubes industry. The demand for *ElectronTube* is essentially derived from the demand for other goods, such as televisions, monitors and displays. As sleeker, larger screen replacements had already started to appear on the market, it is plausible that a substantial growth slowdown in *ElectronTube* could have been expected to occur during the 1998-2005 period; and at the very least, output more than doubling (as was the case in the original forecast) would have been seen to be a most unlikely scenario.

4. Strategy to improve the forecast

In the historical simulation, a large upward shift in the export demand curve was observed for *ElectronTube*; as well as a strong twist trend impact on domestic sales of U.S.-produced *ElectronTube*; and *ElectronTube*-using technological change. The discussion above suggests that these factors ought not to have been projected forward. As a result, the strategy was to zero out contributions to output from: *ElectronTube*-using taste changes, foreign preference changes, and import/domestic preference twists. This simulation markedly reduced the USAGE error from 149% to 17%.

The overall result (shown in the last column of Table 4) is a more plausible forecast for *ElectronTube.* Output of the commodity rises 23.3% rather than 114.3%; sales of domestically produced *ElectronTube* into the U.S. market rise 51.8% instead of the initial forecast of 119.3%. The actual result of *x0dom_dom* was a 14.4% rise – lower growth than in the improved forecast – as a result of lower than expected supply-side cost savings (see *cont_a1prim*).

The improved forecasts for gross exports and gross imports were directionally accurate; however the errors were too great for these to be of much use. It is again worth noting the difficulty in trying to predict trade flows at the gross level. Given that the overall focus of the forecasts is on commodity output, changes in *net* trade are considered. Net imports as a proportion of domestic output rose 21.8% (*dtradeshare*) versus a 10.0% reduction in the original forecast. The actual result was a 24.8% increase.

Dolls → Dolls & Stuffed Toys (SIC 3942)

This is part of Miscellaneous Manufacturing Industries and covers establishments primarily engaged in manufacturing dolls, doll parts, and doll clothing, except doll wigs. Establishments primarily engaged in manufacturing stuffed toys are also included in this industry.

Dolls - Dolls & Stuffed Toys	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-8.6	-10.8	-8.9	-5.6
All factor augmenting technical change	*a1prim*	-38.5	-28.8	-49.4	-49.4
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-17.3	-10.6	-19.9	-19.9
Combined change in household tastes	*a3com*	9.8	-13.9	11.5	11.5
Commodity-using technical and taste change	*ac*	65.5	-36.2	66.6	66.6
Contribution to output of commodity-using technical & taste change	*cont_ac*	2.0	-1.9	2.3	2.3
Vertical shift of the export demand curve	*cont_fepc*	1.1	-27.3	1.3	1.3
Import/domestic twist by commodity	*ftwist_src*	119.6	-30.5	137.4	0.0
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-53.0	39.4	-58.6	0.0
Twist caused by strong growth	*twist_eff*	-1.8	3.7	-12.0	-1.0
Basic price of domestic goods	*p0dom*	-1.3	1.8	4.9	9.7
Basic price of imported goods	*p0imp*	-10.0	5.5	4.5	5.8
Ratio of basic prices: domestic to import	*fpdm*	9.7	-3.6	0.4	3.7
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	74.9	29.0	40.1	39.8
Total supplies of domestic goods	*x0dom*	**15.9**	**40.4**	**-30.8**	**11.0**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	-20.1	76.4	-45.1	15.4
Total supplies of imported goods	*x0imp*	83.8	25.8	45.4	41.6
Household demands undifferentiated by source	*x3*	70.1	30.5	38.9	38.1
Export volumes	*x4*	11.8	-55.4	9.4	0.9
Change in net import share to domestic output	*dtradeshare*	354.8	-63.6	1,188.7	265.9

Table 6: *Dolls* results

1. **Why did the model erroneously give poor prospects to Dolls & Stuffed Toys?**

Dolls had a USAGE error of 51% and was the third highest observation above the 45 degree line. The forecast trend error was just 15%. Actual growth was 40.4% over the 1998-2005 period (highlighted in Table 6 in the row containing "Total supplies of domestic goods"). This followed a 15.9% rise from 1992-1998 – the extrapolated trend was therefore about 19% growth – yet USAGE forecast a 31% decline. The main users, cost structure and other information of interest can be seen in Table 7, which has been divided into 6 sections. Key characteristics of the 1992 database include:

- 90% of total U.S. sales came from imports, and the vast majority of all sales were to consumers (Section 3).
- 28% of domestic production was exported (Section 3).

During the period 1992-1998 there was a 20.1% decrease in domestic sales of domestic production of *Dolls* (see *x0dom_dom* in Table 6). This fall was larger than could be explained by the unfavourable change in relative prices [*p0dom*/*p0imp* = 0.987/0.9 = 9.7%]. A circa 10% relative price change against U.S.-made *Dolls* somehow translated to an 83.8% rise in imported *Dolls* (see *x0imp* in Table 6) despite limited substitutability between foreign and domestic sources.

Dolls & Stuffed Toys (*Dolls*) - 1992 Database

1. Main Producers of the Commodity at Basic Prices

Industries	397 Dolls: 243	396 Games: 47	Rest: 10	**Total: 301**
Proportion	397 Dolls: 0.809	396 Games: 0.156	Rest: 0.035	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	387 Dolls: 243	386 Games: 5	Rest: 6	**Total: 254**
Proportion	387 Dolls: 0.957	386 Games: 0.020	Rest: 0.024	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	14	86	100	**0.05**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	303	2255	2558	**1.01**
Exports	BAS4	84	0	84	**0.28**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	-100	0	-100	**-0.33**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**301**	**2341**	**2642**	
Source/Total		**0.11**	**0.89**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	397 Dolls: 5	508 Holiday: 3	Rest: 6	Total: 14	**Total: 0.138**
Imported	508 Holiday: 20	397 Dolls: 19	Rest: 48	Total: 86	**Total: 0.862**
Total	**397 Dolls: 24**	**508 Holiday: 22**	**Rest: 54**	**Total: 100**	
Proportion	**397 Dolls: 0.237**	**508 Holiday: 0.222**	**Rest: 0.541**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	20	128	148	**0.04**	**0.00**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	553	4182	4734	**1.17**	**0.12**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	-100	0	-100	**-0.21**	**-0.02**
Total	**472**	**4310**	**4782**		
Source/Total	**0.10**	**0.90**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	151	**0.59**	LABOUR	95	**0.95**
Factor	101	**0.40**	CAPITAL	5	**0.05**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	3	**0.01**	**Total**	**101**	
Total	**254**				

Source	c. Intermediate Inputs				Proportion
Domestic	416 WholesleTrde: 17	202 MiscPlPrdnec: 16	Rest: 88	Total: 121	**Total: 0.802**
Imported	387 Dolls: 23	479 NoncompImps: 5	Rest: 2	Total: 30	**Total: 0.198**
Total	**387 Dolls: 29**	**416 WholesleTrde: 17**	**Rest: 105**	**Total: 151**	
Proportion	**387 Dolls: 0.192**	**416 WholesleTrde: 0.113**	**Rest: 0.695**		

Table 7: The key attributes of *Dolls* in 1992

On the basis of relative price changes alone, the ratio of imported to domestic *Dolls* being sold into the domestic market would have increased by 9.7%.[24] [9.7% = 1.097[1]]. Instead it surged 130% [= (1.838/0.799 - 1)*100]. Technological change[25] could only explain a small part of the disparity, so the model inferred that there must have been a large preference twist against domestically produced *Dolls*. An examination of the results listed in Table 6, shows this in the form of *impftwist* falling 53.0%. According to the model, there was a twist towards imported *Dolls* that resulted in 53.0% damage to U.S. output sold domestically (*x0dom_dom*). After all other factors are taken into consideration domestic sales of U.S.-produced *Dolls* fell 20.1%. With an overall 15.9% rise in domestic output (*x0dom*), this would normally mean that the difference was exported. Indeed foreign markets were important to U.S. producers of *Dolls* because exports comprised 28% of production in 1992. However, export volumes rose 11.8% (see *x4* in Table 6); not enough to fully explain the rise in *x0dom*. The remainder was driven by the change in inventories during the period. At the end of 1992 there were negative inventories of *Dolls* to the tune of $100m (see Section 3 of Table 7). This meant that 33% of demand at that time was met by running down inventories. In results not reported here, inventories increased to (positive) $2m by the end of 1998. With domestic basic prices falling only slightly during this period inventories made a $102m contribution to domestic output. This overwhelmed the 20.7% or circa $65m decline in demand by households for the domestic product.[26]

2. What happened in the forecast?

In the USAGE forecast inventories are set to move back to zero by the end of the simulation period. With only minimal inventories on hand by 1998, this output component could repeat the large boost it gave to domestic production from 1992 to 1998. Furthermore, (as seen in the case of *ComFishing*) where there are strong twist factors affecting imports this can result in large forecast errors for domestic output of a commodity because the *impact* of the twist is projected forward. The results of the original forecast simulation that appear in Table 6 show that virtually every variable (except *impftwist*) moved in a way that favoured increasing the output of *Dolls* – producers were becoming more efficient (*a* = -8.9%); consumers, who were by far the main user, preferred to purchase more dolls in 2005 versus 1998 at any given set of prices and per capita income (*a3com* = 11.5%); there was a favourable preference shift in intermediate use of dolls (*cont_ac* = 2.3%); and the export demand curve was projected to shift slightly upwards (*cont_fepc* = 1.3%). At the same time, relative prices (domestic to import) were virtually unchanged. [*p0dom*/*p0imp* = 1.049/1.045 = 0.4%]. Given that domestic-import substitution elasticity was set to 1, *ceteris paribus*, this suggests the import-domestic ratio should have increased slightly. Instead, total supplies of domestic goods were forecast to fall 30.8% (*x0dom*), driven by an expected 45.1% reduction in sales of domestically produced *Dolls* in the U.S. (*x0dom_dom*). With only minimal changes in relative prices, the decline in *x0dom_dom* was the result of projecting *impftwist* forward.

[24] The parameters in the model known as the Armington elasticities were set at 1.0 for *Dolls*. C*eteris paribus,* this indicates minimal substitution between the domestically produced commodity and the imported equivalent.

[25] Table 6 shows that the average of technical change terms in production (*a*) was -8.6%, and the contribution of *Dolls*-using technical and taste change (*cont_ac*) was 2.0% for the period 1992-1998.

[26] This is also not reported in the results table, which instead shows total household demand, undifferentiated by source. Total household demand rose 70.1% on the back of an 82.4% increase in consumption of imported *Dolls* – and that was driven by a strong non-price related import-favouring preference twist (*impftwist* = -53.0%), as well as an import-favouring change in relative prices (*fpdm* = 9.7%).

Table 8 compares the effect of *impftwist* on *Dolls* between the original forecast and the actual result using a back-of-the-envelope estimation. For simplicity the table is divided into 3 parts – sales to producers (*BAS1*); sales to investors (*BAS2*) and sales to consumers (*BAS3*). Focusing on the *BAS3* section (where the vast majority of sales took place) it can be seen that domestic market share in the consumer market was 6.00%. As a result of projecting *impftwist* forward, *ceteris paribus*, market share was forecast to more than halve to 2.62% (left hand side of Table 8). In this case, *impftwist* did nearly 60% damage to domestic market share of U.S.-produced *Dolls* (*x0dom_dom*) by over-estimating the strength of import preferences. In actual fact, *ceteris paribus*, domestic market share would have *increased* to 8.42% (right hand side of Table 8) – more than three times higher than in the original forecast. In any case, with U.S. supplies of *Dolls* moving off such a low base generating an accurate projection for *x0dom* was always going to be difficult.

ftwist_src	137.40%	*Dolls* (Forecast: 1998-2005)		
		start	**end**	
Import	172	93.09	96.97	
Domestic	13	6.91	3.03	-56.12
Total	**185**	**= BAS1**		
		start	**end**	
Import	0	0	0	
Domestic	0	0	0	0.00
Total	**0**	**= BAS2**		
		start	**end**	
Import	3714	94.00	97.38	
Domestic	237	6.00	2.62	-56.36
Total	**3951**	**= BAS3**		
			Weighted Average =	**-56.35**
Sales	**4136**		***Impftwist***	**-58.55**
The difference is due to b.o.t.e. estimation error				

ftwist_src	-30.52%	*Dolls* (Actual: 1998-2005)		
		start	**end**	
Import	172	93.09	90.35	
Domestic	13	6.91	9.65	39.69
Total	**185**	**= BAS1**		
		start	**end**	
Import	0	0	0	
Domestic	0	0	0	0.00
Total	**0**	**= BAS2**		
		start	**end**	
Import	3714	94.00	91.58	
Domestic	237	6.00	8.42	40.23
Total	**3951**	**= BAS3**		
			Weighted Average =	**40.20**
Sales	**4136**		***Impftwist***	**39.42**
The difference is due to b.o.t.e. estimation error				

Table 8: The relative impacts of import twist factors on *Dolls* – Forecast versus Actual

3. Given industry conditions it ought to have been realised that domestic output is *unlikely* to have collapsed in forecast

The doll market is segmented between play dolls and collectible dolls; each characterised by totally different sales distributions. Consumers are by far the largest users of dolls, with gifting by parents and grandparents to young girls being the key driver behind purchases.[27] As a result of competition from computer and electronic games targeted to girls, manufacturers brought out more interactive dolls and updated their current products. Furthermore:

> "...in the late 1990s it was expected that imports would continue to displace domestic production. China, Japan, and Taiwan were major suppliers. Exports were being helped by an increased interest in products made in the United States and the lifting of trade barriers."[28]

[27] http://www.mindbranch.com/listing/product/R395-0009.html, visited 28 July 2009.
[28] http://www.answers.com/topic/dolls-and-stuffed-toys, visited 28 July 2009.

According to an article that originally appeared in Business Wire on 16 September 1997, the collectibles market was growing very strongly as an increasing number of baby boomers entered the market:

> "The U.S. collectible-dolls market, led by character-collectibles manufacturers such as Exclusive Toy Products Inc., has exploded into a $1.7 billion-a-year industry, according to recently released collectibles-industry figures. Considering that the overall collectibles sector [this is broader than the *Dolls* industry] generated more than $9.1 billion in consumer sales in 1996, it becomes apparent that collectibles, and especially collectible dolls, are hotter than ever. The study also found that the increasing popularity of collectibles is being fuelled by new collectors, especially in the baby-boomer category. The infusion of mature newcomers into an already-stable industry was cited as the primary reason for the solid 11.9 percent sales increase in 1996, up from $8.2 billion the previous year. Moreover, 88 percent of the nation's dolls retailers pointed to new collectors as the top industry trend destined to impact store sales over the next five years."[29]

By 1998, total sales (domestic and imported) in the U.S. market for Dolls & Stuffed Toys valued at purchases prices was $7.9b (up from $4.8b in 1992; see Section 5 of Table 7). Thus, collectibles was about 22% of the market, and growing strongly. If inventory changes are excluded, households accounted for more than two thirds of sales of domestically produced *Dolls*, with most of the remainder exported. Had the modeller been aware of the dynamics in the fast-growing collectibles market it is expected that any sharp decline in forecast would have been queried.

4. Conclusion

In the historical simulation, the model inferred that there was a large preference twist towards imports. By projecting already-large import twist factors forward the risk of generating a poor forecast is magnified, especially where high import penetration prevails. The doll market is segmented between play dolls and collectible dolls; each characterised by totally different sales distributions. According to an article that originally appeared in Business Wire on 16 September 1997, the collectibles market was growing very strongly as an increasing number of baby boomers entered the market. By 1998, total sales (domestic and imports) in the U.S. doll market valued at purchases prices had grown to $7.9b. Thus, collectibles comprised about 22% of the market and were growing strongly. U.S. producers were well positioned to meet this demand and were already making more innovative products. Excluding inventory changes, households accounted for more than two thirds of sales of domestically produced *Dolls*, with most of the remainder exported. Given the dynamics in the fast-growing collectibles market, a sharp decline in forecast would have seemed unlikely. In light of this, a better forecast could have been produced for *Dolls*.

5. Strategy to improve the forecast

In re-running the simulation, the strategy was to set *impftwist* to zero on the basis of improving market dynamics. This prevented the model from projecting forward the negative impact on domestic production of the import/domestic preference twist – thus barring the unlikely large

[29] http://www.thefreelibrary.com/FEATURE%2FExclusive+Toy+Products+Targets+Lucrative+Collectible-Dolls...-a019753614, visited 28 July 2009.

contraction to domestic sales of U.S.-produced output versus imports. The results are shown in the last column of Table 6, which is denoted "Improved Forecast". This reduced the USAGE error from 51% to 21%.

The key focus is on *x0dom* and *x0dom_dom*. In the case of *x0dom_dom*, this rises 15.4% versus the 45.1% slump in the original forecast. The actual result between 1998 and 2005 was a 76.4% rise (off a low base) due to a strong reversal in *impftwist*, which gave a 39.4% boost to the market share of domestic producers. The turnaround was so strong that a significant volume of exports was diverted back into the U.S. market (*x4* fell 55.4%). For *x0dom,* the actual rise was 40.4%, compared to the original forecast contraction of 30.8%. The improved forecast was for 11.0% growth with the differences explained by changes in *impftwist* and *a3com* and an unfavourable movement in relative prices.

In terms of *net* trade, net imports as a proportion of domestic output rose 265.9% (*dtradeshare*) versus a 35.2% reduction in the original forecast. The actual result was a 63.6% decrease due to more muted import growth, which again was impacted by a negative preference shifts.

Theatres → Part of Major Group 78: Motion Pictures (excludes Video Rentals)

This major group includes establishments producing and distributing motion pictures, exhibiting motion pictures in commercially operated theaters, and furnishing services to the motion picture industry. The term motion pictures, as used in this major group, includes similar productions for television or other media using film, tape, or other means.

Industry Group 781: Motion Picture Production And Allied Services

- *7812 Motion Picture and Video Tape Production*
- *7819 Services Allied to Motion Picture Production*

Industry Group 782: Motion Picture Distribution And Allied Services

- *7822 Motion Picture and Video Tape Distribution*
- *7829 Services Allied to Motion Picture Distribution*

Industry Group 783: Motion Picture Theaters

- ***7832** Motion Picture Theaters, Except Drive-In*
- *7833 Drive-In Motion Picture Theaters.*

Theatres - Motion Pictures ex Video Rentals	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	10.0	2.3	20.1	19.7
All factor augmenting technical change	*a1prim*	77.2	12.4	101.6	101.6
Contribution to output of all factor augmenting technical change	*cont_a1prim*	27.9	4.8	33.3	33.3
Combined change in household tastes	*a3com*	64.6	-21.0	78.8	0.0
Commodity-using technical and taste change	*ac*	-0.3	-7.5	-0.3	0.0
Contribution to output of commodity-using technical & taste change	*cont_ac*	-0.2	-5.5	-0.2	0.0
Vertical shift of the export demand curve	*cont_fepc*	10.2	-7.0	12.0	0.0
Import/domestic twist by commodity	*ftwist_src*	232.7	0.0	8.9	8.9
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-0.7	0.0	-0.9	-0.9
Twist caused by strong growth	*twist_eff*	-3.8	-3.3	5.7	-2.7
Basic price of domestic goods	*p0dom*	93.2	21.9	58.5	53.7
Basic price of imported goods	*p0imp*	29.1	18.5	49.5	51.3
Ratio of basic prices: domestic to import	*fpdm*	50.5	2.8	6.2	1.6
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	12.3	11.6	29.3	4.2
Total supplies of domestic goods	*x0dom*	6.8	6.5	43.5	3.5
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	9.5	12.1	28.7	4.4
Total supplies of imported goods	*x0imp*	512.0	14.5	87.0	33.7
Household demands undifferentiated by source	*x3*	48.3	-3.1	66.2	-5.3
Export volumes	*x4*	-18.7	-46.8	205.5	-0.4
Change in net import share to domestic output	*dtradeshare*	3.6	4.5	-9.8	0.6

Table 9: *Theatres* results

Motion Pictures ex Video Rentals (*Theatres*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	461 Theatres: 73861	Rest: 367	**Total: 74228**
Proportion	461 Theatres: 0.995	Rest: 0.005	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	451 Theatres: 73861	416 WholesleTrde: 1012	Rest: 117	**Total: 74990**
Proportion	451 Theatres: 0.985	416 WholesleTrde: 0.013	Rest: 0.002	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	53326	792	54118	**0.72**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	14015	0	14015	**0.19**
Exports	BAS4	6556	0	6556	**0.09**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	330	0	330	**0.00**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**74228**	**792**	**75019**	
Source/Total		**0.99**	**0.01**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	461 Theatres: 20377	I20 RadioTVbroad: 12473	Rest: 20477	Total: 53326	**Total: 0.985**
Imported	461 Theatres: 472	420 RadioTVbroad: 214	Rest: 106	Total: 792	**Total: 0.015**
Total	**461 Theatres: 20849**	**I20 RadioTVbroad: 12686**	**Rest: 20583**	**Total: 54118**	
Proportion	**461 Theatres: 0.385**	**420 RadioTVbroad: 0.234**	**Rest: 0.380**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	56275	817	57092	**0.78**	**0.77**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	15861	0	15861	**0.22**	**0.22**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	330	0	330	**0.00**	**0.01**
Total	**72467**	**817**	**73284**		
Source/Total	**0.99**	**0.01**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	30242	**0.40**	LABOUR	19433	**0.64**
Factor	30306	**0.40**	CAPITAL	10873	**0.36**
Other	13512	**0.18**	LAND	1	**0.00**
Production Taxes	929	**0.01**	**Total**	**30306**	
Total	**74990**				

Source	c. Intermediate Inputs				Proportion
Domestic	451 Theatres: 21443	443 Advertising: 2654	Rest: 5363	Total: 29460	**Total: 0.974**
Imported	451 Theatres: 496	479 NoncompImps: 157	Rest: 129	Total: 782	**Total: 0.026**
Total	**451 Theatres: 21939**	**443 Advertising: 2680**	**Rest: 5623**	**Total: 30242**	
Proportion	**451 Theatres: 0.725**	**443 Advertising: 0.089**	**Rest: 0.186**		

Table 10: The key attributes of *Theatres* in 1998

1. **Why did the model erroneously give good prospects to Motion Pictures ex Video Rentals?**

Theatres had a USAGE error of 35% and was the fourth highest observation above the 45 degree line. The forecast trend error was just 1%. The results for this commodity appear in Table 9. Actual growth was 6.5% over the 1998-2005 period. This followed a 6.8% rise from 1992-1998 – the extrapolated trend was therefore about 8% – yet USAGE forecast a 43.5% rise. The main users, cost structure and other information of interest can be seen in Table 10. As usual, this has been divided into 6 sections. However, the key characteristics of the 1998 database are presented so that the reader can see the industry structure at the beginning of the forecast period; these include:

- Domestic production accounts for 99% of total sales in the U.S. (Section 5 of Table 10).
- 9% of production was exported (Section 3 of Table 10).
- 72% of U.S.-destined output was sold to producers and the remainder (28%) to consumers (Section 5 of Table 10).

Table 9 shows that domestic sales of the U.S. produced commodity (*x0dom_dom*) rose 9.5% between 1992 and 1998. This took place despite a materially unfavourable change in relative prices. In particular, the basic price of domestic *Theatres* increased 50.5% more than the basic price of its imported equivalent (see *fpdm* in Table 9). Imported *Theatres* became relatively more attractive and spiked 512.0% (see *x0imp* in Table 9). However, such a large number should be put into context – by 1998 there was still only 1% import penetration into the U.S. market. Since *x0dom_dom* rose faster than overall domestic output (*x0dom*), exports must have declined (*x4* = -18.7%). These were being diverted into the domestic market despite an upward shift in the export demand function (*cont_fepc* = 10.2%). How did domestic sales grow so strongly in the face of soaring prices?

Between 1992 and 1998 household tastes moved strongly in favour of *Theatres*, i.e., by 1998 consumers preferred to purchase more *Theatres* at any given set of prices and per capita income than was the case in 1992 (*a3com* = 64.6%). Given insignificant imports, this drove prices sharply higher for the domestically produced commodity (*p0dom* = 93.2%). The price rise hurt export volumes. However, as was the case for U.S. households, foreigners increased their liking to the commodity at any given price, thereby preventing a larger fall in exports (*cont_fepc* = 10.2%).

As shall be seen further below, by 1998 the industry was beginning to experience the impact of piracy and other negative dynamics such as rising costs. The forward projection of strongly positive preference and taste changes for households and foreigners during the period from 1992 to 1998 resulted in a strong growth forecast that was unlikely to eventuate.

2. **What happened in the forecast?**

In the original forecast for 1998-2005, both domestic and foreign preference shifts, or their contributions to output, were projected forward. This had the effect of grossly overestimating household and foreign demand and overall output (*x3*, *x4* and *x0dom*, respectively). The left hand side of Table 11 provides a rundown of the approximate contributions to the change in the total supplies of the domestic commodity (*x0dom*). In the original forecast simulation, producers, households and exports made fairly even contributions to the overall output result. The actual result tells a different story with the contributions to the 6.5% rise in *x0dom* as follows: producers (*BAS1*) 178%; households (*BAS3*) -9%; exports (*BAS4*) -63%; and inventory changes (*BAS6*) -6%.

Theatres: 1998-2005							
Contribution to Growth				Back-of-the-envelope Growth Calculation			
	Actual	Original Forecast	Improved Forecast		Actual	Original Forecast	Improved Forecast
Producers	178%	31%	105%	*BAS1*	16%	19%	52%
Households	-9%	29%	-3%	*BAS3*	-3%	66%	-5%
Exports	-63%	42%	-1%	*BAS4*	-47%	206%	-4%
Inventories	-6%	-1%	-1%	*BAS6*	-84%	-100%	-100%
Total	100%	100%	100%	*x0dom*	6.5%	43.5%	3.5%

Table 11: Estimated contributions to *x0dom* and growth in BAS_i components for the 1998-2005 simulations

Looking at the right hand side of Table 11 it is immediately apparent that the forecast had vastly overestimated household demand and export demand. This is confirmed in Table 9.

3. **Given industry headwinds it ought to have been realised that domestic output is *unlikely* to have surged in forecast**

What follows is a *précis* of an industry report from the late 1990s by the "Labor Market & Economic Analysis" division of the Washington State Employment Security Department.[30] Most of their information was taken from the Motion Picture Association of America (MPAA).

U.S. films, videos and television tape are shown in over 100 foreign countries. By 1998, in many of these countries, U.S. films had acquired a share of box office receipts equal to or higher than that of domestic films – a situation that encourages protectionism. However, foreign markets have recently increased their own domestic production, reflected in increased share of box office receipts and admissions. During the 1992-1998 period there were a number of mergers and acquisitions leaving the largest entertainment companies accounting for about three-quarters of the industry's revenues. Furthermore, according to the MPAA:

a. The average cost of producing a motion picture was about $53 million in 1998, nearly double of what it was in 1992.
b. Growth in the number of new releases by MPAA member companies slowed dramatically in the late 1990s.
c. Releases by all U.S. companies rose from 460 in 1997 to 490 in 1998, an increase of 6 percent.
d. The cost of distributing films (especially printing and advertising) rose sharply in the late 1990s – the combined average cost per film to MPAA member companies for advertising and printing rose 13.5 percent in 1998; distribution costs increased every year from 1986 to 1998.
e. From 1996 to 1998 box office receipts showed strong growth and growth in admissions rebounded (see Figure 3). Specifically, box office receipts increased 8.6 percent (in real terms) in 1998 and 6 percent growth was expected in 1999.
f. Theatrical exhibition of films remains the principal method for introducing new movies to the public. The number of screens grew 8 percent during 1998, and the number of screens

[30] http://www.wa.gov/esd/lmea/sprepts/indprof/motionp.htm, page visited 20 August 2009.

had increased every year from 1990 to 1998; similar small increases were expected over the next few years, driven by growth in multiplex theatres.

g. Worldwide demand for U.S. entertainment was expected to grow in the long run. Sales of U.S. entertainment both domestically and abroad were expected to depend in part on how new technologies were to be used for the delivery of entertainment and the barriers that U.S. companies were likely to encounter in foreign markets, in addition to general economic conditions. New technologies at the time included:
   I. the internet
   II. DVD and
   III. satellite delivery systems for programming.

h. Many industry observers believe that within a decade the Internet will play a major role in delivering filmed entertainment to homes.

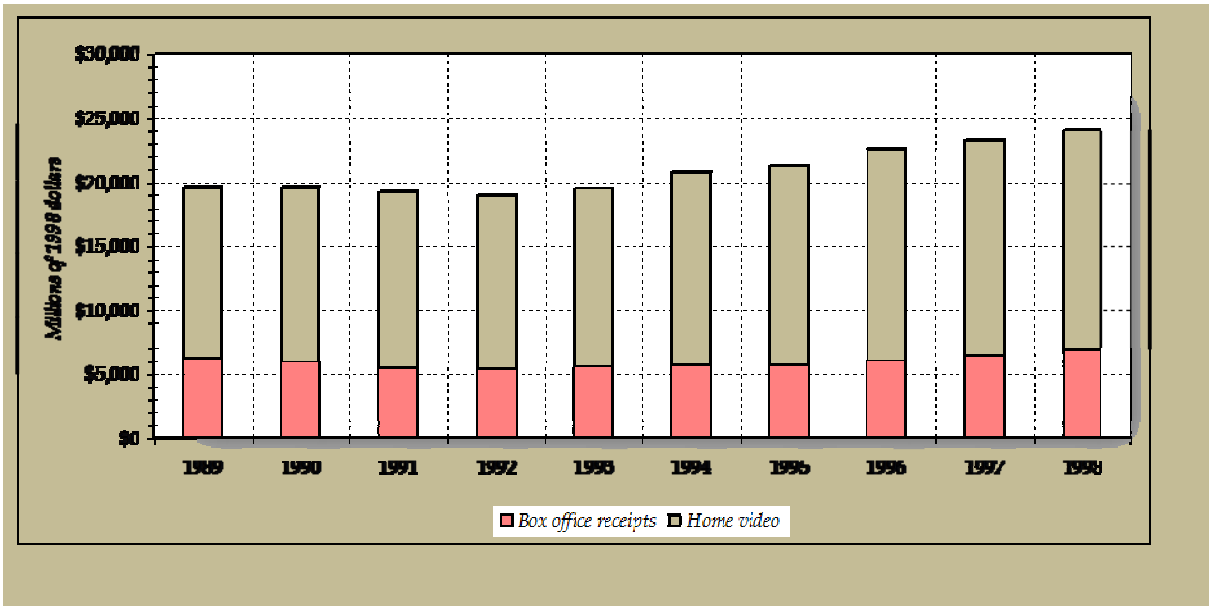

Figure 3: U.S. Box Office Receipts and Home Video Sales & Rental Receipts, 1989-1998 (Source: MPAA)

The above analysis and forecasts (that mostly came from the MPAA) were unsurprisingly glowing about the industry's prospects. They were however silent about movie piracy. In 1998 music piracy was a common feature of the internet, and movie piracy was perhaps less of a concern because it involved larger amounts of data and bandwidth was still relatively expensive in most countries:

> "When dial-up was common in early and mid 1990s, movies distributed on the Internet tended to be small. The techniques that were usually used to make them small were to use compression software and lower the video quality ... However, along with the rise in broadband internet connections beginning around 1998, higher quality movies began to see widespread distribution – with the release of DeCSS, ISO images copied directly from the original DVDs were slowly becoming a feasible distribution method."[31]

Where faster broadband connections were available (e.g., universities, businesses, and government departments, etc) the downloading of television shows and movies (that had made it to the video

[31] http://en.wikipedia.org/wiki/Warez, page visited 21 August 2009.

stores) was not unusual. Monash University became *in*famous for unwittingly hosting the very latest episodes of South Park in 1997, well before they were scheduled to air in Australia (this was the cunning work of a former student at the university). Before long, pirates were also making new release movies available on the internet. In an article about the history of internet piracy it can be read that:

> "Movie piracy started with pirates using camcorders to copy movies shown in a theater, a process known as 'ripping'. The sound, via the camera's microphone, was of poor quality because audience noises were also recorded. These cam rips were put on the Internet, usually after a film premiere ... Another common movie pirate method is copying screener DVDs. Movie companies often release promotional copies of a film for critics and industry people to review in advance. Pirates remove the Promotional Copy Only message and release it as a DVD rip. The digital age has ushered in a plethora of ways to steal."[32]

Based on the way that the music industry had reacted to piracy, this should have set the warning bells ringing to the forecaster that growth in Theatres could be blunted by growing movie piracy during the 1998-2005 period. The problem is that it would have been nigh on impossible to have estimated the impact. For instance, the forecaster could not have relied on the music industry to provide an indication of the impending damage because the figures it released during the 1990s made it impossible to determine sales displacement. In any case, according to the Recording Industry Association of America (RIAA) music sales grew 14% in 1998 alone, and by 52% from 1992-1998 – at the same time new releases were down 2% and up 80%, respectively.[33] On this basis it would be difficult to believe that the projected 5.35% p.a. growth for Theatres over the 1998-2005 period would necessarily be unattainable.

From most of the reading covered in this area (not all cited) it became apparent that from the late 1990s right up until today there is no general consensus of the true cost of piracy in terms of lost demand for the legitimate item (irrespective of intent). Hui & Png (2003) developed and tested hypotheses from theoretical models of piracy on international data for music CDs over the period 1994-98:

> "Empirically, we find that the demand for music CDs decreased with piracy, suggesting that "theft" outweighed the "positive" effects of piracy. However, the impact of piracy on CD sales was considerably less than estimated by industry. We estimated that, in 1998, actual losses amounted to about 6.6% of sales, or 42% of industry estimates. But, we found evidence that publishers would have raised prices in the absence of piracy, suggesting that the actual revenue loss would have been higher."[34]

The positive effects are that many illegal 'downloaders' use this technique as a way of screening for potential purchases and are typically exposed/alerted to a broader range of items that might have

[32] http://www.ehow.com/about_5107851_history-movie-piracy.html, page visited 21 August 2009.
[33] http://www.azoz.com/music/features/0008.html, page visited 21 August 2009.
[34] Hui, Kai-Lung and Png, Ivan (2003) "Piracy and the Legitimate Demand for Recorded Music," Contributions to Economic Analysis & Policy: Vol. 2 : Iss. 1, Article 11. Available at http://www.bepress.com/bejeap/contributions/vol2/iss1/art11, page visited 21 August 2009.

otherwise been the case. In other words, piracy may raise legitimate demand through positive demand-side externalities, sampling, and sharing; though this is outweighed by the impact of theft.

4. Conclusion

By 1998, U.S. films had acquired a share of box office receipts equal to or higher than that of domestic films in numerous countries – a situation that encourages protectionism on the grounds of "cultural sovereignty". Sales of U.S. entertainment both domestically and abroad were expected to depend in part on how new technologies were to be used for the delivery of entertainment and the barriers that U.S. companies were likely to encounter in foreign markets. New technologies at the time included: the internet; DVD and satellite delivery systems for programming. Many industry observers believed that within a decade the Internet would play a major role in delivering filmed entertainment to homes. In 1998 music piracy was a common feature of the internet. However, with the rise in broadband internet connections beginning around 1998, higher quality movies began to see widespread distribution – and ISO images copied directly from the original DVDs were slowly becoming a feasible distribution method. Where faster broadband connections were available (e.g., universities, businesses, and government departments, etc.) the downloading of television shows and movies was not unusual. Based on the way that the music industry had reacted to piracy it is clear that growth in *Theatres* could have been blunted by growing movie piracy during the 1998-2005 period. In the historical simulation an upward shift in the export demand curve was observed. In the case of household demand, the model computed a large positive value for taste change (a3com). It must have seemed highly likely at the time that movie piracy would have a strong negative impact on these parameters. Furthermore, the model calculated a taste shift away from *Theatres* in the actual results for 1998-2005. It is quite conceivable that this is the impact of movie piracy.

5. Strategy to improve the forecast

In re-running the simulation, the strategy was to set *cont_ac* and *a3com* and *cont_fep* to zero on the basis of negative industry dynamics and the likely impact of piracy. This reduced the USAGE error from 35% to just 3%. The results are shown in the last column of Table 9, denoted "Improved Forecast". The key focus is on outcomes for *x0dom* and *x3* and *x4*. In the case of *x0dom*, this now rises 3.5% versus 43.5% in the original forecast. The actual result between 1998 and 2005 was a 6.5% rise on the back of strong producer demand; but offset by a downward shift in the export demand schedule and a sharp reduction in household tastes. The improved forecast has household demand (*x3*) falling 5.3% versus the original 66.2% forecast expansion. The actual result was a decline of 3.1%. Export volumes almost halved in the actual result off a low base (*x4* fell 46.8%). The difficulty of forecasting trade movements at the gross level has already been noted. This was originally forecast to surge by 205.5%, but improved to a 5.3% decline. In terms of *net* trade, net imports as a proportion of domestic output rose 0.6% (*dtradeshare*) in the improved forecast versus a 9.8% reduction in the original forecast. The actual result for *dtradeshare* was a 4.5% increase due to lower exports.

Recordmedia → Magnetic and Optical Recording Media (SIC 3695)

This classification comprises establishments primarily engaged in manufacturing blank tape, disk, or cassette magnetic or optical recording media for use in recording audio, video, or other signals. Excluded from this classification are establishments primarily engaged in manufacturing blank or recorded records and prerecorded audio tapes, prepackaged computer software, prerecorded video tape cassettes and disks.

Recordmedia - Magnetic & Optical Recording Media	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-3.7	-2.0	-2.5	-6.1
All factor augmenting technical change	*a1prim*	-24.0	-10.9	-28.7	-28.7
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-9.6	-4.0	-11.1	-11.1
Combined change in household tastes	*a3com*	7.0	44.5	8.2	8.2
Commodity-using technical and taste change	*ac*	-7.2	-6.7	-8.3	-8.3
Contribution to output of commodity-using technical & taste change	*cont_ac*	-5.1	-4.8	-5.9	-5.9
Vertical shift of the export demand curve	*cont_fepc*	19.3	-14.2	22.9	0.0
Import/domestic twist by commodity	*ftwist_src*	-61.8	423.9	-73.7	0.0
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	31.2	-45.9	37.3	0.0
Twist caused by strong growth	*twist_eff*	0.9	-12.8	5.3	-4.2
Basic price of domestic goods	*p0dom*	4.3	7.8	10.0	3.7
Basic price of imported goods	*p0imp*	-16.7	5.8	-6.2	-5.1
Ratio of basic prices: domestic to import	*fpdm*	24.9	1.9	17.3	9.2
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	37.8	19.2	34.1	25.0
Total supplies of domestic goods	*x0dom*	**29.1**	**-29.8**	**41.7**	**-2.8**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	36.5	-33.6	50.8	6.1
Total supplies of imported goods	*x0imp*	34.9	110.3	3.2	61.3
Household demands undifferentiated by source	*x3*	56.4	112.9	31.7	36.7
Export volumes	*x4*	12.6	-21.3	25.0	-20.0
Change in net import share to domestic output	*dtradeshare*	-2.2	63.1	-9.8	24.1

Table 12: Key results for *Recordmedia*

1. **Why did the model erroneously give good prospects to Motion Pictures ex Video Rentals?**

Recordmedia had a USAGE error of 101% versus the smaller trend forecast error of 91%. The key results for this commodity are shown in Table 12. The actual outcome for *Recordmedia* output (*x0dom*) was a 29.8% contraction over the 1998-2005 period. This followed 29.1% growth from 1992-1998. The extrapolated trend was therefore 35% growth versus the USAGE forecast of 41.7% growth. Table 13 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- The commodity was mostly produced by the *Recordmedia* industry (74.6%); and Computer Peripheral Equipment (*ComPerEquip*: 14.4%) (Section 1 of Table 13).
- Import penetration was 34% of the domestic market (Section 5 of Table 13).
- Producers purchased 52% of domestic output; foreigners 32%; investors 10%; and households 6% (Section 3 of Table 13).

Magnetic & Optical Recording Media (*Recordmedia*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	361 Recordmedia: 4523	329 ComPerEquip: 874	Rest: 669	**Total: 6066**
Proportion	361 Recordmedia: 0.746	329 ComPerEquip: 0.144	Rest: 0.110	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	351 Recordmedia: 4523	380 PhotoEquip: 342	Rest: 248	**Total: 5113**
Proportion	351 Recordmedia: 0.885	380 PhotoEquip: 0.067	Rest: 0.049	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	3122	1752	4874	**0.52**
Industry Investment	BAS2	620	342	961	**0.10**
Private Consumption	BAS3	340	48	388	**0.06**
Exports	BAS4	1955	0	1955	**0.32**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	29	0	29	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**6066**	**2142**	**8207**	
Source/Total		**0.74**	**0.26**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	461 Theatres: 584	352 RecordTapes: 314	Rest: 2225	Total: 3122	**Total: 0.641**
Imported	446 ComputerServ: 219	428 Banking: 151	Rest: 1382	Total: 1752	**Total: 0.359**
Total	**461 Theatres: 587**	**446 ComputerServ: 480**	**Rest: 3808**	**Total: 4874**	
Proportion	**461 Theatres: 0.120**	**446 ComputerServ: 0.098**	**Rest: 0.781**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	461 Theatres: 314	418 TelephonCom: 217	Rest: 89	Total: 620	**Total: 0.645**
Imported	461 Theatres: 174	418 TelephonCom: 119	Rest: 49	Total: 342	**Total: 0.355**
Total	461 Theatres: 487	418 TelephonCom: 336	Rest: 138	**Total: 961**	
Proportion	**461 Theatres: 0.507**	**418 TelephonCom: 0.349**	**Rest: 0.144**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	3335	1929	5264	**0.73**	**0.48**
Industry Investment	669	381	1049	**0.15**	**0.10**
Private Consumption	556	86	643	**0.12**	**0.08**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	29	0	29	**0.01**	**0.00**
Total	**4588**	**2397**	**6985**		
Source/Total	**0.66**	**0.34**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	3300	**0.65**	LABOUR	1193	**0.66**
Factor	1802	**0.35**	CAPITAL	609	**0.34**
Other	-19	**0.00**	LAND	0	**0.00**
Production Taxes	30	**0.01**	**Total**	**1802**	
Total	**5113**				

Source	c. Intermediate Inputs				Proportion
Domestic	202 MiscPlPrdnec: 842	184 Plastics: 199	Rest: 1771	Total: 2812	**Total: 0.852**
Imported	319 ComPerEquip: 88	479 NoncompImps: 88	Rest: 312	Total: 488	**Total: 0.148**
Total	**202 MiscPlPrdnec: 920**	**184 Plastics: 231**	**Rest: 2149**	**Total: 3300**	
Proportion	**202 MiscPlPrdnec: 0.279**	**184 Plastics: 0.070**	**Rest: 0.651**		

Table 13: Key attributes of the *Recordmedia* database in 1998

There were two key drivers behind the erroneous forecast. These were import/domestic twist factors, and foreign demand impacts. From 1992 to 1998, USAGE calculated significant relative price changes between domestic and imported *Recordmedia* favouring imports to the tune of 24.9%. The Armington import-domestic substitution elasticity parameter was set quite high in the model ($SIGMA_i$ = 3.8). Yet imported *Recordmedia* rose *only* 34.9% (see *x0imp* in Table 12). On the basis of relative price changes alone, the ratio of imported to domestic *Recordmedia* being sold into the domestic market would have increased by 132.8% [= $1.249^{3.8}$]. Instead it fell 1.2% [= (1.349/1.365 - 1)*100].

In the absence of large-scale technological change, given the observed historical values for *Recordmedia* from 1992 to 1998 and given the unfavourable change in relative prices (positive *fpdm*), the model inferred that there must have been a large preference twist favouring domestic production. Examining the results listed in Table 12, this is seen in the form of *impftwist* (up 31.2%). According to the model, there was a twist away from imports that resulted in a 31.2% boost to domestic output sold domestically (*x0dom_dom*). Furthermore, between 1992 and 1998 there was a strong upward shift in the export demand curve (*cont_fepc* = 19.3%). This did not translate into a boom in export volumes (*x4* = 12.6%) because exports were being diverted back into the domestic market.

2. What happened in the forecast?

The impact of the import/domestic twist factors (*impftwist*) was projected forward to be 37.3% when the true outcome had reversed to -45.9%. As a result, local sales of domestically produced *Recordmedia* that were forecast expand 50.8%, in fact fell 33.6%. The effect of the disparity in *impftwist* was magnified by a larger than expected change in relative prices favouring imported *Recordmedia*. A similar situation happened in relation to the position of the export demand curve. The large upward shift that occurred between 1992 and 1998 was projected forward (*cont_fepc* = 22.9%), when in fact a significant downward shift took place between 1998 and 2005 (*cont_fepc* = -14.2%). As shall be seen below, this could have been anticipated.

3. Given the advent of new competing technologies and falling export volumes after 1996 it ought to have been realised that domestic output was *unlikely* to surge in forecast

The magnetic and optical recording media industry manufactures blank audio and video recording tape, computer tape, and both rigid and floppy computer disks, utilizing either magnetic or optical recording technology. According to one source there were conflicting forecasts for this industry stretching throughout the 1990s:

> "Conflicting forecasts pelted the industry. Some called for its collapse in anticipation of competing technology that would render magnetic and optical recording technology obsolete, while others promised a meteoric rise in sales. Without question, financial success in the industry is predicated on a manufacturer's continued ability to remain at the forefront of technology, to consistently develop new products to stimulate public interest, and to keep pace with the evolving sophistication of audio, video, and computer equipment. This industry is characterized by frenetically evolving technologies that, some have argued, are still in their infancy. Thus, manufacturers in

the industry throughout the 1990s and early 2000s were challenged by not only an undetermined future but also often by an undecided present."[35]

Blank tape technologies (such as VHS and Mini-DV) were jostling for market share in the mid 1990s. However, in November of 1996, Sanyo-Verbatim CD Company announced the onset of Digital Versatile Disc (DVD) production in the first quarter of 1997. DVD had the potential to store seven times the capacity of a CD-ROM.[36] In 1998 the unit shipments of all types of blank tapes were in decline except 8mm videotapes, which increased by 8% in 1997.[37] Part of this was due to mounting foreign competition, particularly from China. Although Chinese products were of inferior quality they had the impact of blunting industry prices.

In relation to exports, by 1998 these comprised 32% of total sales of domestic output (Section 3 of Table 13). The trade data in Figure 4 makes it clear that exports were trending downward after peaking in 1996.

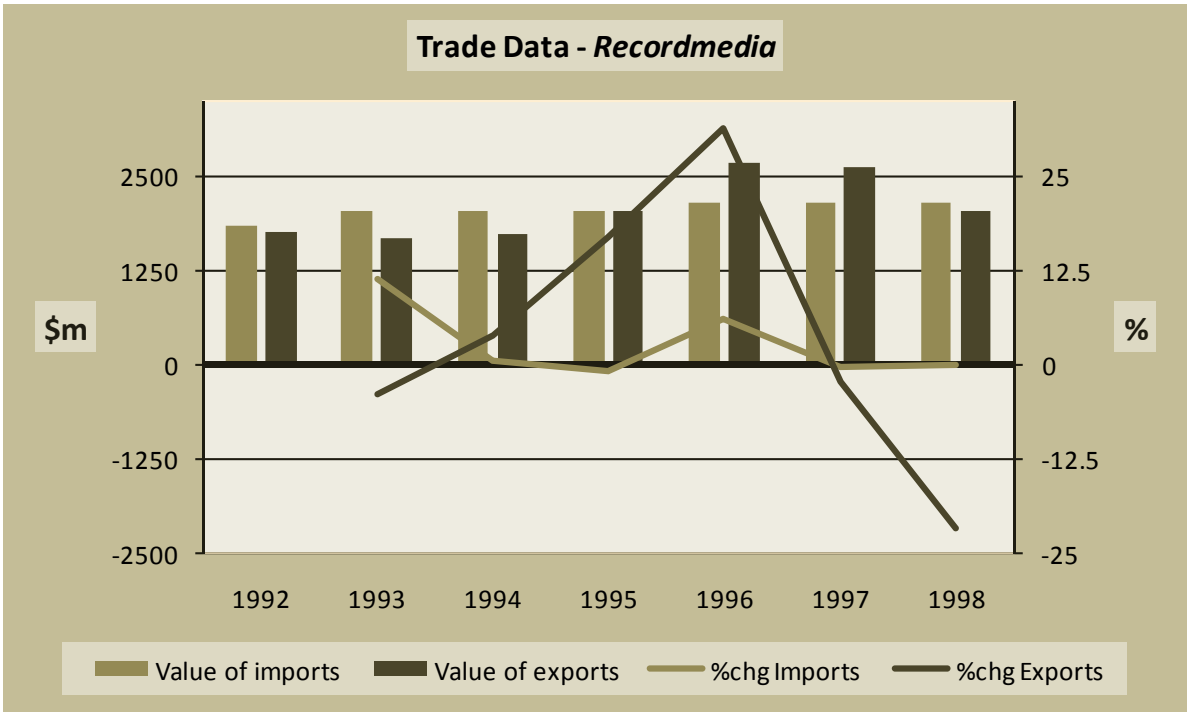

Figure 4: 1992-1998 – U.S. trade by the *Recordmedia* industry in nominal dollars

4. Conclusion

Based on this information the modeller could have anticipated that further strong swings against imports were unlikely. With Chinese imports appearing in the U.S. market during the period 1992-1998, their inferior quality might explain the strong twist against imports during this period. However as China began to export CDs and DVDs, quality attributes became more difficult to distinguish – perhaps explaining the twist towards imports during the 1998-2005 period. As for exports, the demand function was projected to shift outward, when trade data showed exports trending downward in 1997 and 1998. Hence the modeller could have reduced the size of the error.

[35] http://www.answers.com/topic/magnetic-and-optical-recording-media, visited 14 September 2009.
[36] http://www.answers.com/topic/magnetic-and-optical-recording-media, visited 14 September 2009.
[37] http://www.answers.com/topic/magnetic-and-optical-recording-media, visited 14 September 2009.

In any case, as noted earlier, it is quite difficult to predict foreign demand. Perhaps very large shifts in foreign preferences should be closely investigated, in terms of likely sustainability, rather than be automatically projected forward.

5. Strategy to improve the forecast

In re-running the simulation, the strategy was to set *impftwist* and *cont_fepc* to zero on the basis of new competing technologies and falling export volumes. This reduced the USAGE error from 101% to 38%. The results are shown under "Improved Forecast" in the last column of Table 12. This shows that *x0dom* fell 2.8% versus a 41.7% rise in the original forecast. The small decline in the improved forecast was driven by an unfavourable move in relative prices and would have been a larger decline if not for the projected rise in household demand. The actual result between 1998 and 2005 was a 29.8% decline on the back of a strong preference twist towards imports and a downward shift in the export demand schedule (export volumes fell 21.3%). The original forecast 25.0% export growth was improved to a 20.0% decline. In terms of *net* trade, net imports as a proportion of domestic output rose 24.1% (*dtradeshare*) in the improved forecast versus a 9.8% reduction in the original forecast. The actual result for *dtradeshare* was a 63.1% increase due to surging imports and lower exports.

Broad Brush Approach: Textiles, Clothing & Footwear (TCF)

In the previous section was seen that large values for import-domestic twist factors were being projected forward despite overwhelming evidence against such moves. This meant that one could reasonably been expected to have made *ad hoc* error reducing adjustments to the forecast by the end of 1998. In the case of the textile, clothing and footwear (TCF) industries large forecast errors were often generated by underestimating the size of import-domestic twist factors that heavily favoured imported commodities. Based on the evidence that obtained, it seems very unlikely that the modeller would have seen cause to make adjustments to import twist factors such as *impftwist*. Even so, and assuming the modeller believed that the general trend of twist factors favouring imports would continue, it would have been most difficult to sensibly estimate the magnitude of any such adjustment.

In general, it was very difficult to reliably pin down macro evidence that would have instilled sufficient confidence to tweak the model in various *ad hoc* ways. For instance, it was difficult to source evidence that was publicly available prior to the end of 1998 that could provide a convincing argument that output of any of these commodities would likely be directionally biased during the forecast period. Among the investigations undertaken official industry data was examined, however it was often scant or 1998 data would not have been available until well after these simulations would have notionally been conducted. For example, in the case of Knit Fabric Mills, it wasn't until 1999 that the U.S. Census Bureau issued its 1997 Economic Census Manufacturing Industry Series reports; time-series data was limited; and manufacturing shipments for the specific SIC categories from separate reports published pre-1999 could not be sourced.

The modeller would however have been aware of the TCF industry dynamics as they related to the removal of protectionist policies. The Uruguay Round was the 8th round of multilateral trade negotiations (MTN) conducted within the framework of the General Agreement on Tariffs and Trade (GATT), spanning from 1986-1993. The Round transformed the GATT into the World Trade Organization and came into effect in 1995. It was implemented over the period 1995-2000 for developed countries.

> "From 1990 to 1995, the effective U.S. tariff rate for imported apparel declined from 18.6 to 14.2 percent, a drop of 4.4 percentage points. This occurred as more apparel was imported through preference programs, taking advantage of lower duty rates through the NAFTA and CBTPA programs. During that same period, the U.S. apparel industry lost 93,000 production jobs. Likewise, total imports (by volume) climbed by 3,242 million square meter equivalents (SMEs). However, from 1995 to 2000, when the effective rate dropped at a slower pace – losing only 1.7 percentage points to end up at 12.5 percent – total apparel production job losses equalled 280,000. During that same period, imports jumped an additional 6,000 million SMEs. The record of this period suggests that as the pace of liberalization of the effective U.S. tariff rate on apparel dropped in half, the rate of job losses and imports actually doubled or tripled."[38]

[38] http://www.apparelandfootwear.org/letters/AAFAComments-ITCTariffStudy020520.pdf, visited 28 August 2009.

Whilst the comments above ignore the heavy impact of quota reductions, it is clear that trade liberalisation was starting to have a big impact by 1998, at least on the apparel industries (*Apparel*). This is reinforced by the strong growth in the value of apparel imports, which is displayed in Figure 5.

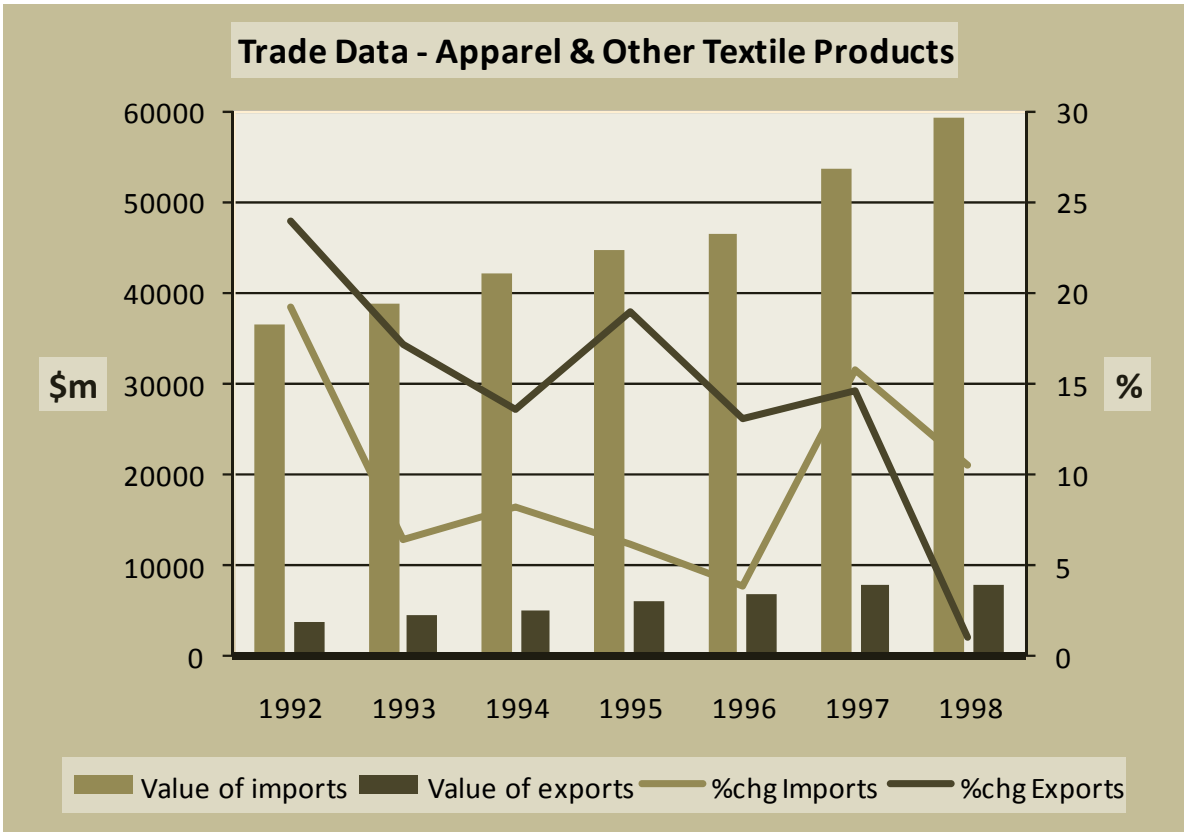

Figure 5: 1992-1998 – U.S. trade by the Apparel & Other Textile Products industries in nominal dollars

Pressure to remove protection in the form of tariffs and quotas was in place well before the beginning of the historical simulation period. Indeed this seemed to be a stumbling block on many occasions as the Uruguay Round progressed. In December 1991, the CBO released a study that commented:

> "...the Uruguay Round of negotiations to expand the General Agreement on Tariffs and Trade (GATT) has focused on, in addition to other issues, proposals to phase out the Multifiber Arrangement (MFA). This arrangement exempts textile and apparel trade from the standard GATT prohibitions on import quotas. Also, the proposed North American Free-Trade Area will probably reduce or eliminate tariffs and other restrictions on textile and apparel trade between the United States and Mexico."[39]

The Multifibre Arrangement was originally established in 1974 as a temporary quota program designed to allow governments to control imports of specific products from specific countries. This was eventually expanded and applied to an ever-increasing number of products. During the 1990s the U.S. lowered tariffs and commenced the phaseout of quotas as agreed in the Uruguay Round under the Agreement on Textiles and Clothing (or ATC, the pre-cursor of which was the MFA) but

[39] http://www.cbo.gov/ftpdocs/100xx/doc10075/1991_12_traderestraints.pdf, visited 1 September 2009.

reserved the right to impose safeguards once the phaseout was complete. However, the U.S. refused to agree to accelerated quota growth and tariff reductions. Furthermore under the terms of the Uruguay Round agreement, developing countries were afforded much higher tariff rates than developed countries.[40] This had the potential to hurt export markets for U.S. producers.

> "The ATC called for reductions of 16% (January 1, 1995), 17% (January 1, 1998), 18% (January 2002), and 49% (January 1, 2005) of the quotas pertaining to specified textile and clothing products based upon 1990 volumes. In addition, the growth rates of quotas of products not liberalized as above or of products otherwise restrained were increased during the first three steps of the phaseout period. There were numerous exceptions; and, in the four-stage process of liberalization, importing countries had the choice of how much of each (defined) product category to liberalize at which step; and they could, and did, defer liberalization of the most "sensitive" products until the final stage of the ATC."[41]

Furthermore, a forecast was found for *Apparel* (made pre-1999) that was used in an industry report by the "Labor Market & Economic Analysis" division of the Washington State Employment Security Department:

> "Continued global competition for textiles and apparel markets are expected to spur changes in the domestic industries for the next decade ... Industry experts forecast that between 1999 and 2006, global sales of most textiles and apparel will increase between 2-3 percent a year."[42]

Whilst this provided a positive global outlook, the prospect of ongoing foreign competition didn't seem to augur well for U.S. producers. Overall, the above commentaries perhaps spelt danger signs for domestic producers of *Apparel.* Whilst the modeller might have been suspicious of steady growth over the forecast horizon, it is concluded that this was not sufficiently compelling to drive *ad hoc* adjustments to the forecast of each of these industries throughout the TCF sector.

In thinking about the broader issues associated with modelling the TCF sector it was noticed that, in the original forecast results, the model had performed poorly when it came to projecting basic import prices for these commodities. To elaborate, there are different types of prices in the model but output growth rates (the main focus here) are partly driven by changes in relative basic prices such as the landed duty-paid import price for a commodity. This is a function of the foreign currency price, the exchange rate, and any tariffs on the commodity. From 1992 to 1998 the foreign currency price of TCF commodities invariably increased, and the main driver of the increase was projected forward.[43] This strongly contributed to a higher basic price of imported TCF commodities than turned out to be the case (in fact, from 1998 to 2005 basic import prices for these commodities most

[40] http://www.tx.ncsu.edu/jtatm/volume2issue1/articles/antoshak/antoshakcomplete.pdf, visited 1 September 2009.
[41] http://docs.google.com/gview?a=v&q=cache:IuD6L3nlSgsJ:opencrs.com/rpts/RS20889_20050610.pdf+1995+quotas+apparel&hl=en&gl=au, visited 1 September 2009.
[42] http://www.wa.gov/esd/lmea/sprepts/indprof/textiles.htm, visited 1 September 2009.
[43] The model estimates the foreign currency import price by summing several component price changes, including a broad change (from 1992-1998 this was -2.0%) that impacts all commodities as well as a change that is specific to the commodity in question (e.g., +16.9% for *Knitfabric*). In the forecast, the historical move in the commodity-specific foreign currency price is projected forward (this was +20.0% for *Knitfabric*).

often fell). Figure F shows how the USAGE pure forecast errors for the 31 TCF commodities compares to the extrapolated 1992-1998 trend forecast errors. With the exception of *BootCutStock* USAGE outperforms trend extrapolation for each commodity. Overall, USAGE outperforms the trend forecast by 26% (*M* = 0.74). However, the model's AE for the TCF sector is very high, at 66.2%. It is interesting to note that (visually) there seems to be a high degree of proportionality in the plot of the percentage errors. In other words, both forecast methods seem to make quite similar errors for any given commodity. For example, large errors were made for both *Knifabric* and *Luggage*, etc.

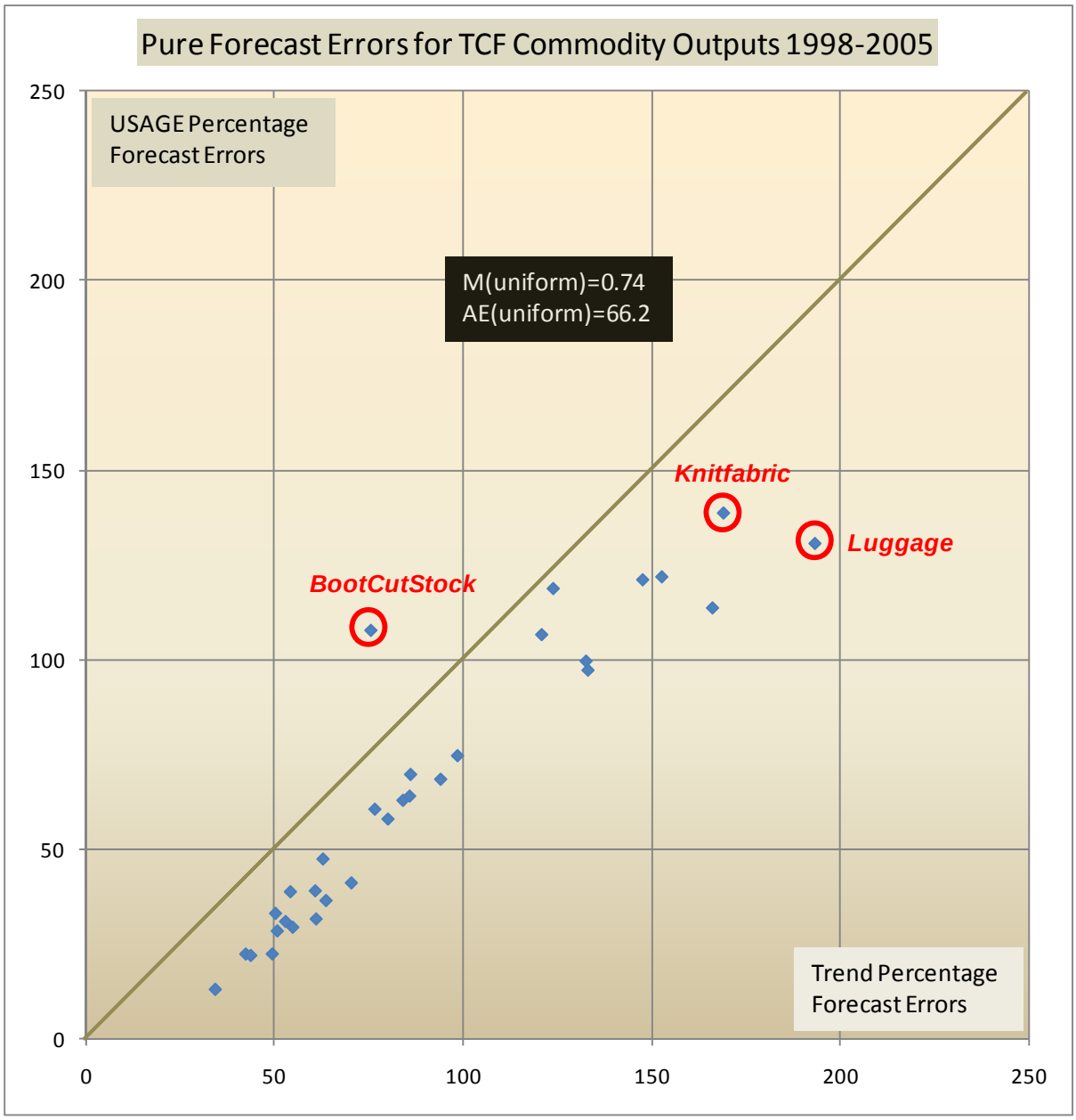

Figure F: Percentage forecast errors for TCF commodity outputs in the original USAGE pure forecast for 1998-2005 relative to the extrapolated 1992-1998 trend forecast

In reviewing the macro environment for the TCF sector it was evident that *basic* import prices for these commodities were heavily tied to policy. From 1992 to 1998 (nominal) landed duty-paid import prices (*p0imp*) for most TCF commodities typically fell slightly or increased by only small amounts – but usually fell considerably in real terms after accounting for the rise in the CPI. As such,

it seemed sensible to assume that policy-makers would allow real basic import prices to continue to fall at the same rate. (Compare this to the highly unlikely rises in nominal basic import prices that were being driven by, also unlikely, projected rises in foreign currency import prices.) In re-running the simulation, import price forecasts were generated by extrapolating the *real* or inflation-adjusted duty-paid price change from 1992 to 1998 for all TCF industries. This resulted in more realistic import price projections and less erroneous domestic-import relative (basic) price movements. This is *version 1* of the improved USAGE pure forecast for 1998-2005. The analysis of the 'large-error' TCF commodities that appears further below is based on this version of the forecast. Figure G shows the updated positions of the relative forecast errors. The TCF commodity AE for USAGE falls to 55.4% from 66.2% in the original pure forecast. This is reflected in an enhanced *M* coefficient of 0.62, which implies that the improved USAGE forecast outperformed the trend forecast by 38%.

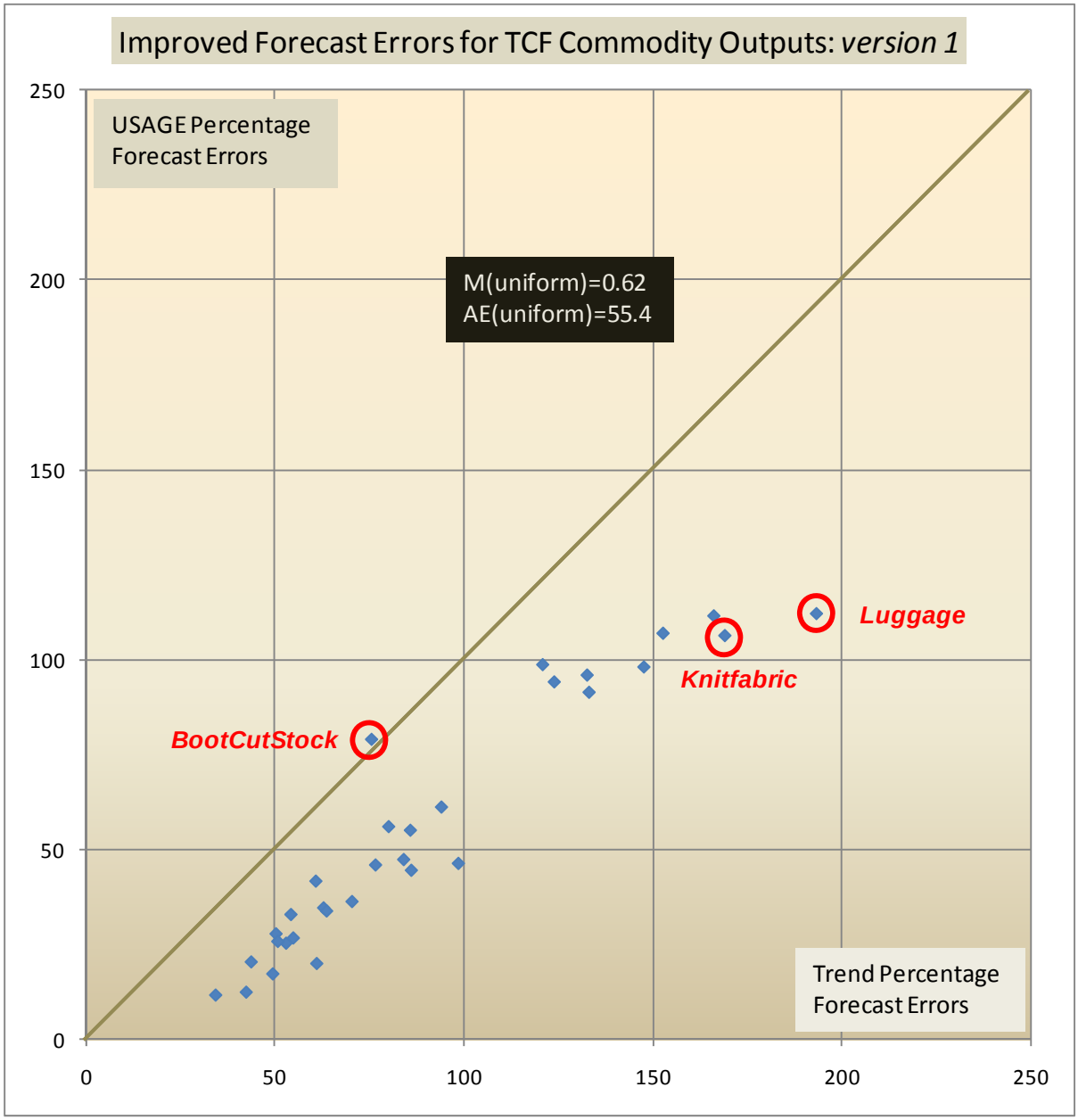

Figure G: Percentage forecast errors for TCF commodity outputs in *version 1* of the improved USAGE pure forecast for 1998-2005 relative to the extrapolated 1992-1998 trend forecast

This seemingly more intuitive approach to projecting import prices is congruent with macro environmental factors as they stood by the end of 1998. It is clear that trade liberalisation was starting to have a big impact on this sector by 1998 as evidenced by the strong growth in the value of imports. The ATC (later MFA) called for significant reductions in the number of quotas pertaining to specified textile and clothing products based upon 1990 volumes. At the time of the original forecast simulations USAGE did not adequately cater for this type of situation. The improved implementation of the model usually resulted in more realistic import price projections and hence, less erroneous relative price movements.

COMMODITY *i*	Original Forecast	Original USAGE ERROR	*Version 1* Forecast	*Version 1* USAGE ERROR	TREND ERROR	Orig. 45° LINE above/(below)	*V.1:* 45° LINE above/(below)
206 BootCutStock	45	108	25	79	75	**32**	**4**
115 Knitfabric	24	139	7	106	169	**(30)**	**(63)**
210 Luggage	-12	131	-19	112	193	**(63)**	**(81)**
114 Hosierynec	19	122	11	107	153	**(31)**	**(46)**
116 Apparel	16	121	4	98	148	**(26)**	**(49)**
205 LeatherTan	-5	119	-15	94	124	**(5)**	**(30)**
209 Leathrgloves	-17	114	-18	112	166	**(52)**	**(54)**
211 WmnsHandbag	19	107	14	99	121	**(14)**	**(22)**

Table 14a: The worst TCF commodity output errors – original forecast versus *version 1* of the improved forecast

This strategy generally reduced the size of the forecast error for each TCF commodity, though sometimes only by a small amount. Recall that Table A lists the twenty worst errors on a relative and/or absolute basis under the original forecast versus the extrapolated trend. It is noteworthy that 8 of the 9 largest errors on an absolute basis were TCF commodities. However, with the exception of *BootCutStock*, USAGE always outperformed the trend forecast, and usually by a significant margin. This was seen in Figure G and can also be seen in Table 14a, which compares the original forecast to the improved forecast (*version 1*); the respective forecast errors; and the model's performance versus the trend error as measured by vertical displacement around a 45-degree line.

After running the improved simulation some more thought was given to the large reductions (from 1992 to 1998) seen in total primary factor input costs. In USAGE this term is referred to as "all-factor augmenting technical change" and can be interpreted as follows: the industry could *potentially* produce the same output in 1998 as it did in 1992 with less primary factor inputs and the same other inputs. It is potential because actual output will also depend on other factors such as relative price changes. The large falls, sector wide, in all-factor augmenting technical change were having a significant impact in terms of output contributions (by stifling domestic basic prices thereby improving competitiveness). In forecast this impact on output is projected forward. It became clear that for the TCF sector that this ought to not be automatically baked in to the forecast. Why? Because the share of total primary factor input costs to total costs was declining significantly throughout these industries. In this relatively labour-intensive sector, output-boosting cost savings from shedding workers (in particular) were likely to be getting smaller; and this effect could be reinforced by possibly higher unit labour costs that might arise from increased labour scarcity (especially as companies were shifting operations abroad). To see how this would pan out the improved forecast simulation was rerun with the single change of no additional potentially output-boosting primary factor cost savings for the TCF commodities (*version 2* of the improved forecast).

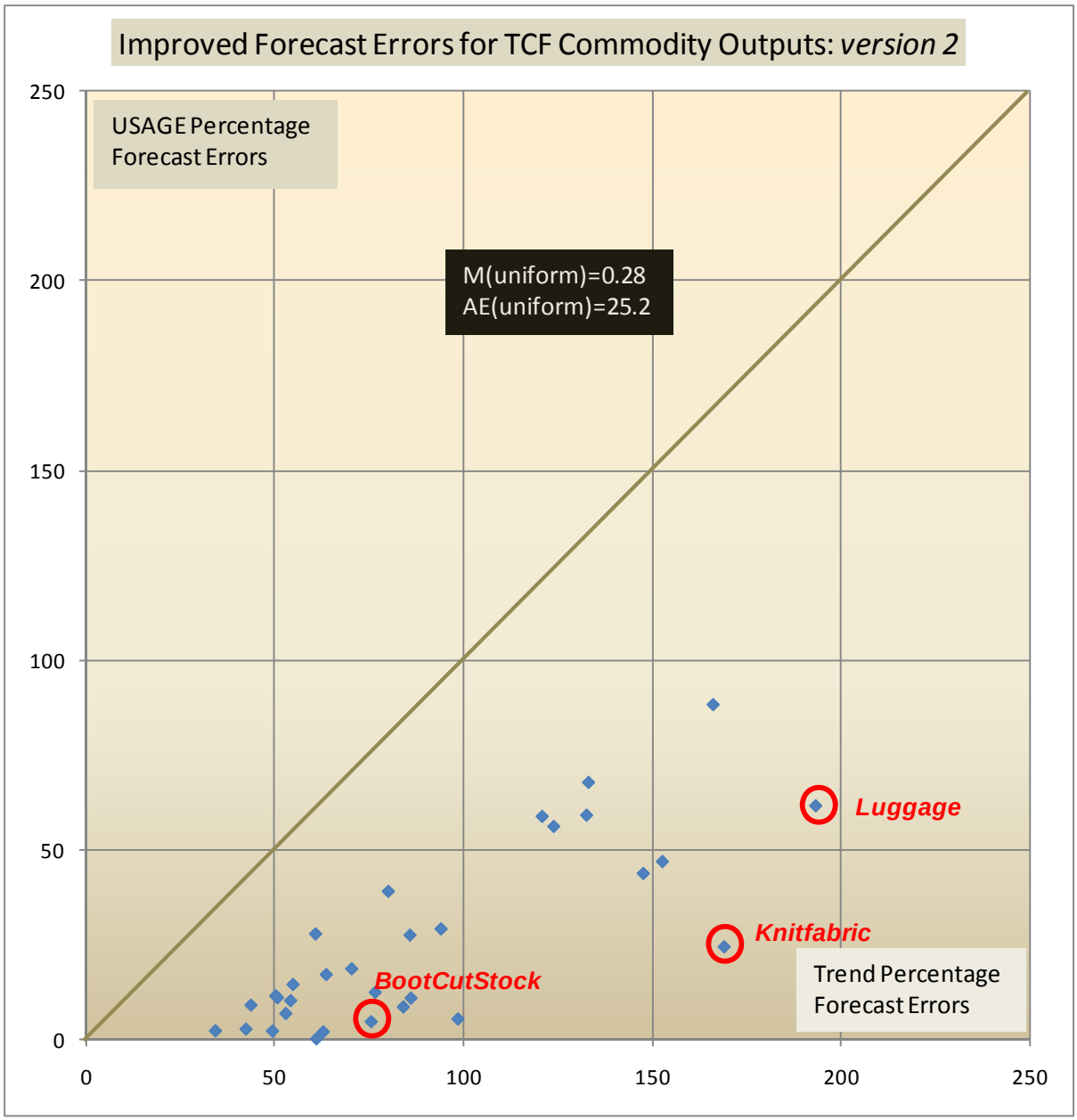

Figure H: Percentage forecast errors for TCF commodity outputs in *version 2* of the improved USAGE pure forecast for 1998-2005 relative to the extrapolated 1992-1998 trend forecast

COMMODITY *i*	Original Forecast	Original USAGE ERROR	*Version 1* Forecast	*Version 1* USAGE ERROR	*Version 2* Forecast	*Version 2* USAGE ERROR	1998-2005 Actual Output
206 BootCutStock	45	108	25	79	-27	5	-31
115 Knitfabric	24	139	7	106	-35	24	-48
210 Luggage	-12	131	-19	112	-38	62	-62
114 Hosierynec	19	122	11	107	-21	47	-46
116 Apparel	16	121	4	98	-25	44	-48
205 LeatherTan	-5	119	-15	94	-32	56	-56
209 Leathrgloves	-17	114	-18	112	-27	88	-61
211 WmnsHandbag	19	107	14	99	-9	59	-42

Table 14b: The worst TCF commodity output percentage forecast errors – original forecast, and versions 1 & 2 of the improved USAGE pure forecast

The results were very promising, e.g., for *Knitfabric* output contracted 35.4% on the back of rising costs, and its USAGE error fell significantly, to 24%. This can be seen in Table 14.b with the results of the new simulation listed in the 2nd- and 3rd-last columns. Figure H shows the updated positions of the relative forecast errors under *version 2* of the improved USAGE pure forecast. In this instance, the TCF commodity AE for USAGE falls to 25.2% from 66.2% in the original pure forecast. This is reflected in a vastly enhanced *M* coefficient of 0.28, which implies that the improved USAGE forecast outperformed the trend forecast by 72%. The bulk of the remaining error for this sector was due to the significant underestimation of the import-favouring movement in *impftwist*, which in all likelihood could not have been predicted by the modeller.

As mentioned previously, the analysis of the 'large-error' TCF commodities that appears below is based on *version 1* of the improved USAGE pure forecast.

Knitfabric → Knit Fabric Mills (Part of Industry Group 225: Knitting Mills)

- ***2257: Weft Knit Fabric Mills –*** *Establishments primarily engaged in knitting weft (circular) fabrics or in dyeing, or finishing weft (circular) knit fabrics.*
- ***2258: Lace and Warp Knit Fabric Mills –*** *Establishments primarily engaged in knitting, dyeing, or finishing warp (flat) knit fabrics, or in manufacturing, dyeing, or finishing lace goods.*

Knitfabric - Knit Fabric Mills	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-8.7	-17.3	-6.7	-6.8
All factor augmenting technical change	*a1prim*	-55.0	-6.4	-69.3	-69.3
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-18.8	-1.4	-21.6	-21.6
Combined change in household tastes	*a3com*	9.2	-18.9	10.8	10.8
Commodity-using technical and taste change	*ac*	-10.8	-21.8	-12.7	-12.7
Contribution to output of commodity-using technical & taste change	*cont_ac*	-9.8	-19.6	-11.4	-11.4
Vertical shift of the export demand curve	*cont_fepc*	1.4	11.0	1.7	1.7
Import/domestic twist by commodity	*ftwist_src*	195.4	429.2	85.7	82.7
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-6.9	-30.7	-7.9	-7.9
Twist caused by strong growth	*twist_eff*	1.7	-19.1	1.8	-1.9
Basic price of domestic goods	*p0dom*	-6.5	-16.4	2.4	1.3
Basic price of imported goods	*p0imp*	-1.4	-27.7	12.8	2.9
Ratio of basic prices: domestic to import	*fpdm*	-5.2	15.2	-9.3	-1.6
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	38.1	-51.8	29.5	16.8
Total supplies of domestic goods	*x0dom*	**33.0**	**-48.4**	**23.8**	**7.1**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	29.7	-70.5	20.3	5.3
Total supplies of imported goods	*x0imp*	233.3	85.3	113.4	116.7
Household demands undifferentiated by source	*x3*	50.3	27.8	32.0	33.1
Export volumes	*x4*	88.9	183.9	67.4	31.5
Change in net import share to domestic output	*dtradeshare*	3.7	-17.2	5.9	8.6

Table 15: Key results for *Knitfabric*

1. Why did the model erroneously give good prospects to Knit Fabric Mills?

Knitfabric had a USAGE error of 139% versus the larger trend forecast error of 169%. The key results for this commodity are shown in Table 15. The actual outcome for *Knitfabric* output (*x0dom*) was a 48.4% contraction over the 1998-2005 period. This followed 33.0% growth from 1992-1998. The extrapolated trend was therefore 40% growth versus the USAGE forecast of 23.8% growth. Table 16 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- Import penetration was just 10% of the domestic market (Section 5 of Table 16).
- Producers purchased 88% of domestic output; foreigners 9%; and households 3% (Section 3 of Table 16).
- Labour makes up 85% of factor input costs (Section 6b of Table 16).

Knit Fabric Mills (*Knitfabric*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	119 Knitfabric: 8668	116 Knitoutwear: 277	Rest: 320	**Total: 9266**
Proportion	119 Knitfabric: 0.936	116 Knitoutwear: 0.030	Rest: 0.035	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	115 Knitfabric: 8668	103 Broadfabric: 261	Rest: 89	**Total: 9018**
Proportion	115 Knitfabric: 0.961	103 Broadfabric: 0.029	Rest: 0.010	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	8142	898	9040	**0.88**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	284	23	307	**0.03**
Exports	BAS4	796	0	796	**0.09**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	45	0	45	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**9266**	**921**	**10188**	
Source/Total		**0.91**	**0.09**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	120 Apparel: 4883	119 Knitfabric: 2020	Rest: 1238	Total: 8142	**Total: 0.901**
Imported	120 Apparel: 622	119 Knitfabric: 163	Rest: 113	Total: 898	**Total: 0.099**
Total	**120 Apparel: 5506**	**119 Knitfabric: 2183**	**Rest: 1351**	**Total: 9040**	
Proportion	**120 Apparel: 0.609**	**119 Knitfabric: 0.241**	**Rest: 0.149**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	8651	962	9613	**0.92**	**0.83**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	721	57	777	**0.08**	**0.07**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	45	0	45	**0.00**	**0.00**
Total	**9416**	**1019**	**10435**		
Source/Total	**0.90**	**0.10**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	7222	**0.80**	LABOUR	1622	**0.85**
Factor	1912	**0.21**	CAPITAL	290	**0.15**
Other	-178	**-0.02**	LAND	0	**0.00**
Production Taxes	61	**0.01**	**Total**	**1912**	
Total	**9018**				

Source	c. Intermediate Inputs				Proportion
Domestic	115 Knitfabric: 2174	105 YarnFinish: 1971	Rest: 2641	Total: 6786	**Total: 0.940**
Imported	115 Knitfabric: 177	105 YarnFinish: 105	Rest: 154	Total: 436	**Total: 0.060**
Total	**115 Knitfabric: 2351**	**105 YarnFinish: 2077**	**Rest: 2795**	**Total: 7222**	
Proportion	**115 Knitfabric: 0.325**	**105 YarnFinish: 0.288**	**Rest: 0.387**		

Table 16: Key attributes of the *Knitfabric* database in 1998

From Table 16 Section 4a, it can be determined that the majority of sales were to the *Apparel* industry. As shall be seen later, the model did a poor job (in absolute terms) of forecasting *Apparel* where the USAGE error was 121%. It is this error that drove the poor result in *Knitfabric*. In particular, USAGE vastly overestimated the growth of the U.S. *Apparel* industry. Hence, if the modeller could have done better at forecasting *Apparel*, it is likely that a better projection for *Knitfabric* would have eventuated.

2. What happened in the forecast?

Column 4 of Table 15 shows that from 1998 to 2005 total sales (or absorption) of *Knitfabric* in the U.S. slumped 51.8% (*x0*) on the back of lower sales into the U.S. of domestically produced *Knitfabric* (*x0dom_dom* fell 70.5%). The market was dominated by local producers, and at the same time, imports (*x0imp*) rose 85.3% off a low base. The main drivers of the actual results were:

- A 15.2% change in relative prices favouring the purchase of more imports (note that the Armington elasticities were set to one) – versus a 9.3% move *against* imports in forecast.
- A sharp move in *impftwist* favouring the sale of imports of -30.7%, versus a more subdued -7.9% in forecast.
- Slower output growth relative to real GDP resulting in a partially offsetting twist against imported *Knitfabric* (*twist_eff* of -19.1% versus +1.8% in forecast).

Hence, the forecast underestimated the impact of import/domestic preference twists (the nature of this effect has been described previously). Also, relative prices were expected to strongly favour domestic producers, when in fact they moved in favour of importers. To elaborate, there are different types of prices in the model but output changes are partly driven by changes in relative basic prices such as the landed duty-paid import price for a commodity. This is a function of the foreign currency price, the exchange rate, and any tariffs on the commodity. From 1992 to 1998 the foreign currency price of *Knitfabric* increased, and the main driver of this was projected forward. This strongly contributed to a higher basic price of imported *Knitfabric* than turned out to be the case (in fact, the basic import price fell). Finally, the sharp factor input cost reductions that occurred from 1992 to 1998 were also projected forward; but instead of maintaining their growth rate they largely failed to materialise.

3. Macro perspective

In sync with earlier commentary, it was very difficult to source evidence that was publicly available prior to the end of 1998 that could provide a convincing argument that output of this commodity would slump during the forecast period. A manufacturing report comparing two data points, 1992 and 1995, was found. However, this was for the broader industry group and it was showing a rise, consistent with the results from the historical simulation. In terms of more general information, we garnered that major domestic players in the industry had embarked on an aggressive expansion and acquisition program during the mid to late 1990s. However, this ended badly with many key manufacturers filing for Chapter 11 bankruptcy protection under heavy debt burdens in the early part of the next decade; and only very few re-emerged. Furthermore, in the lace & warp knit fabric space:

"During the 1980s a slump in clothing sales and a growing flood of inexpensive imports slowed growth in this industry considerably. Throughout the mid-1990s domestic manufacturers remained competitive by introducing new specialty fabrics, such as microdeniers and spandex blends ... During the mid-1990s the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT) opened new markets for the textile industry, but also increased foreign competition ... In general, however, despite efforts to expand operations overseas, U.S. textile mills in the early 2000 continued to struggle with increased foreign competition."[44]

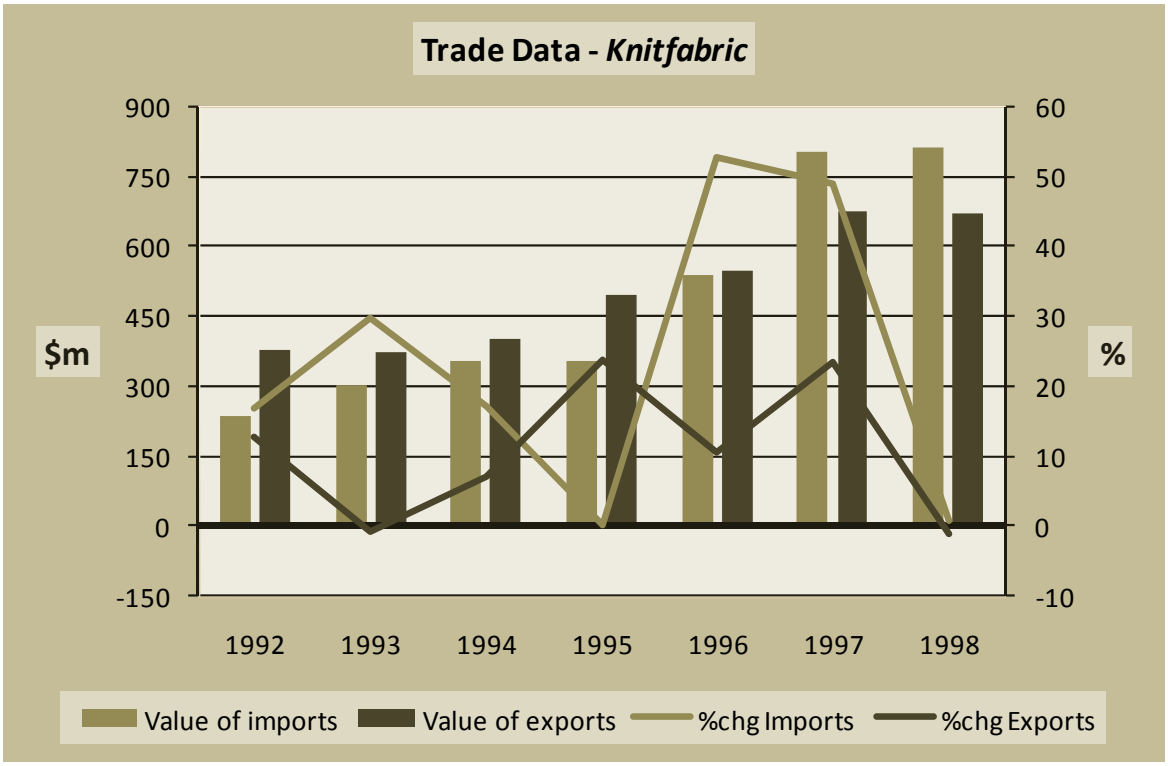

Figure 6: 1992-1998 – U.S. trade by the *Knitfabric* industry in nominal dollars

The relaxation of trade barriers saw to a surge in imports in the period from 1992 to 1998 for *Knitfabric* (see Figure 6). This may have pointed to a slowdown in the overall production of this trade exposed sector but without hard evidence in terms of falling product shipments one might have been loathed to adopt this as the default position.[45]

4. Conclusion

Most of *Knitfabric's* sales were to the *Apparel* industry. As shall be seen below, *Apparel* registered 25.0% growth during the historical simulation, and exports of the commodity grew by 124.6% whilst imports grew by 59.6%. Following strong increases in 1996 and 1997 growth in *Knitfabric* imports paused in 1998. It would have been difficult for the modeller to confidently assert that imports would continue to surge and decimate *Knitfabric*. It is also unlikely the modeller would have seen cause to adjust domestic-import twist factors, or even to sensibly estimate the magnitude of any

[44] http://www.encyclopedia.com/doc/1G2-3434500073.html, visited 17 August 2009.
[45] The modeller would have had data for the value of shipments and for capex up until only 1997 available to them. This data showed the value of shipments rebounding strongly in 1997 after a contraction in 1996. In addition, the capex data showed a surge in 1997, probably reflecting the rise in merger and acquisition activity.

such adjustment. However, it is clear that improvements could have been made to the import price forecasts. Basic import prices for commodities in this sector were heavily tied to policy. From 1992 to 1998 the (nominal) landed duty-paid import price for *Knitfabric* fell slightly; but fell considerably in real terms. It is sensible to assume that policy-makers would allow real basic import prices to continue to fall at the same annual rate. (Compare this to a highly unlikely rise in nominal basic import prices; being driven by also unlikely rising foreign currency import prices.)

5. Strategy to improve the forecast

In re-running the simulation, import price forecasts were generated by extrapolating the *real* price change from 1992 to 1998. This was done for all textile, clothing and footwear (TCF) industries. For *Knitfabric* this resulted in more realistic import price projections and less erroneous domestic-import relative (basic) price movements, and hence an improved estimate for *x0dom_dom*. These effects culminated in an improved forecast for output growth of 7.1% and reduced the USAGE error from 139% to 106%. The absolute size of the error remained quite large due to the ongoing underestimation of *impftwist*, the error in forecasting the main buyer, *Apparel*, and the projection of the impact on output for even higher factor input cost reductions.

Apparel → Apparel Made From Purchased Materials (SICs 231-238)

Known as the cutting-up and needle trades, includes establishments producing clothing and fabricating products by cutting and sewing purchased woven or knit textile fabrics and related materials, such as leather, rubberized fabrics, plastics, and furs. Also included are establishments that manufacture clothing by cutting and joining (for example, by adhesives) materials such as paper and non-woven textiles. Included in the apparel industries are three types of establishments: (1) the regular or inside factories; (2) contract factories; and (3) apparel jobbers. The regular factories perform all of the usual manufacturing functions within their own plant; the contract factories manufacture apparel from materials owned by others; and apparel jobbers perform the entrepreneurial functions of a manufacturing company, such as buying raw materials, designing and preparing samples, arranging for the manufacture of clothing from their materials, and selling of the finished apparel.

- ***Industry Group 231:*** *Men's And Boys' Suits, Coats, And Overcoats*
- ***Industry Group 232:*** *Men's And Boys' Furnishings, Work Clothing, And Allied Garments*
- ***Industry Group 233:*** *Women's, Misses', And Juniors' Outerwear*
- ***Industry Group 234:*** *Women's, Misses', Children's, And Infants'*
- ***Industry Group 235:*** *Hats, Caps, And Millinery*
- ***Industry Group 236:*** *Girls', Children's, And Infants' Outerwear*
- ***Industry Group 237:*** *Fur Goods*
- ***Industry Group 238:*** *Miscellaneous Apparel And Accessories*

Apparel - Apparel Made From Purchased Materials	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-12.3	-16.4	-9.9	-10.0
All factor augmenting technical change	*a1prim*	-55.9	-0.9	-70.5	-70.5
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-24.3	-0.3	-27.7	-27.7
Combined change in household tastes	*a3com*	8.0	-15.2	9.4	9.4
Commodity-using technical and taste change	*ac*	-5.5	-6.5	-6.6	-6.6
Contribution to output of commodity-using technical & taste change	*cont_ac*	-0.7	-0.8	-0.8	-0.8
Vertical shift of the export demand curve	*cont_fepc*	2.2	-5.3	2.5	2.5
Import/domestic twist by commodity	*ftwist_src*	29.2	291.8	29.9	29.4
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-10.7	-57.8	-12.3	-12.3
Twist caused by strong growth	*twist_eff*	0.1	-18.8	0.1	-2.6
Basic price of domestic goods	*p0dom*	-9.1	-17.6	-0.3	-2.1
Basic price of imported goods	*p0imp*	-7.9	-27.3	12.8	-4.8
Ratio of basic prices: domestic to import	*fpdm*	-1.3	13.0	-11.7	2.8
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	38.5	25.1	26.5	30.1
Total supplies of domestic goods	*x0dom*	**25.0**	**-47.6**	**15.8**	**3.8**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	26.5	-47.4	7.9	2.7
Total supplies of imported goods	*x0imp*	59.6	95.6	45.8	57.9
Household demands undifferentiated by source	*x3*	41.6	28.7	26.4	30.9
Export volumes	*x4*	124.6	-47.8	85.1	17.4
Change in net import share to domestic output	*dtradeshare*	14.7	190.9	29.6	39.7

Table 17: Key results for *Apparel*

1. **Why did the model erroneously give good prospects to *Apparel*?**

Apparel had a USAGE error of 121% versus the larger trend forecast error of 148%. The key results for this commodity are shown in Table 17. The actual outcome for *Apparel* output (*x0dom*) was a 47.6% contraction over the 1998-2005 period. This followed 25.0% growth from 1992-1998. The extrapolated trend was therefore 30% growth versus the USAGE forecast of 15.8% growth. Table 19 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- About 49% of total domestic sales came from imports (Section 5 of Table 19).
- Just 11% of domestic production was exported (Section 3 of Table 19).
- 87% of domestic output was sold to consumers (Section 5 of Table 19).

A priori, given the strong share of sales to consumers, an inaccurate projection for the household taste variable (*a3com*) could create a material divergence between forecast and reality. The model extrapolated household preferences from the historical run resulting in tastes moving in favour of *Apparel*. This did not turn out to be true, with a difference of 24.6 percentage points. However, no clear evidence could be found to suggest that by 1998 consumer tastes were souring towards this commodity.

More important was the model's underestimation of *impftwist*. As mentioned previously, this purports to measure the impact of the shifter on the twist (*ftwist_src*). This can be seen in Table 18. The impact on the domestic sales share of *Apparel* was a 12.3% contraction in forecast, *ceteris paribus*, when in reality the damage to the market share of domestic producers was 57.8%.

ftwist_src	29.87%	*Apparel* (original forecast)		
		start	**end**	
Import	3211	21.44	26.17	
Domestic	11764	78.56	73.83	-6.02
Total	**14975**	**= BAS1**		
		start	**end**	
Import	0	0	0	
Domestic	0	0	0	0.00
Total	**0**	**= BAS2**		
		start	**end**	
Import	51931	53.38	59.79	
Domestic	45350	46.62	40.21	-13.75
Total	**97281**	**= BAS3**		
			Weighted Average =	**-12.72**
Sales	**112256**		***impftwist (%)***	**-12.33**
The difference is due to b.o.t.e. estimation error				

ftwist_src	291.82%	*Apparel* (actual outcome)		
		start	**end**	
Import	3211	21.44	51.68	
Domestic	11764	78.56	48.32	-38.49
Total	**14975**	**= BAS1**		
		start	**end**	
Import	0	0	0	
Domestic	0	0	0	0.00
Total	**0**	**= BAS2**		
		start	**end**	
Import	51931	53.38	81.77	
Domestic	45350	46.62	18.23	-60.90
Total	**97281**	**= BAS3**		
			Weighted Average =	**-57.91**
Sales	**112256**		***impftwist (%)***	**-57.83**
The difference is due to b.o.t.e. estimation error				

Table 18: The predicted and actual impacts of import twist factors on *Apparel* in the period from 1998 to 2005

In addition, reduced protection coincided with the increasing emergence of China and India as super-cheap producers and exporters of *Apparel.* This is reflected in the trade data, which is illustrated in Figure 7. As was the case for all TCF commodities, the foreign currency price increase of imported *Apparel* that occurred between 1992 and 1998 was projected forward. This strongly contributed to a higher basic price of imported *Apparel* than turned out to be the case (in fact, the

basic import price fell sharply). This impacted relative basic prices in a way that was incorrectly favourable to domestic producers. The model estimated an 11.7% change in favour of domestic output, when in reality there was an *unfavourable* 13.0% change.

Finally, the impact on output of the sharp cost reductions relating to primary factor input that occurred from 1992 to 1998 were also projected forward; but instead of these intensifying they failed to materialise.

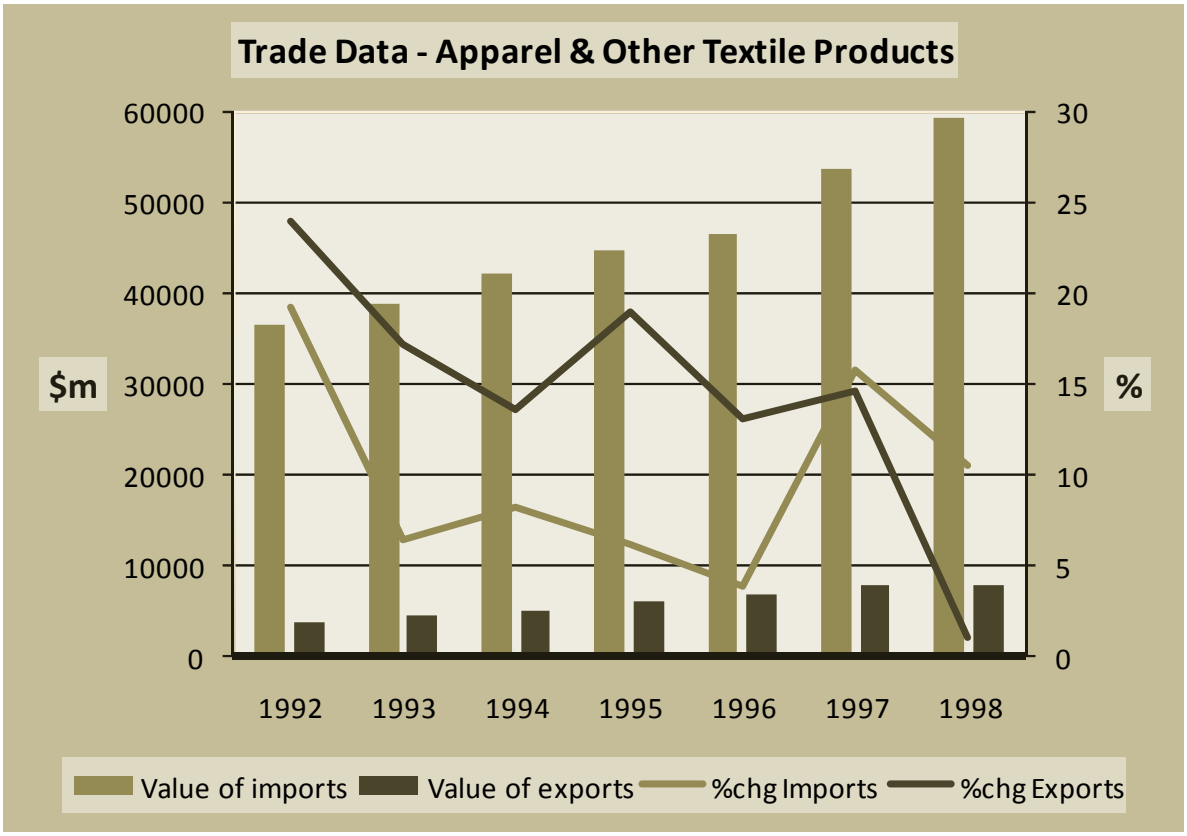

Figure 7: 1992-1998 – U.S. trade by the Apparel & Other Textile Products industries in nominal dollars

Apparel Made From Purchased Materials (*Apparel*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	120 Apparel: 57932	116 Knitoutwear: 4689	Rest: 1891	**Total: 64512**
Proportion	120 Apparel: 0.898	116 Knitoutwear: 0.073	Rest: 0.029	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	116 Apparel: 57932	Rest: 805	**Total: 58737**
Proportion	116 Apparel: 0.986	Rest: 0.014	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	11764	3211	14975	**0.18**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	45350	51931	97281	**0.70**
Exports	BAS4	7082	0	7082	**0.11**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	315	0	315	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**64512**	**55142**	**119653**	
Source/Total		**0.54**	**0.46**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	120 Apparel: 6796	504 SLCEcorrect: 959	Rest: 4009	Total: 11764	**Total: 0.786**
Imported	120 Apparel: 1252	508 Holiday: 476	Rest: 1483	Total: 3211	**Total: 0.214**
Total	**120 Apparel: 8048**	**504 SLCEcorrect: 1012**	**Rest: 5915**	**Total: 14975**	
Proportion	**120 Apparel: 0.537**	**504 SLCEcorrect: 0.068**	**Rest: 0.395**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	14198	4587	18786	**0.12**	**0.06**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	99753	114874	214627	**0.87**	**0.43**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	315	0	315	**0.00**	**0.00**
Total	**114266**	**119462**	**233728**		
Source/Total	**0.49**	**0.51**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	44102	**0.75**	LABOUR	14106	**0.88**
Factor	16030	**0.27**	CAPITAL	1924	**0.12**
Other	-1576	**-0.03**	LAND	0	**0.00**
Production Taxes	181	**0.00**	**Total**	**16030**	
Total	**58737**				

Source	c. Intermediate Inputs				Proportion
Domestic	103 Broadfabric: 10025	116 Apparel: 7693	Rest: 21552	Total: 39270	**Total: 0.890**
Imported	103 Broadfabric: 1678	116 Apparel: 1435	Rest: 1720	Total: 4832	**Total: 0.110**
Total	**103 Broadfabric: 11703**	**116 Apparel: 9128**	**Rest: 23272**	**Total: 44102**	
Proportion	**103 Broadfabric: 0.265**	**116 Apparel: 0.207**	**Rest: 0.528**		

Table 19: The key attributes of *Apparel* in 1998

2. Macro perspective

The impact of the Uruguay Round of multilateral trade negotiations (MTN) that was implemented over the period 1995-2000 for developed countries has already been discussed. As part of this the U.S. lowered tariffs and commenced the phaseout of quotas but reserved the right to impose safeguards once the phaseout was complete. However, the U.S. refused to agree to accelerated quota growth and tariff reductions. Furthermore under the terms of the Uruguay Round agreement, developing countries were afforded much higher tariff rates than developed countries. The modeller could not have been sure that reductions in protection would subsequently be reversed.

In forming a view about the prospects for *Apparel* the modeller could have noted the advice in the following quote:

> "Key factors that affect the demand for many textiles and apparel subsectors include health of end-use markets, growth in the overall economy and consumer spending, and trends in foreign trade. A broad range of textile products are used in the production of apparel, home furnishings, and industrial products ... Most apparel markets are affected by trends in consumer spending, overall growth in the national economy, demographics, and foreign trade."[46]

By late 1998 it was not clear that consumer tastes would begin to sour overall, whilst taking an increased liking to imports – well beyond that which could be explained by changes in relative prices.

3. Conclusion

In summary, import twist factors, relative prices and household preferences all worked against domestic output of *Apparel*, resulting in a large forecast error. Whilst the modeller could have been wary of strong domestic growth numbers given that TCF industries were becoming increasingly exposed to foreign entry, it seems that it would have been too difficult to predict the magnitude of the preference twist in favour of imports. By late 1998 it was not clear that consumer tastes would begin to sour overall, whilst taking an increased liking to imports – well beyond that which could be explained by changes in relative prices. Furthermore, the modeller could not have been sure that reductions in protection would not subsequently be reversed. However, as was the case for all TCF commodities, improvements could have been made to the import price forecasts because basic import prices were heavily tied to policy.

4. Strategy to improve the forecast

In re-running the simulation, real basic import prices were projected forward, generating more realistic relative basic price changes. For *Apparel* this produced an improved forecast for output growth of 3.8% and reduced the USAGE error from 121% to 98%. This was done for all TCF industries, which resulted in more realistic import price projections and hence, less erroneous domestic-import relative price movements. This improved the estimate for *x0dom_dom* and, in

[46] http://www.wa.gov/esd/lmea/sprepts/indprof/textiles.htm, visited 1 September 2009.

turn, for *x0dom.* However, the absolute size of the error remained quite large due to the ongoing underestimation of *impftwist*, the error in forecasting household preferences, and the overestimation of factor input cost reductions. A subsequent simulation differing only by the additional forecast of no further primary factor cost savings (i.e., no further all factor augmenting technical change) gave better results. (See earlier comments for elaboration.) In this case, higher costs meant that output contracted 24.7% and the USAGE error improved to 44%.

Luggage → Luggage (SIC 3161)

Establishments primarily engaged in manufacturing luggage of leather or other materials. The luggage industry produces a wide variety of products, including suitcases, briefcases, attaché cases, hand luggage, tote bags, trunks, and occupational cases. Materials used in addition to leather include plastics, nylon, cotton, linen, and metals. Many products use a combination of these materials. Construction methods include sewing, molding, and laminating.

Luggage - Luggage	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-4.6	1.1	-2.7	-2.9
All factor augmenting technical change	*a1prim*	-22.5	60.7	-25.9	-25.9
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-10.9	24.0	-12.5	-12.5
Combined change in household tastes	*a3com*	8.3	-19.9	9.7	9.7
Commodity-using technical and taste change	*ac*	11.0	6.2	13.9	13.9
Contribution to output of commodity-using technical & taste change	*cont_ac*	1.5	0.8	1.8	1.8
Vertical shift of the export demand curve	*cont_fepc*	4.2	-10.7	4.9	4.9
Import/domestic twist by commodity	*ftwist_src*	120.9	682.3	127.7	127.5
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-42.9	-83.3	-48.0	-48.0
Twist caused by strong growth	*twist_eff*	-3.1	-24.8	-6.6	-8.5
Basic price of domestic goods	*p0dom*	2.8	5.9	7.2	5.4
Basic price of imported goods	*p0imp*	2.8	8.6	15.6	7.9
Ratio of basic prices: domestic to import	*fpdm*	0.1	-2.5	-7.3	-2.4
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	50.0	13.2	26.8	30.5
Total supplies of domestic goods	*x0dom*	10.0	-61.9	-12.1	-19.1
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	-14.7	-74.5	-32.2	-34.6
Total supplies of imported goods	*x0imp*	78.1	37.6	42.7	48.1
Household demands undifferentiated by source	*x3*	45.1	12.1	26.3	30.3
Export volumes	*x4*	65.2	-14.6	64.7	40.3
Change in net import share to domestic output	*dtradeshare*	104.1	697.0	196.3	233.9

Table 20: Key results for *Luggage*

1. Why did the model erroneously give good prospects to *Luggage*?

Luggage had a USAGE error of 131% versus the larger trend forecast error of 193%. The key results for this commodity are shown in Table 20. The actual outcome for *Luggage* output (*x0dom*) was a 61.9% contraction over the 1998-2005 period. This followed 10.0% growth from 1992-1998. The extrapolated trend was therefore 12% growth versus the USAGE forecast of a 12.1% contraction. Table 21 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- About 79% of total sales in the U.S. came from imports (Section 5 of Table 21).
- 21% of production was exported (Section 3 of Table 21).
- 88% of U.S.-destined domestic output was sold to consumers (Section 5 of Table 21).

Luggage (*Luggage*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	215 Luggage: 947	Rest: 43	**Total: 990**	
Proportion	215 Luggage: 0.957	Rest: 0.043		

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	210 Luggage: 947	416 WholesleTrde: 30	Rest: 62	**Total: 1039**
Proportion	210 Luggage: 0.912	416 WholesleTrde: 0.029	Rest: 0.060	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	137	377	514	**0.14**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	640	2485	3125	**0.65**
Exports	BAS4	209	0	209	**0.21**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	5	0	5	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**990**	**2862**	**3853**	
Source/Total		**0.26**	**0.74**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	479 LaborOrgan: 23	215 Luggage: 12	Rest: 101	Total: 137	**Total: 0.266**
Imported	479 LaborOrgan: 106	508 Holiday: 25	Rest: 247	Total: 377	**Total: 0.734**
Total	**479 LaborOrgan: 129**	**508 Holiday: 31**	**Rest: 353**	**Total: 514**	
Proportion	**479 LaborOrgan: 0.251**	**508 Holiday: 0.061**	**Rest: 0.688**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	152	441	593	**0.12**	**0.03**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	1100	4333	5433	**0.88**	**0.18**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	5	0	5	**0.00**	**0.00**
Total	**1257**	**4774**	**6031**		
Source/Total	**0.21**	**0.79**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	577	**0.56**	LABOUR	293	**0.63**
Factor	467	**0.45**	CAPITAL	174	**0.37**
Other	-8	**-0.01**	LAND	0	**0.00**
Production Taxes	3	**0.00**	**Total**	**467**	
Total	**1039**				

Source	c. Intermediate Inputs				Proportion
Domestic	103 Broadfabric: 126	108 Coatdfabric: 76	Rest: 300	Total: 501	**Total: 0.869**
Imported	103 Broadfabric: 20	108 Coatdfabric: 19	Rest: 37	Total: 76	**Total: 0.131**
Total	**103 Broadfabric: 146**	**108 Coatdfabric: 95**	**Rest: 337**	**Total: 577**	
Proportion	**103 Broadfabric: 0.253**	**108 Coatdfabric: 0.164**	**Rest: 0.583**		

Table 21: The key attributes of *Luggage* in 1998

There were several factors contributing to the erroneous forecast. On the supply side, primary factors comprised 45% of total input costs (Section 6a of Table 21); "all primary factor augmenting technical change" (*a1prim*) indicated a 25.9% improvement in primary factor efficiency (see Table 20). This meant that the *Luggage* industry was projected to require 26% less primary factors to produce the same level of output whilst holding all other inputs constant. The *contribution* of "all primary factor augmenting technical change" to total input costs in the forecast was estimated to be an overall cost reduction of about 12.5% (*cont_a1prim*). In reality, this efficiency measure deteriorated by 60.7%, and its contribution to total input costs rose 24.0%.

On the demand side, households were responsible for 65% of sales of domestically produced *Luggage* and 90% of total sales (domestic and imported). This meant that any large change in household preferences would have a significant impact on the forecast. In particular, the combined change in household tastes (*a3com*) was projected forward to be 9.7%. This means that at any given set of prices and per capita income, consumption per household of *Luggage* would be about 9.7% higher in 2005 than in 1998.[47] In reality, household tastes towards Luggage soured by 19.9% – a difference of 29.6 percentage points. Even though exports were a much smaller share of output, the prediction for foreign preferences was also off the mark. The export demand curve was forecast to shift upward when it in fact shifted downward (see *cont_fepc* in Table 20). This was a difference of 15.6 percentage points.

Import twist factors worked overwhelmingly against the domestic commodity. In particular, the impact of the shifter on the twist was *(ceteris paribus)* projected to do 48.0% damage to the market share of domestic producers of *Luggage*. In reality, it did an even more significant 83.3% damage, as illustrated in Table 22. This shows both in forecast and reality, that if not for other factors (e.g., changes in relative prices) the market share of domestic producers would have fallen dramatically.

ftwist_src	127.70%	*Luggage* (original forecast)		
		start	end	
Import	377	73	86	
Domestic	137	27	14	-48.36
Total	**514**	**= BAS1**		
		start	end	
Import	0	0	0	
Domestic	0	0	0	0.00
Total	**0**	**= BAS2**		
		start	end	
Import	2485	80	90	
Domestic	640	20	10	-50.38
Total	**3125**	**= BAS3**		
			Weighted Average =	**-50.10**
Sales	**3639**		***impftwist (%)***	**-48.00**
The difference is due to b.o.t.e. estimation error				

ftwist_src	682.30%	*Luggage* (actual outcome)		
		start	end	
Import	377	73	96	
Domestic	137	27	4	-83.35
Total	**514**	**= BAS1**		
		start	end	
Import	0	0	0	
Domestic	0	0	0	0.00
Total	**0**	**= BAS2**		
		start	end	
Import	2485	80	97	
Domestic	640	20	3	-84.44
Total	**3125**	**= BAS3**		
			Weighted Average =	**-84.28**
Sales	**3639**		***impftwist (%)***	**-83.35**
The difference is due to b.o.t.e. estimation error				

Table 22: The impact of import twist factors on *Luggage*

[47] More precisely, the consumption per household of *Luggage* in 2005 would be 10*(1 – share of *Luggage* in household expenditure) percent higher than in 1998.

2. Macro perspective

An external forecast was found, dated February 1995, by SBI, a division of MarketResearch.com, who claim to be the world's largest aggregator of syndicated market research reports. The report provided the following quote:

> "U.S. luggage market growth trends strengthened over the 1990s due to sharper gains in personal income and favorable demographics. Demand was also stimulated by the introduction of wheeled and lightweight luggage products and casual luggage lines, and the growing need for lifestyle products such as backpacks, sports bags, and computer cases. Stronger growth resulted in rising U.S. luggage manufacturer profit margins. Margin gains also benefited from improvements in labour productivity and moderating material costs. U.S. manufacturers were able to boost plant profit margins despite rising competition from foreign-sourced products and relatively weak product price gains. Market growth is forecast to strengthen further over the next five years as the key baby boomer market moves through its prime luggage buying years."[48]

SBI had a very bullish outlook for the *Luggage* industry, however the commodity increased by just 10.0% over the period 1992-1998. By 1998, SBI's view may well have changed but any further reports could not be located. Turning to the trade data for *Luggage* that is illustrated in Figure 8, it is quite clear that imports were growing strongly from 1992 to 1998. Exports also grew strongly as foreign markets became more open, but this growth was off a relatively low base.

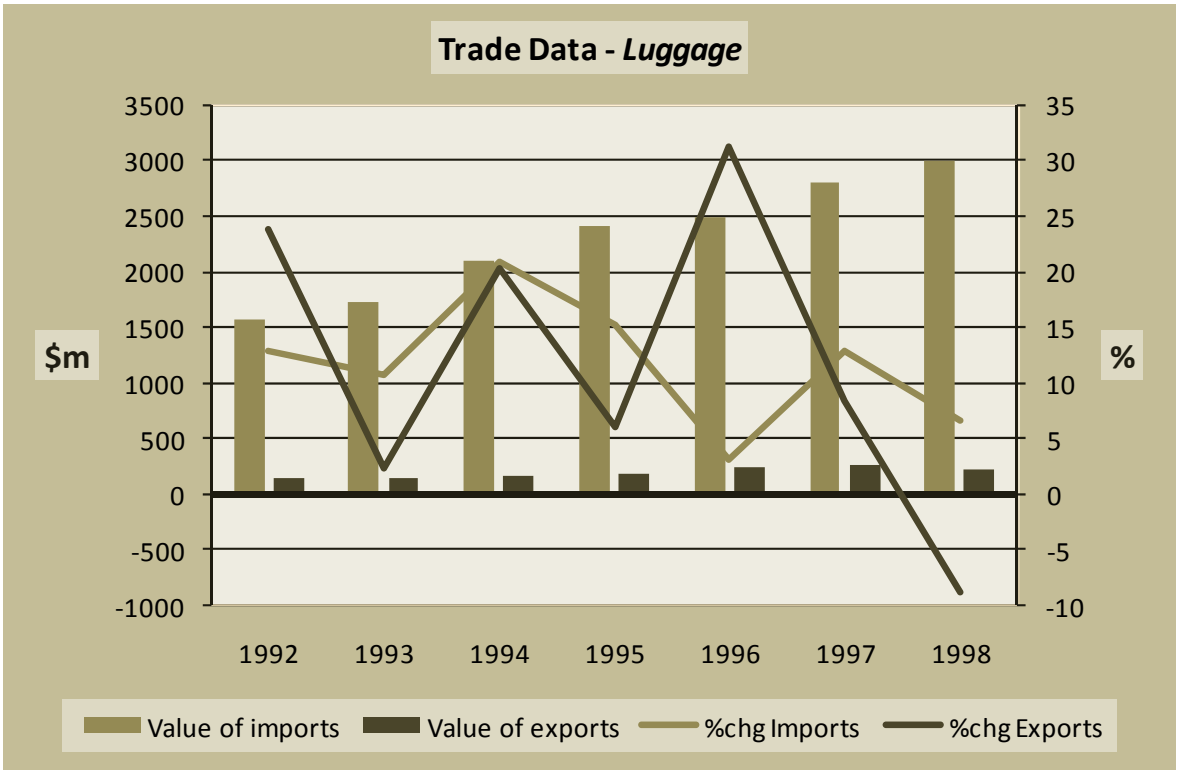

Figure 8: 1992-1998 – U.S. trade by the *Luggage* industry in nominal dollars

[48] http://www.mindbranch.com/Luggage-R460-19, visited 3 September 2009.

3. Conclusion

Luggage output increased modestly over the period from 1992 to 1998. As noted earlier, where commodities have large import shares (e.g., there was 79% import penetration in *Luggage* in the 1998 database), it is notoriously difficult to accurately forecast domestic output in the absence of specialised knowledge. This is because total supplies of domestic goods (*x0dom*) will move off a low base. In this instance, the model usually does a better job at predicting the commodity's absorption (*x0*), i.e., all U.S. sales of the commodity both domestic and imported. By late 1998 it was not clear that consumer tastes would begin to sour overall, whilst taking an increased liking to imports – well beyond that which could be explained by changes in relative prices. Overall, it is unlikely the modeller could have confidently made *ad hoc* changes to the forecast parameters regarding *Luggage*. However, as was the case for all TCF commodities, knowing that basic import prices were heavily tied to policy an improved forecast could have been produced by projecting real basic import prices.

4. Strategy to improve the forecast

In re-running the simulation, a more intuitive approach was used to generate import price forecasts by extrapolating what had happened to *real* basic import prices in the historical period (1992 to 1998). This resulted in more realistic import price projections and hence, less erroneous domestic-import relative price movements. This improved the estimate for *x0dom_dom* and, in turn, for *x0dom* resulting in a 19.1% contraction in forecast output. The USAGE error fell from 131% to 112%. However, the absolute size of the error remained quite large due to the ongoing underestimation of *impftwist*; the errors in forecasting household and foreign preferences; as well as technical change parameters. A subsequent simulation differing only by the additional forecast of no further primary factor cost savings saw forecast output contract 38.4% and the USAGE error improved to 62%.

BootCutStock → Boot and Shoe Cut Stock and Findings (SIC 3131)

Part of Major Group 31: Leather And Leather Products, BootCutStock covers establishments primarily engaged in manufacturing leather soles, inner soles, and other boot and shoe cut stock and findings. This industry also includes finished wood heels.

BootCutStock - Boot & Shoe Cut Stock & Findings	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-7.4	-17.7	-6.1	-6.3
All factor augmenting technical change	*a1prim*	-35.5	1.6	-42.3	-42.3
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-16.6	0.6	-19.1	-19.1
Combined change in household tastes	*a3com*	-15.5	-46.0	-17.8	-17.8
Commodity-using technical and taste change	*ac*	-26.1	-14.2	-35.9	-35.9
Contribution to output of commodity-using technical & taste change	*cont_ac*	-18.8	-8.0	-21.5	-21.5
Vertical shift of the export demand curve	*cont_fepc*	31.5	-78.5	37.7	37.7
Import/domestic twist by commodity	*ftwist_src*	201.2	-60.7	201.3	201.6
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-61.7	110.0	-67.3	-67.3
Twist caused by strong growth	*twist_eff*	-1.2	-13.0	5.9	2.0
Basic price of domestic goods	*p0dom*	-0.2	-17.2	7.8	4.5
Basic price of imported goods	*p0imp*	-1.9	8.2	10.7	2.3
Ratio of basic prices: domestic to import	*fpdm*	1.8	-23.6	-2.6	2.2
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	-10.9	-24.2	-15.7	-16.9
Total supplies of domestic goods	*x0dom*	**18.8**	**-30.6**	**44.7**	**24.7**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	-64.2	118.0	-78.3	-78.8
Total supplies of imported goods	*x0imp*	16.4	-39.2	-8.2	-9.4
Household demands undifferentiated by source	*x3*	15.8	-22.8	-3.9	-0.8
Export volumes	*x4*	98.4	-49.9	61.6	39.0
Change in net import share to domestic output	*dtradeshare*	-39.4	37.2	-44.9	-38.4

Table 23: Results for *BootCutStock*

1. Why did the model erroneously give good prospects to *BootCutStock*?

As was the case with *AsbestosPrd*, *BootCutStock* produced an error that was large in both absolute and relative terms.

BootCutStock had a USAGE error of 108% versus the smaller trend forecast error of 75%. The key results for this commodity are shown in Table 23. The actual outcome for *BootCutStock* output (*x0dom*) was a 30.6% contraction over the 1998-2005 period. This followed 18.8% growth from 1992-1998. The extrapolated trend was therefore 22% growth versus the USAGE forecast of a 44.7% expansion.

Table 24 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- 89% of total sales in the U.S. came from imports (Section 5 of Table 24).
- 88% of production was exported (Section 3 of Table 24).
- 68% of factor inputs were labour (Section 6b of Table 24).

Boot & Shoe Cut Stock & Findings (*BootCutStock*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	211 BootCutStock: 330	112 Nonwovenfab: 24	Rest: 22	**Total: 376**
Proportion	211 BootCutStock: 0.877	112 Nonwovenfab: 0.065	Rest: 0.058	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	206 BootCutStock: 330	207 ShoesExrub: 10	Rest: 6	**Total: 346**
Proportion	206 BootCutStock: 0.953	207 ShoesExrub: 0.028	Rest: 0.019	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	43	361	405	**0.12**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	0	1	1	**0.00**
Exports	BAS4	331	0	331	**0.88**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	2	0	2	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**376**	**362**	**739**	
Source/Total		**0.51**	**0.49**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	437 Laundry: 21	212 ShoesExrub: 7	Rest: 14	Total: 43	**Total: 0.107**
Imported	437 Laundry: 183	212 ShoesExrub: 64	Rest: 115	Total: 361	**Total: 0.893**
Total	**437 Laundry: 204**	**212 ShoesExrub: 71**	**Rest: 130**	**Total: 405**	
Proportion	**437 Laundry: 0.504**	**212 ShoesExrub: 0.176**	**Rest: 0.320**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	46	394	440	**0.96**	**0.10**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	0	2	2	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	2	0	2	**0.04**	**0.00**
Total	**48**	**396**	**444**		
Source/Total	**0.11**	**0.89**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	214	**0.62**	LABOUR	92	**0.68**
Factor	135	**0.39**	CAPITAL	42	**0.32**
Other	-6	**-0.02**	LAND	0	**0.00**
Production Taxes	3	**0.01**	**Total**	**135**	
Total	**346**				

Source	c. Intermediate Inputs				Proportion
Domestic	205 LeatherTan: 66	53 MeatpackpInt: 25	Rest: 37	Total: 128	**Total: 0.600**
Imported	206 BootCutStock: 51	205 LeatherTan: 31	Rest: 3	Total: 85	**Total: 0.400**
Total	**205 LeatherTan: 97**	**206 BootCutStock: 58**	**Rest: 58**	**Total: 214**	
Proportion	**205 LeatherTan: 0.455**	**206 BootCutStock: 0.272**	**Rest: 0.273**		

Table 24: The key attributes of *BootCutStock* in 1998

Exports were by far the largest share of domestic output. Hence, the accuracy of the forecast for output hinged on the foreign demand forecast. In simplified terms, USAGE relates foreign demand for a commodity to overseas activity; foreign currency prices; and to several autonomous variables that determine the position of the export demand curve. From 1992 to 1998 the export demand curve moved considerably higher. This upward shift in foreign demand was projected forward (*cont_fepc* was +37.7%), which had a highly expansionary impact on forecast output. However, this proved to be a vast overestimation because in reality a very sharp downward shift occurred (*cont-fepc* slumped 78.5%). The collapse in foreign preferences dominated any offsetting effects from a reduction in export prices. Hence the expected strong increase in export volumes did not turn out to be true – instead export volumes virtually halved (down 49.9%). On the supply side, the material primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these did not materialise.

Furthermore, given the overwhelming importance of export markets for *BootCutStock*, the collapse in foreign demand easily outweighed highly favourable twist trend impacts towards the domestically produced commodity (*impftwist* was +110.0%). The impact of the twist was coupled with a favourable 23.6% move in relative prices. This accounted for the 118.0% increase in sales of U.S. output into the domestic market (to producers) but was not enough to prevent a 30.6% decline in total supplies of the commodity.

2. Macro perspective

It was very difficult to source information about this industry that was specifically pre-1999. It was, however, found that by 1996 U.S. manufacturers began to shift operations overseas to take advantage of lower operating costs in countries like China. Many of the footwear plants that did remain in the U.S. were forced to close, and plant openings had slowed to a trickle by the late 1990s. Pricing was also under intense pressure due to competition from imported shoes. In the labour-intensive footwear industry, U.S. makers simply could not compete with manufacturers overseas whose wage rates were far below U.S. levels.[49] The following quote adds further colour to the situation:

> "The drop in domestically produced footwear, of course, had depressed the business of companies that supply shoe manufacturers. Besides the dramatic increase in shoe imports, leather sole makers also had to contend with a shift by consumers to more casual footwear and the rising cost of leather. While there remained a market for the fine leather shoe, many Americans were no longer dressing up for work and did not require several pairs of dress shoes. During the recession of the early 1990s, the repair trade picked up somewhat, as consumers have traditionally mended old shoes when they did not have the money to buy new ones. Some manufacturers thought sales were less robust than in previous recessions, however, because of the loss of white-collar jobs. There was also concern about longer term trends in the repair market."[50]

[49] http://www.allbusiness.com/leather-leather-products/boot-shoe-cut-stock-findings-boot/3779454-2.html, visited 7 September 2009.
[50] http://www.allbusiness.com/leather-leather-products/boot-shoe-cut-stock-findings-boot/3779454-2.html, visited 7 September 2009.

Figure 9 illustrates the trade data. Strong export growth peaked in 1996 at around 50% and was still greater than 10% in 1997. In 1998 exports fell by more than 10%. Imports were quite cyclical.

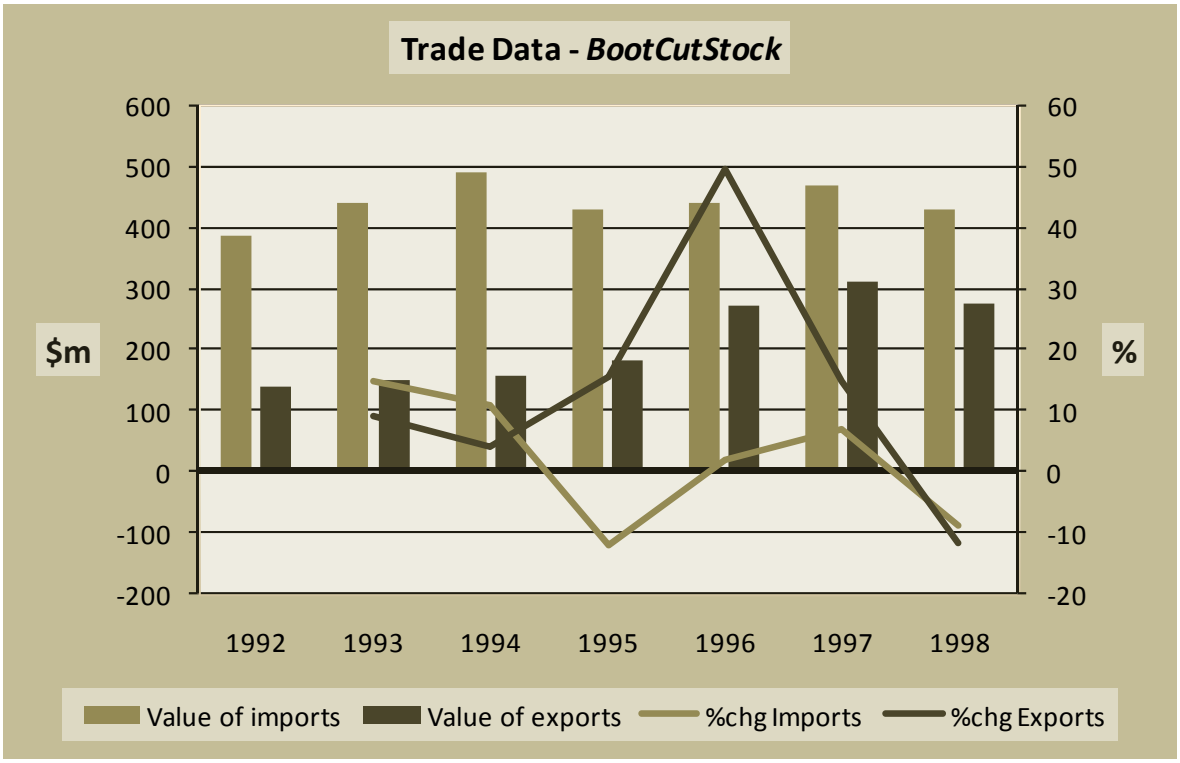

Figure 9: 1992-1998 – U.S. trade by the *BootCutStock* industry in nominal dollars

3. Conclusion

Whilst there was some evidence that exports were beginning to slow, the halving of volumes could not have been anticipated. In any case it is usually difficult to predict foreign demand. Perhaps very large shifts in foreign preferences should be closely investigated, in terms of likely sustainability, rather than be automatically projected forward. Industry conditions were getting tougher as evidenced by a slowdown of plant openings in the late 1990s; the "offshoring" of the industry; and rising competition from low wage nations more generally. This could have indicated that further expansion would be unlikely. This is an instance where the modeller probably would have made *ad hoc* changes to the forecast parameters, such as by nullifying export demand shifts and/or domestic output – but was not pursued here as TCF industries were treated with a broad brush approach.

4. Strategy to improve the forecast

In re-running the simulation, a more intuitive approach was adopted to generate import price forecasts by extrapolating what had happened to *real* prices in the historical period (1992 to 1998). This resulted in less erroneous domestic-import relative basic price movements. This improved the estimate for *x0dom*, with 24.7% output growth. The USAGE error fell from 108% to 79%. However the absolute size of the error remained quite large due to the ongoing overestimation of the foreign demand function as well as cost savings. A subsequent simulation differing only by the additional forecast of no further primary factor cost savings saw forecast output contract 27.0% and the USAGE error improve significantly, to just 5%.

LeatherTan → Leather Tanning and Finishing (SIC 3111)

Establishments primarily engaged in tanning, currying, and finishing hides and skins into leather. This industry also includes leather converters, who buy hides and skins and have them processed into leather on a contract basis by others.

LeatherTan - Leather Tanning & Finishing	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-2.7	-14.8	-1.3	-1.6
All factor augmenting technical change	*a1prim*	-23.5	17.4	-27.7	-27.7
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-6.6	4.1	-7.7	-7.7
Combined change in household tastes	*a3com*	5.8	-19.8	6.8	6.8
Commodity-using technical and taste change	*ac*	-4.6	-25.2	-5.3	-5.3
Contribution to output of commodity-using technical & taste change	*cont_ac*	-3.7	-20.8	-4.3	-4.3
Vertical shift of the export demand curve	*cont_fepc*	0.6	-16.3	0.7	0.7
Import/domestic twist by commodity	*ftwist_src*	41.8	303.8	36.1	35.4
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-8.7	-46.3	-10.0	-10.0
Twist caused by strong growth	*twist_eff*	-5.9	-22.4	-4.7	-7.5
Basic price of domestic goods	*p0dom*	8.2	-6.6	12.9	11.9
Basic price of imported goods	*p0imp*	1.9	-0.2	14.4	7.0
Ratio of basic prices: domestic to import	*fpdm*	6.1	-6.5	-1.3	4.6
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	7.7	-50.6	4.1	-0.9
Total supplies of domestic goods	*x0dom*	**-2.1**	**-56.4**	**-4.6**	**-15.3**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	-3.3	-68.3	-9.6	-17.8
Total supplies of imported goods	*x0imp*	51.4	-9.4	38.1	41.4
Household demands undifferentiated by source	*x3*	31.0	2.9	24.7	25.0
Export volumes	*x4*	5.4	-21.1	11.8	-6.4
Change in net import share to domestic output	*dtradeshare*	7.8	16.2	9.9	15.5

Table 25: Results for *LeatherTan*

1. **Why did the model erroneously give relatively good prospects to *LeatherTan*?**

LeatherTan had a USAGE error of 119% versus the bigger trend forecast error of 124%. The key results for this commodity are shown in Table 25. The actual outcome for *LeatherTan* output (*x0dom*) was a 56.4% contraction over the 1998-2005 period. This followed a 2.1% contraction from 1992-1998. The extrapolated trend was therefore a further 2% contraction versus the USAGE forecast of a 4.6% contraction.

Table 26 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- 29% of total sales in the U.S. came from imports (Section 5 of Table 26).
- 25% of production was exported (Section 3 of Table 26).
- 74% of production costs were intermediate inputs (Section 6a of Table 26).

Leather Tanning & Finishing (*LeatherTan*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	210 LeatherTan: 3032	54 Meatpackplnt: 186	Rest: 10	**Total: 3228**
Proportion	210 LeatherTan: 0.939	54 Meatpackplnt: 0.058	Rest: 0.003	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	205 LeatherTan: 3032	Rest: 50	**Total: 3082**
Proportion	205 LeatherTan: 0.984	Rest: 0.016	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	2396	990	3385	**0.74**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	817	0	817	**0.25**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	16	0	16	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**3228**	**990**	**4218**	
Source/Total		**0.77**	**0.23**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	212 ShoesExrub: 498	210 LeatherTan: 497	Rest: 1400	Total: 2396	**Total: 0.708**
Imported	212 ShoesExrub: 229	126 AutoAppTrim: 175	Rest: 585	Total: 990	**Total: 0.292**
Total	**212 ShoesExrub: 728**	**210 LeatherTan: 662**	**Rest: 1996**	**Total: 3385**	
Proportion	**212 ShoesExrub: 0.215**	**210 LeatherTan: 0.196**	**Rest: 0.589**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	2491	1044	3534	**0.99**	**0.70**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	16	0	16	**0.01**	**0.01**
Total	**2507**	**1044**	**3550**		
Source/Total	**0.71**	**0.29**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	2289	**0.74**	LABOUR	645	**0.84**
Factor	766	**0.25**	CAPITAL	121	**0.16**
Other	5	**0.00**	LAND	0	**0.00**
Production Taxes	22	**0.01**	**Total**	**766**	
Total	**3082**				

Source	c. Intermediate Inputs				Proportion
Domestic	53 Meatpackplnt: 872	205 LeatherTan: 514	Rest: 545	Total: 1931	**Total: 0.844**
Imported	205 LeatherTan: 173	53 Meatpackplnt: 114	Rest: 71	Total: 358	**Total: 0.156**
Total	**53 Meatpackplnt: 986**	**205 LeatherTan: 687**	**Rest: 616**	**Total: 2289**	
Proportion	**53 Meatpackplnt: 0.431**	**205 LeatherTan: 0.300**	**Rest: 0.269**		

Table 26: The key attributes of *LeatherTan* in 1998

Several factors contributed to the erroneous forecast. The main buyers of the commodity were other TCF industries. As seen earlier, these industries generally underperformed in the period from 1998 to 2005. Furthermore, there was a large shift away from use of *LeatherTan*. This is reflected in the contribution to output of *LeatherTan*-using technical and taste change (*cont_ac*). This is projected forward in forecast, where USAGE calculated a 4.3% reduction; in reality there was a 20.8% decline. In addition, the USAGE prediction for foreign preferences was also off the mark. The export demand curve was forecast to shift slightly upward when it in fact shifted strongly downward (see *cont_fepc* in Table 25). As has been the norm in these industries, import twist factors worked overwhelmingly against the domestic commodity. In particular, the impact of the shifter on the twist was *(ceteris paribus)* projected to do 10.0% damage to domestic market share of *LeatherTan*. In reality, it did an even more significant 46.3% damage. However, as a result of the *actual* larger contraction in output the impact of the growth-related twist (*twist_eff*) somewhat dampened import growth. On the supply side, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these were reversed over the seven years from 1998 to 2005.

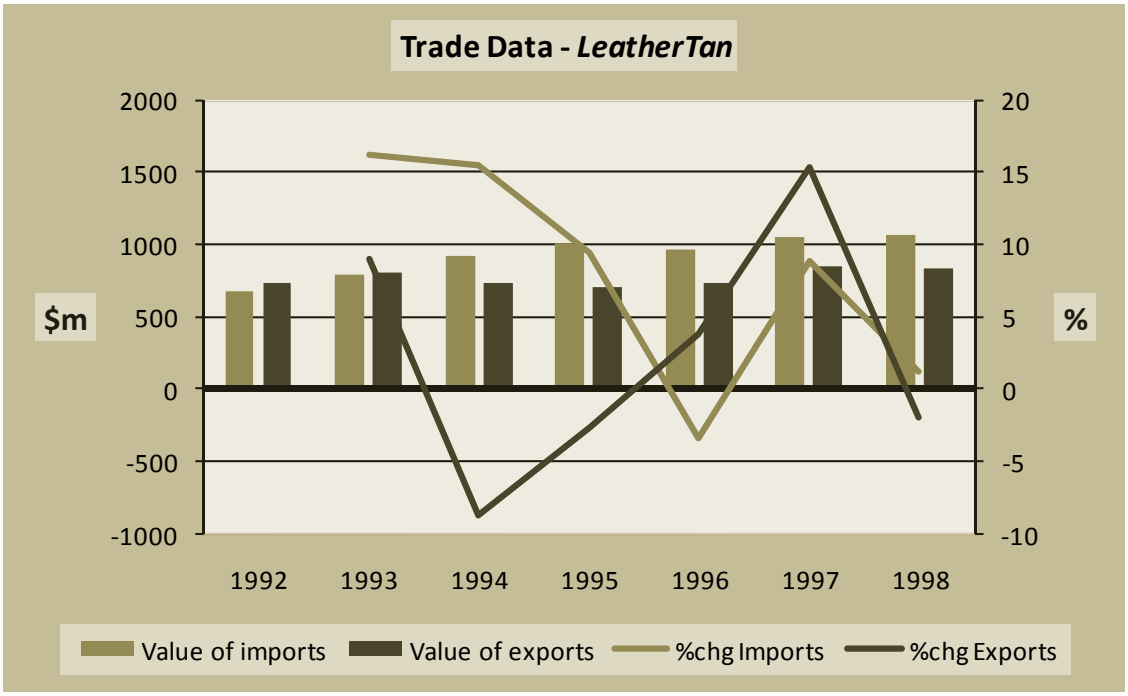

Figure 10: 1992-1998 – U.S. trade by the *LeatherTan* industry in nominal dollars

2. Macro perspective

In the U.S., automotive upholstery and casual footwear make up most of the leather market. The number of companies engaged in leather tanning and finishing had declined since the 1980s, as a result of takeover activity. The number of U.S. tanning and finishing establishments decreased from 342 in the early 1980s to 328 in the late 1990s. Competition from overseas leather tanners, especially in developing nations, had adversely affected the industry in the U.S. Leather tanning in the U.S. is primarily the work of privately held companies, where the vast majority of the leather processed is cattle hide. So-called specialty leathers – including deer, calf, pig, goat, sheep, lamb,

kangaroo, and various reptiles – comprised only about 5%. With 72 establishments, New York has the most companies engaged in leather tanning and finishing.[51]

Turning to the trade data for *LeatherTan* in Figure 10, it can be seen that the rebound in exports that occurred in the mid 1990s had stalled by 1998. Overall, the growth patterns for both imports and exports seemed cyclical but fairly sharp and out of sync. This created a degree of volatility that made it difficult pinpoint any long term trend.

3. Conclusion

Great volatility was evident in the trade data, so there seemed to be no convincing argument that overall trade volumes would fall away. With no *a priori* view that the TCF sector was facing a gloomy period ahead, the modeller is unlikely to have imagined that output would more than halve.

4. Strategy to improve the forecast

In re-running the simulation, a more intuitive approach was used to generate import price forecasts by extrapolating what had happened to *real* prices in the historical period (1992 to 1998). This was done for all TCF industries, which generally resulted in more realistic import price projections and hence, less erroneous domestic-import relative price movements. In the case of *LeatherTan*, this technique resulted in a larger distortion in relative prices. However, the larger divergence in relative prices placed more pressure on sales and choked off exports, thereby muting output. The resultant 15.3% contraction in forecast output saw the USAGE error fall to 94%. The error remained large due to the overestimation of foreign demand and underestimation of domestic-import twist factors. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 31.9% and the USAGE error improve markedly, to 56%.

[51] http://www.answers.com/topic/leather-tanning-and-finishing, visited 16 September 2009.

Hosierynec → Hosiery, Not Elsewhere Classified (SIC 2252)

This industry is defined as establishments primarily engaged in knitting, dyeing, or finishing hosiery, not elsewhere classified. Establishments primarily engaged in manufacturing women's full-length and knee-length hosiery (except socks), and panty hose are classified in Industry 2251. Establishments primarily engaged in manufacturing elastic (orthopedic) hosiery are classified in Industry 3842.

- Anklets, hosiery
- Boys' hosiery
- Children's hosiery
- Dyeing and finishing hosiery, except women's full-length and
- Girls' hosiery
- Hosiery, except women's and misses' full-length and knee-length
- Leg warmers
- Men's hosiery
- Nylons, except women's full-length and knee-length
- Socks
- Socks, slipper-mitse
- Stockings, except women's and misses' full-length and knee-length
- Tights, except women's

Hosierynec - Hosiery, Not Elsewhere Classified	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-14.0	-21.3	-12.1	-11.9
All factor augmenting technical change	*a1prim*	-54.4	-17.5	-66.7	-66.7
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-26.0	-6.1	-29.6	-29.6
Combined change in household tastes	*a3com*	10.7	-3.3	12.6	12.6
Commodity-using technical and taste change	*ac*	-1.5	8.5	-1.8	-1.8
Contribution to output of commodity-using technical & taste change	*cont_ac*	0.0	0.2	0.0	0.0
Vertical shift of the export demand curve	*cont_fepc*	2.4	1.2	2.8	2.8
Import/domestic twist by commodity	*ftwist_src*	191.0	899.2	89.0	87.5
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-14.8	-68.9	-17.1	-17.1
Twist caused by strong growth	*twist_eff*	1.1	-18.3	0.8	-0.9
Basic price of domestic goods	*p0dom*	-10.4	-16.0	-3.3	-3.4
Basic price of imported goods	*p0imp*	-4.4	-24.4	12.8	-0.7
Ratio of basic prices: domestic to import	*fpdm*	-6.3	10.8	-14.3	-2.8
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	44.1	44.7	32.7	34.7
Total supplies of domestic goods	*x0dom*	30.1	-46.1	19.3	11.3
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	26.6	-50.6	9.8	7.6
Total supplies of imported goods	*x0imp*	238.6	388.5	112.3	131.0
Household demands undifferentiated by source	*x3*	46.4	45.4	32.9	35.0
Export volumes	*x4*	239.7	1.5	124.9	56.3
Change in net import share to domestic output	*dtradeshare*	9.3	152.6	16.6	22.5

Table 27: Results for *Hosierynec*

1. **Why did the model erroneously give good prospects to *Hosierynec*?**

Hosierynec had a USAGE error of 122% versus the bigger trend forecast error of 153%. The key results for this commodity are shown in Table 27. The actual outcome for *Hosierynec* output (*x0dom*) was a 46.1% contraction over the 1998-2005 period. This followed 30.1% growth from 1992-1998. The extrapolated trend was therefore a further 36% expansion versus the USAGE forecast of 19.3% growth.

Table 28 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- USAGE industry *Hosierynec* produced more of USAGE commodity *WomenHosiery* (51.4%) compared to USAGE commodity *Hosierynec* (47.7% – Section 2 of Table 28).
- 22% of total sales in the U.S. came from imports (Section 5 of Table 28).
- 89% of production was purchased by households (Section 3 of Table 28).
- 70% of production costs were intermediate inputs (Section 6a of Table 28).

There were several key drivers behind the erroneous forecast. Firstly, the model calculated a 14.3% change in relative prices favouring the domestically-produced commodity, when in reality there was a 10.8% unfavourable move in relative prices. The Armington elasticities were set at 2, thereby indicating a good degree of substitutability between domestic and imported *Hosierynec*.

Secondly, the price disadvantage faced by domestic producers was magnified by a strong preference twist towards the imported commodity. The model underestimated the impact of this on domestic market share. In the absence of relative price changes (and other factors) this would have done 68.9% damage to domestic market share. This impact is reflected in the sharp move in *impftwist,* as can be seen in Table 27. Given that imports held just 22% of the U.S. *Hosierynec* market there was plenty of room for these to grow. Households were by far the largest buyer and overall household demand rose by 45.4% over the period; stronger than the 32.9% that USAGE predicted. This came despite a 3.3% swing away in consumer tastes (*a3com*) from *Hosierynec.* For the reasons mentioned above, this strong rise in household demand essentially drove the 388.5% spike in imports (*x0imp*) and the 50.6% collapse in domestic sales of the locally produced product (*x0dom_dom*).

Also, exports were much weaker than forecast. However, as they comprised a relatively minor segment of production, these were not as an important determinant of the results.

Finally, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these prevailed only in part in the seven years from 1998 to 2005.

Hosiery, Not Elsewhere Classified (*Hosierynec*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	115 Hosierynec: 1436	114 Womenhosiery: 28	Rest: 11	**Total: 1476**
Proportion	115 Hosierynec: 0.973	114 Womenhosiery: 0.019	Rest: 0.008	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	113 Womenhosiery: 1546	114 Hosierynec: 1436	Rest: 29	**Total: 3011**
Proportion	113 Womenhosiery: 0.514	114 Hosierynec: 0.477	Rest: 0.009	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	33	5	39	**0.02**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	1306	332	1638	**0.89**
Exports	BAS4	129	0	129	**0.09**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	7	0	7	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**1476**	**337**	**1813**	
Source/Total		**0.81**	**0.19**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	115 Hosierynec: 13	508 Holiday: 12	Rest: 9	Total: 33	**Total: 0.865**
Imported	508 Holiday: 3	510 ExpTour: 1	Rest: 1	Total: 5	**Total: 0.135**
Total	**508 Holiday: 15**	**115 Hosierynec: 13**	**Rest: 11**	**Total: 39**	
Proportion	**508 Holiday: 0.389**	**115 Hosierynec: 0.331**	**Rest: 0.280**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	49	10	60	**0.02**	**0.02**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	2315	661	2977	**0.98**	**0.76**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	7	0	7	**0.00**	**0.00**
Total	**2372**	**672**	**3044**		
Source/Total	**0.78**	**0.22**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	2093	**0.70**	LABOUR	786	**0.80**
Factor	986	**0.33**	CAPITAL	200	**0.20**
Other	-88	**-0.03**	LAND	0	**0.00**
Production Taxes	20	**0.01**	**Total**	**986**	
Total	**3011**				

Source	c. Intermediate Inputs				Proportion
Domestic	105 YarnFinish: 642	113 Womenhosiery: 322	Rest: 1011	Total: 1975	**Total: 0.944**
Imported	105 YarnFinish: 31	301 TextMach: 29	Rest: 58	Total: 118	**Total: 0.056**
Total	**105 YarnFinish: 673**	**113 Womenhosiery: 322**	**Rest: 1098**	**Total: 2093**	
Proportion	**105 YarnFinish: 0.321**	**113 Womenhosiery: 0.154**	**Rest: 0.524**		

Table 28: The key attributes of *Hosierynec* in 1998

2. Macro perspective

The biggest impact on the commodity's lamentable performance over the 1998-2005 period was the replacement of domestic production with surging imports. While other countries such as Taiwan and South Korea were already exerting pressure on domestic production, the entry of China into the WTO in 2001 and phasing out of the MFA quotas by 2005 amplified these pressures. The Multifibre Agreement, or Agreement on Textiles and Clothing, covered the period 1974-2004, replacing earlier agreements. The phase-out of import quotas took place over ten years (1995-2005) in four phases. At each stage, the percentage of goods not limited by quotas increased, while the quotas for goods still protected also increased. However, as mentioned previously, the U.S. had recourse to special safeguard provisions in the case that imports from China caused or threatened to cause market disruptions to local industry. The trade data in Figure 11 shows strong growth in both imports and exports.

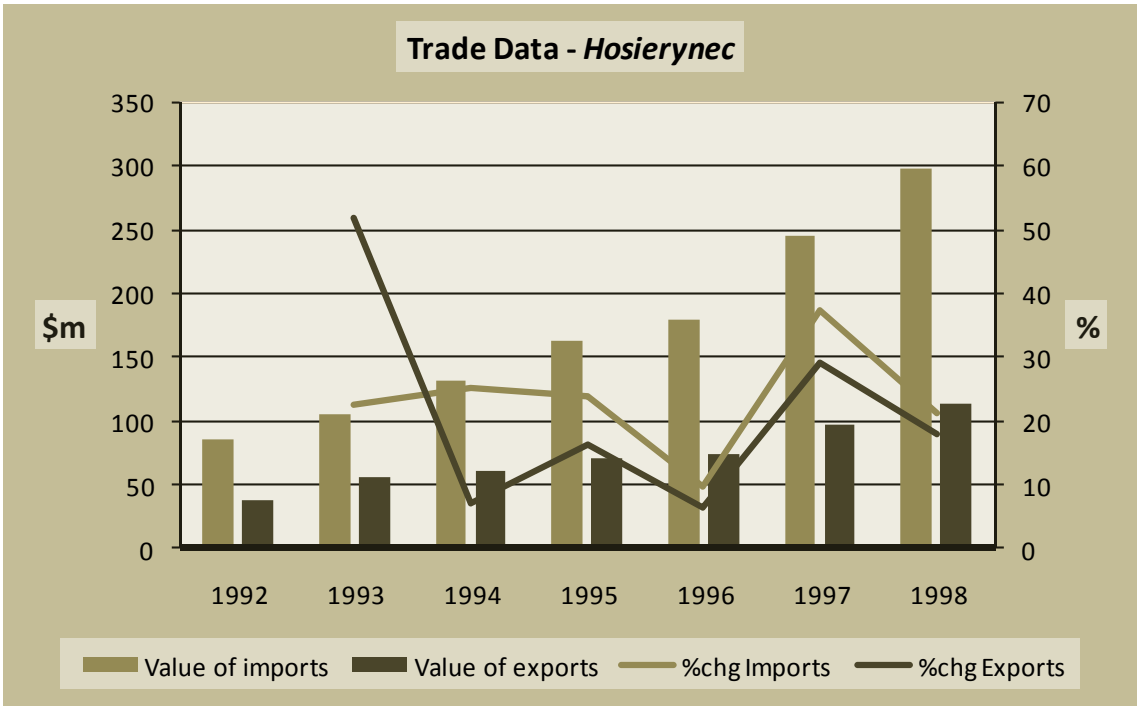

Figure 11: 1992-1998 – U.S. trade by the *Hosierynec* industry in nominal dollars

3. Conclusion

Even with the strong growth in imports and the impact of trade reform, it is unlikely that the modeller could have imagined that output would almost halve over the forecast period. The import favouring twists and the household preference shift away from *Hosierynec* also could not have been predicted.

4. Strategy to improve the forecast

In re-running the simulation, a more intuitive approach was used to generate import price forecasts by extrapolating what had happened to *real* prices in the historical period (1992 to 1998). This was done for all TCF industries, which generally resulted in more realistic import price projections and hence, less erroneous domestic-import relative price movements. The resultant 11.3% output

growth in forecast *Hosierynec* output saw the USAGE error fall to 107% from 122%. The error remained large due to the ongoing underestimation of domestic-import twist factors and overestimation of cost savings from primary factor inputs. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 21.0% and the USAGE error improve markedly, to 47%.

Leathrgloves → Leather Gloves & Mittens (SIC 3151)

This sector is comprised of establishments primarily engaged in manufacturing dress, semidress, and work gloves exclusively of leather or leather with lining of other material. Establishments primarily engaged in manufacturing sporting and athletic gloves are classified in Industry 3949; those manufacturing dress, semidress, and work gloves and mittens of cloth or cloth and leather combined are classified in Industry 2381; and those manufacturing safety gloves are classified in Industry 3842.

- Dress and semidress gloves, leather
- Gloves, leather
- Mittens, leather
- Welders' gloves
- Work gloves, leather

Leathrgloves - Leather Gloves & Mittens	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-6.6	-7.7	-6.4	-6.0
All factor augmenting technical change	*a1prim*	-23.4	31.1	-26.4	-26.4
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-10.6	12.3	-12.2	-12.2
Combined change in household tastes	*a3com*	6.3	-23.2	7.4	7.4
Commodity-using technical and taste change	*ac*	-0.7	-14.4	-0.9	-0.9
Contribution to output of commodity-using technical & taste change	*cont_ac*	0.0	-0.7	0.0	0.0
Vertical shift of the export demand curve	*cont_fepc*	-6.4	-2.6	-7.4	-7.4
Import/domestic twist by commodity	*ftwist_src*	37.4	374.3	40.5	40.5
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-20.7	-76.5	-23.7	-23.7
Twist caused by strong growth	*twist_eff*	-4.6	-24.4	-7.8	-8.1
Basic price of domestic goods	*p0dom*	6.4	-1.0	10.7	9.8
Basic price of imported goods	*p0imp*	1.2	9.5	12.8	6.1
Ratio of basic prices: domestic to import	*fpdm*	5.1	-9.6	-1.8	3.5
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	40.9	7.9	24.1	27.1
Total supplies of domestic goods	*x0dom*	**3.2**	**-61.0**	**-16.7**	**-17.5**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	12.5	-65.2	-12.9	-13.5
Total supplies of imported goods	*x0imp*	53.4	30.4	35.7	39.9
Household demands undifferentiated by source	*x3*	42.6	8.4	24.4	27.5
Export volumes	*x4*	-43.8	9.3	-71.9	-76.5
Change in net import share to domestic output	*dtradeshare*	88.2	696.0	187.9	182.8

Table 29: Results for *Leathrgloves*

1. **Why did the model erroneously give relatively good prospects to *Leathrgloves*?**

Leathrgloves had a USAGE error of 114% versus the bigger trend forecast error of 166%. The key results for this commodity are shown in Table 29. The actual outcome for *Leathrgloves* output (*x0dom*) was a 61.0% contraction over the 1998-2005 period. This followed 3.2% growth from 1992-1998. The extrapolated trend was therefore a further 4% expansion versus the USAGE forecast of a 16.7% decline. Table 30 shows the main users, cost structure and other information of interest of the 1998 database that was used in the forecast. The following observations can be made:

- 75% of total sales in the U.S. came from imports (Section 5 of Table 30).
- 89% of production was purchased by households (Section 3 of Table 30).

Leather Gloves & Mittens (*Leathrgloves*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	214 Leathrgloves: 114	206 FabRubPrdnec: 6	Rest: 6	**Total: 126**
Proportion	214 Leathrgloves: 0.902	206 FabRubPrdnec: 0.051	Rest: 0.047	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	209 Leathrgloves: 114	116 Apparel: 10	Rest: 8	**Total: 132**
Proportion	209 Leathrgloves: 0.865	116 Apparel: 0.073	Rest: 0.062	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	7	14	21	**0.05**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	112	344	456	**0.89**
Exports	BAS4	7	0	7	**0.06**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	1	0	1	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**126**	**358**	**485**	
Source/Total		**0.26**	**0.74**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	443 MiscRepair: 3	214 Leathrgloves: 2	Rest: 2	Total: 7	**Total: 0.316**
Imported	443 MiscRepair: 8	508 Holiday: 3	Rest: 3	Total: 14	**Total: 0.684**
Total	**443 MiscRepair: 11**	**508 Holiday: 4**	**Rest: 6**	**Total: 21**	
Proportion	**443 MiscRepair: 0.502**	**508 Holiday: 0.201**	**Rest: 0.297**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	8	20	28	**0.04**	**0.01**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	207	659	867	**0.96**	**0.23**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	1	0	1	**0.00**	**0.00**
Total	**216**	**679**	**895**		
Source/Total	**0.24**	**0.76**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	77	**0.59**	LABOUR	52	**0.93**
Factor	56	**0.43**	CAPITAL	4	**0.07**
Other	-2	**0.00**	LAND	0	**0.00**
Production Taxes	0	**-0.01**	**Total**	**56**	
Total	**132**				

Source	c. Intermediate Inputs				Proportion
Domestic	205 LeatherTan: 30	106 Threadmills: 4	Rest: 27	Total: 62	**Total: 0.944**
Imported	205 LeatherTan: 15	103 Broadfabric: 1	Rest: 0	Total: 16	**Total: 0.056**
Total	**205 LeatherTan: 46**	**103 Broadfabric: 5**	**Rest: 27**	**Total: 77**	
Proportion	**105 YarnFinish: 0.321**	**113 Womenhosiery: 0.154**	**Rest: 0.524**		

Table 30: The key attributes of *Leathrgloves* in 1998

There were three main drivers behind the erroneous forecast. Firstly, there was a strong preference twist towards the imported commodity. The model underestimated the impact of this on domestic market share. In the absence of relative price changes (and other factors) this would have done 76.5% damage to domestic market share. This impact is reflected in the sharp move in *impftwist,* as can be seen in Table 29. As it turns out, in forecast, USAGE underestimated the extent that the change in relative prices favoured the domestic commodity; largely offsetting the *impftwist* error. Secondly, households were by far the largest buyer and overall household demand rose by 8.4% over the period from 1998 to 2005; considerably weaker than the 24.4% that USAGE predicted. This arose because USAGE failed to account for a 23.2% swing away in consumer tastes (*a3com*) from *Leathrgloves.* USAGE projected forward the 6.3% favourable preference/taste shift (+7.4% in forecast). As a result, the sharp decline in household demand drove the 65.2% collapse domestic sales of the locally produced product (*x0dom_dom*). Finally, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these actually reversed in the seven years from 1998 to 2005.

2. Macro perspective

This is a very small industry which has been squeezed by cheaper imports since WWII. Historical data shows that the domestic industry was relatively stagnant between 1992 and 1998. Figure 12 indicates that any growth in demand was met by rising imports. This strength in imports is also consistent with the solid growth in absorption in the historical period (*x0* rose 40.9%). Other than commentary around rising import penetration and a chronological history of industry consolidation, it was difficult to source external forecasts around 1998 that were specifically for the U.S.

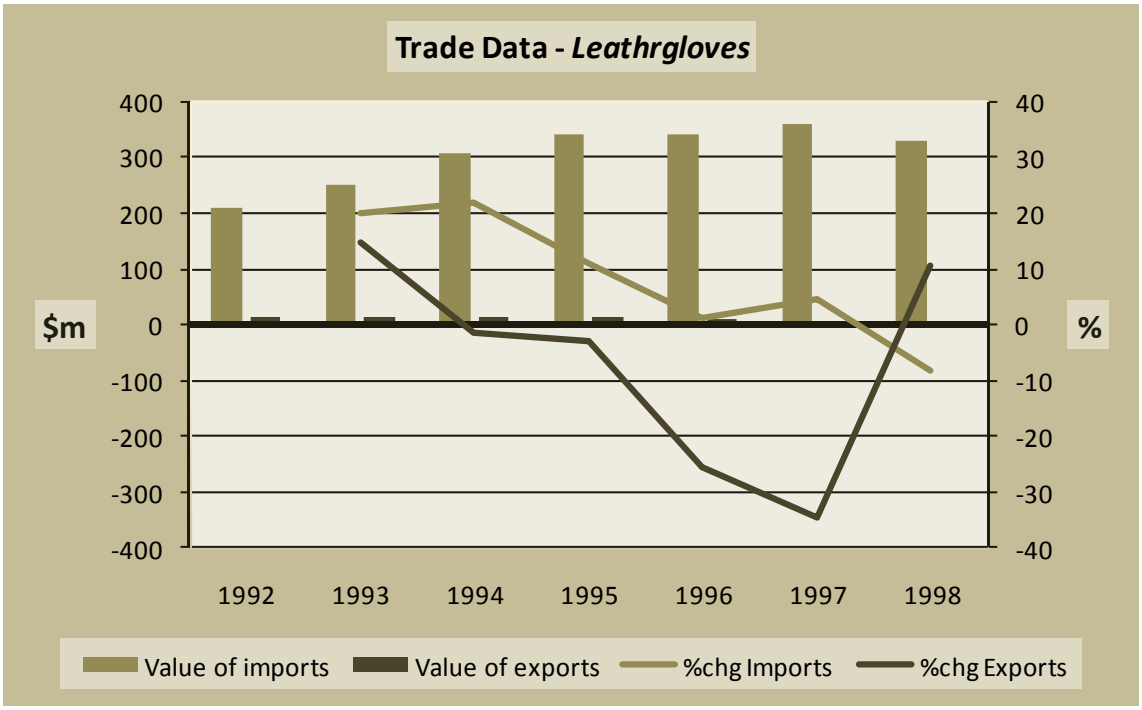

Figure 12: 1992-1998 – U.S. trade by the *Leathrgloves* industry in nominal dollars

3. Conclusion

This is a small industry and as such it was always going to be difficult to accurately forecast output growth. Even with the strong growth in imports and the impact of trade reform, it is unlikely that the modeller could have imagined that output (*x0dom*) would more than halve over the forecast period. In particular, there was nothing to suggest that consumers would experience a significant preference shift away from the commodity.

4. Strategy to improve the forecast

In re-running the simulation, a more intuitive approach was used to generate import price forecasts by extrapolating what had happened to *real* prices in the historical period (1992 to 1998). This was done for all TCF industries, which generally resulted in more realistic import price projections and hence, less erroneous domestic-import relative price movements. This reduced the size of the forecast error through its negating impact on domestic sales and export volumes.

In the case of *Leathrgloves*, this technique resulted in a larger distortion in relative prices, which favoured the imported commodity. The ensuing pressure on domestic and foreign destination sales had the effect of muting *x0dom*, albeit slightly. The resultant 17.5% contraction in forecast output saw the USAGE error fall only slightly, to 112%. The error remained large mostly due to the ongoing mis-estimation of the change away from the commodity in household tastes and preferences and the underestimation of domestic-import twist factors. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 26.6% and the USAGE error improve to 88%.

WmnsHandbag → Women's Handbags (SIC 3171)

Establishments in this industry are primarily engaged in manufacturing women's handbags and purses of leather or other materials, except precious metal. Establishments primarily engaged in manufacturing precious metal handbags and purses are classified in Industry 3911.

- Handbags, women's: of all materials, except precious metal
- Pocketbooks, women's: of all materials, except precious metal
- Purses, women's: of all materials, except precious metal

WmnsHandbag - Women's Handbags	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-6.4	3.8	-3.3	-3.3
All factor augmenting technical change	*a1prim*	-22.5	57.6	-26.5	-26.5
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-12.8	26.9	-14.8	-14.8
Combined change in household tastes	*a3com*	-5.2	8.5	-6.1	-6.1
Commodity-using technical and taste change	*ac*	-43.8	-38.4	-59.4	-59.4
Contribution to output of commodity-using technical & taste change	*cont_ac*	-0.9	-0.6	-1.0	-1.0
Vertical shift of the export demand curve	*cont_fepc*	-0.6	11.1	-0.8	-0.8
Import/domestic twist by commodity	*ftwist_src*	-18.9	554.0	-22.5	-22.4
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	17.3	-84.8	20.4	20.4
Twist caused by strong growth	*twist_eff*	-0.4	-16.9	0.7	-0.2
Basic price of domestic goods	*p0dom*	2.6	12.5	9.0	7.8
Basic price of imported goods	*p0imp*	3.8	7.3	15.6	9.1
Ratio of basic prices: domestic to import	*fpdm*	-1.1	4.9	-5.8	-1.2
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	23.7	51.5	7.8	10.2
Total supplies of domestic goods	*x0dom*	**22.7**	**-42.2**	**18.9**	**14.3**
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	49.8	-73.0	19.8	16.3
Total supplies of imported goods	*x0imp*	20.2	94.5	3.9	8.2
Household demands undifferentiated by source	*x3*	27.1	52.4	8.4	10.8
Export volumes	*x4*	15.6	293.9	15.2	-0.1
Change in net import share to domestic output	*dtradeshare*	-2.3	521.3	-19.5	-10.4

Table 31: Results for *WmnsHandbag*

1. **Why did the model erroneously give good prospects to *WmnsHandbag*?**

WmnsHandbag had a USAGE error of 107% versus the bigger trend forecast error of 121%. The key results for this commodity are shown in Table 31. The actual outcome for *WmnsHandbag* output (*x0dom*) was a 42.2% contraction over the 1998-2005 period. This followed 22.7% growth from 1992-1998. The extrapolated trend was therefore a further 27% expansion versus the USAGE forecast of 18.9% growth. Table 32 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- 75% of total sales in the U.S. came from imports (Section 5 of Table 32).
- 90% of production was purchased by households (Section 3 of Table 32).
- 9% of production was exported (Section 3 of Table 32).
- Factor inputs comprised 52% of total costs (Section 6a of Table 32).
- Labour comprised 54% of factor costs (Section 6b of Table 32).
- *LeatherTan* was the main intermediate input at 46.4% (Section 6c of Table 32).

Women's Handbags (*WmnsHandbag*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	216 WmnsHandbag: 534	215 Luggage: 10	Rest: 1	**Total: 545**
Proportion	216 WmnsHandbag: 0.979	215 Luggage: 0.018	Rest: 0.002	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	211 WmnsHandbag: 534	212 PerLeathrGds: 20	Rest: 19	**Total: 574**
Proportion	211 WmnsHandbag: 0.931	212 PerLeathrGds: 0.036	Rest: 0.034	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	7	17	24	**0.01**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	489	1449	1938	**0.90**
Exports	BAS4	46	0	46	**0.09**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	3	0	3	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**545**	**1466**	**2011**	
Source/Total		**0.27**	**0.73**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	508 Holiday: 3	216 WmnsHandbag: 2	Rest: 2	Total: 7	**Total: 0.306**
Imported	508 Holiday: 10	510 ExpTour: 5	Rest: 2	Total: 17	**Total: 0.694**
Total	**508 Holiday: 13**	**510 ExpTour: 6**	**Rest: 5**	**Total: 24**	
Proportion	**508 Holiday: 0.541**	**510 ExpTour: 0.252**	**Rest: 0.207**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	13	33	46	**0.01**	**0.00**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	969	2896	3865	**0.98**	**0.25**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	3	0	3	**0.00**	**0.00**
Total	**985**	**2930**	**3915**		
Source/Total	**0.25**	**0.75**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	279	**0.49**	LABOUR	161	**0.54**
Factor	299	**0.52**	CAPITAL	137	**0.46**
Other	-8	**-0.01**	LAND	0	**0.00**
Production Taxes	3	**0.01**	**Total**	**299**	
Total	**574**				

Source	c. Intermediate Inputs				Proportion
Domestic	205 LeatherTan: 89	273 Hardwarenec: 26	Rest: 113	Total: 228	**Total: 0.817**
Imported	205 LeatherTan: 40	273 Hardwarenec: 5	Rest: 6	Total: 51	**Total: 0.183**
Total	**205 LeatherTan: 130**	**273 Hardwarenec: 31**	**Rest: 119**	**Total: 279**	
Proportion	**205 LeatherTan: 0.464**	**273 Hardwarenec: 0.111**	**Rest: 0.425**		

Table 32: The key attributes of *WmnsHandbag* in 1998

The key reason for the erroneous forecast was the incorrect projection of the impact of import-domestic twist trends (*impftwist*). Based on the composition of absorption of the commodity (*x0dom_dom* and *x0imp*) in the historical period and relative price changes between domestic and imported *WmnsHandbag*, the model calculated that there must have been a twist against imports (*ftwist_src*); the impact of this twist (namely a 17.3% boost, *ceteris paribus*, to market share of domestic producers) was projected forward. This meant that USAGE was predicting an additional 20.4% boost to the market share of domestic producers in the forecast period. It turned out that, from 1998 to 2005, there was an enormous import-favouring twist that had the impact (*ceteris paribus*) equivalent to 84.8% damage to the market share of domestic producers.

Focusing on the actual result between 1998 and 2005, on the basis of relative price changes alone (where there was a 4.9% change favouring imports) the ratio of imported to domestic *WmnsHandbag* being sold into the domestic market would have increased by about 15%.[52] [15% = 1.049^3]. However the ratio spiked upward by 620% [= (1.945/0.270 - 1)*100]. As imports surged 94.5% higher to meet rising household demand, domestic sales slumped by 73%. Hence, USAGE inferred that there must have been an enormous twist towards imports. If not for a strong rise in exports (*x4* rose 293.9% off a low base; driven by an 11.1% increase in the export demand function) overall domestic output would have fallen by more than 42.2%. By chance, the model's mis-estimation of household tastes (*a3com*) prevented an even larger forecasting error as this tempered the key demand driver for the commodity. On the supply side, the modest primary factor input cost savings that occurred from 1992 to 1998 were projected to continue, but these sharply reversed over the seven years from 1998 to 2005.

2. Macro perspective

What distinguishes *WmnsHandbag* from the other TCF sectors examined above is that in the period from 1992 to 1998 the quantity of sales of the domestically produced commodity (*x0dom_dom*) grew faster than the imported equivalent (49.8% versus 20.2%, respectively). This growth was rapid enough for domestic producers to increase their market share (valued at purchasers' prices) from 23.1% in 1992 to 25.0% in 1998. However, similar to many of the TCF industries, *WmnsHandbag* experienced significant outsourcing of manufacturing to China. An example of this is the high-end American label "Coach", which outsourced and shifted production to lower cost markets. In 1998, only around 25% of "Coach" products were produced by independent manufacturers; two years later, around 80% of the products were made by outsourcers. Thus, "Coach" retains responsibility for design and marketing, but no longer manufacture *per se*.

3. Conclusion

Given than domestic producers gained market share over the period from 1992 to 1998, and that imports appeared to have peaked in 1996 (see the trade data in Figure 13), it is unlikely that the modeller could have imagined that output (*x0dom*) would fall by nearly three quarters over the forecast period – even though outsourcing of the commodity was already taking place.

[52] The parameters in the model known as the Armington elasticities were set at 3. C*eteris paribus,* this indicates a good degree of substitution between the domestically produced commodity and the imported equivalent.

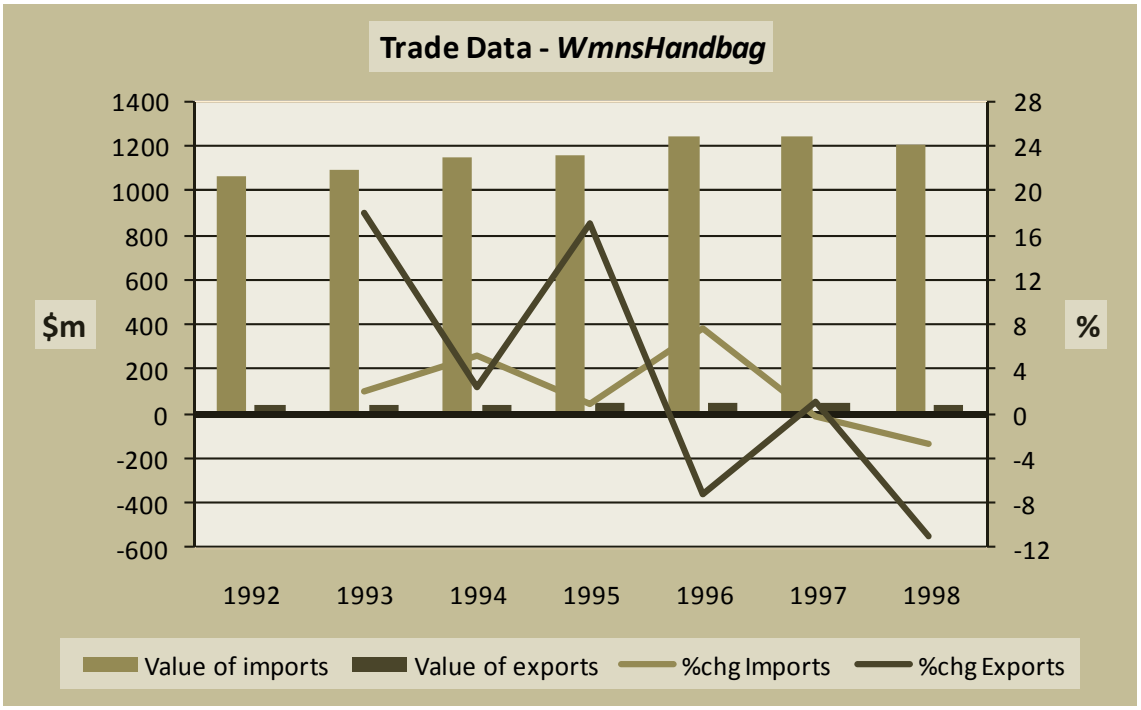

Figure 13: 1992-1998 – U.S. trade by the *WmnsHandbag* industry in nominal dollars

4. Strategy to improve the forecast

An improved forecast was generated by treating the TCF industries with a broad brush – by projecting *real* basic import prices. This produced more realistic relative price changes for *WmnsHandbag* that placed additional pressure on sales. The resultant 14.3% output growth in forecast output saw the USAGE error fall from 107% to 99%. The error remained large due to the ongoing mis-estimation of domestic-import twist factors and overestimation of cost savings from primary factor inputs. A subsequent simulation differing only by the additional forecast of no further primary factor input cost savings saw forecast output contract 8.7% and the USAGE error improve markedly, to 59%.

Commodities where the USAGE Forecast Could Not be Improved

Among the 20 worst errors featured in Table A were 5 commodities that could be described as resources related. These are essentially energy and mining related commodities: *AccStrucSMD, PetNgExplor, PetNgDrill, Nonferrores,* and *Copperore*. It was concluded that without great foresight it is probably unlikely that a better forecast could have been generated for these commodities or sectors in general. The same is perhaps true for the construction-related commodity, *CutStone*, where it was not clear cut whether an improved forecast could have been generated.

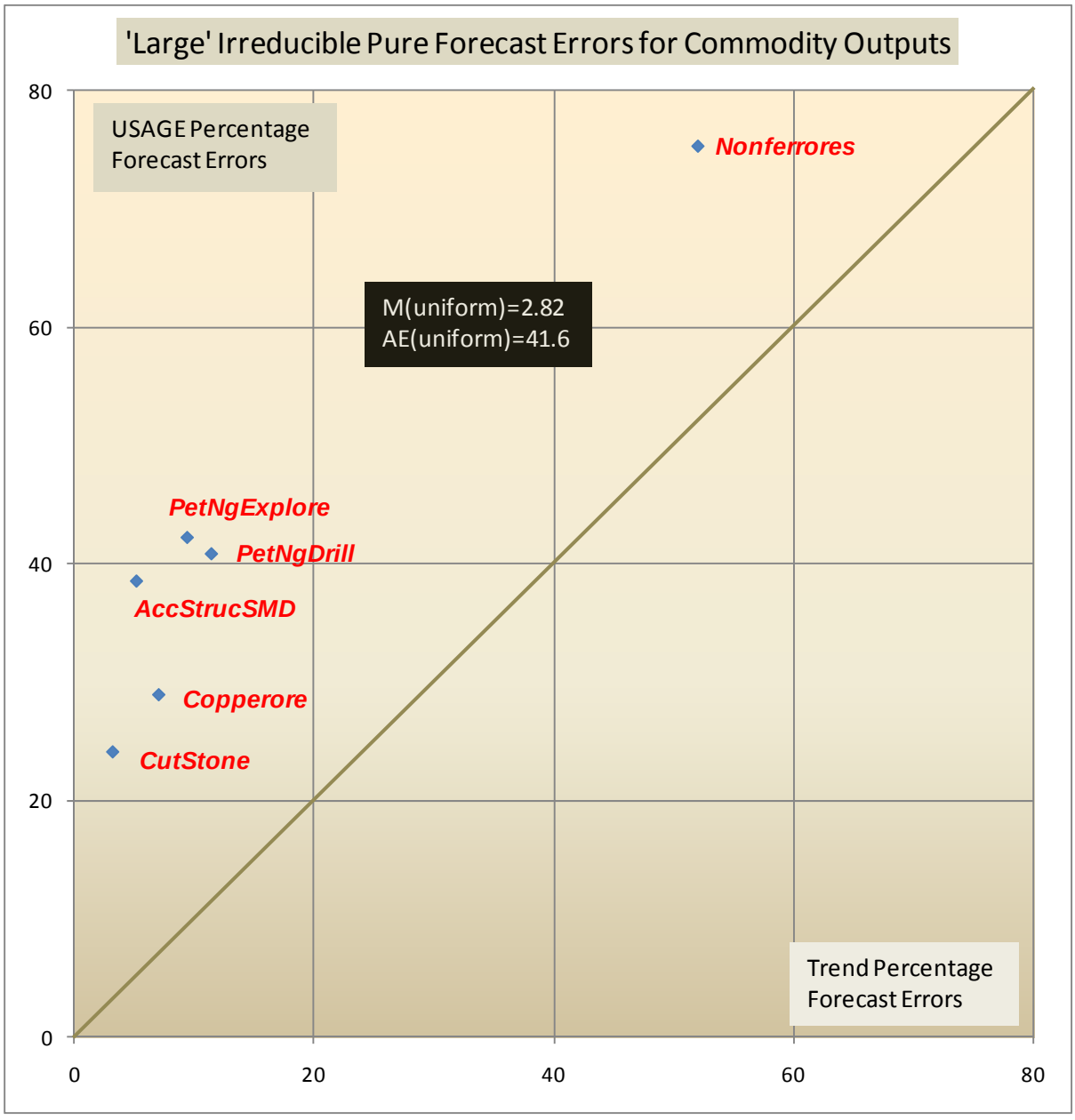

Figure I: Percentage forecast errors for 'large error' commodity outputs 1998-2005 – extrapolated 1992-1998 trend forecast versus the original USAGE pure forecast

Figure I shows that each of these 6 commodities underperformed the trend extrapolation forecast. In this case, USAGE's unweighted AE was 41.6%. The *M* coefficient was 2.82 – which translates to

182% underperformance – reflecting that this small sub-set of commodities all appeared well above the 45-degree line.

Analysis of these commodities generally found that their volatile and cyclical nature would require great faith in even the most well-regarded sector experts for projections extending beyond a couple of years. In 1998 could the modeller have confidently predicted the economic gloom of 2002 and the strength of the rebound from 2004? It seems unlikely. Diversified resources giant, BHP Billiton (formerly BHP), can be considered a bellwether for this sector. Its 10-year price chart using quarterly data from the beginning of 1989 to the end of 1998 is shown in Figure 14. It shows the cyclical and volatile nature of the metals and mining industries. For the sake of completeness analysis of these 6 'large-error' commodities is provided below.

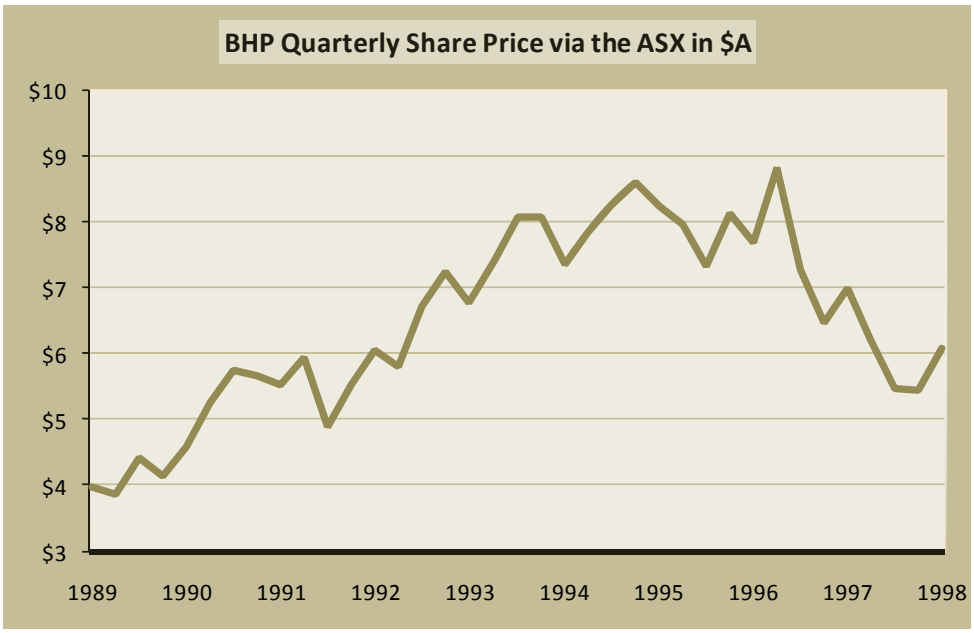

Figure 14: Quarterly share price data for BHP in AUDs as traded on the Australian Stock Exchange

AccStrucSMD → Access Structures for Solid Mineral Development

This comprises parts of three different SIC industries:

- ***1081 Metal Mining Services***

  Establishments primarily engaged in performing metal mining services for others on a contract or fee basis, such as the removal of overburden, strip mining for metallic ores, prospect and test drilling, and mine exploration and development.

- ***1241 Coal Mining Services***

  Establishments primarily engaged in performing coal mining services for others on a contract or fee basis.

- ***1481 Nonmetallic Minerals Services, Except Fuels***

  Establishments primarily engaged in the removal of overburden, strip mining, and other services for nonmetallic minerals, except fuels, for others on a contract or fee basis.

AccStrucSMD - Access Structures for Solid Mineral Development	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-0.6	1.8	4.4	
All-factor augmenting technical change	*a1prim*	-4.1	3.5	-4.6	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-2.2	1.9	-2.5	
Commodity-using technical and taste change	*ac*	-29.0	-33.5	-33.0	
Contribution to output of commodity-using technical & taste change	*cont_ac*	-29.0	-33.4	-32.9	
Neutral technical change - capital creation	*a2*	-1.3	10.9	-0.0	N/A
Average i-augmenting tech change in capital formation	*ac2_tot*	-19.4	-14.2	-21.4	
Basic price of domestic goods	*p0dom*	24.3	27.4	29.8	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	28.5	41.5	-13.1	
Total supplies of domestic goods	*x0dom*	**28.5**	**41.5**	**-13.1**	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	27.9	41.9	-12.6	

Table 33a: Key results for *AccStrucSMD*

Coal - Coal	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Basic price of domestic goods	*p0dom*	-9.6	41.9	10.5	
Total supplies of domestic goods	*x0dom*	10.7	9.5	6.0	
Level of expected rate of return in period t-1	*lev_eror_l*	-1.4%	10.9%	10.9%	N/A
Level of actual rate of return in period t-1	*lev_ror_act_l*	11.1%	29.4%	10.2%	
Level of expected rate of return in period t	*lev_eror*	**4.1%**	**12.3%**	**7.9%**	
Capital creation by using industry	*y*	**51.5**	**117.5**	**11.4**	

Table 33b: Key results for *Coal*

Access Structures for Solid Mineral Development (*AccStrucSMD*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	41 AccStrucSMD: 1689	**Total: 1689**
Proportion	41 AccStrucSMD: 1.000	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	40 AccStrucSMD: 1689	**Total: 1689**
Proportion	40 AccStrucSMD: 1.000	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	0	0	0	**0.00**
Industry Investment	BAS2	1681	0	1681	**1.00**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	0	0	0	**0.00**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	8	0	8	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**1689**	**0**	**1689**	
Source/Total		**1.00**	**0.00**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	**0**	**0**	**0**	**Total: 0**	
Proportion	**0**	**0**	**0**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	25 Coal: 961	23 Copperore: 183	Rest: 537	Total: 1681	**Total: 1.000**
Imported	0	0	0	Total: 0	**Total: 0**
Total	25 Coal: 961	23 Copperore: 183	Rest: 537	**Total: 1681**	
Proportion	**25 Coal: 0.572**	**23 Copperore: 0.109**	**Rest: 0.320**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	0	0	0	**0.00**	**0.00**
Industry Investment	1681	0	1681	**1.00**	**1.00**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	8	0	8	**0.00**	**0.01**
Total	**1689**	**0**	**1689**		
Source/Total	**1.00**	**0.00**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	743	**0.44**	LABOUR	766	**0.84**
Factor	916	**0.54**	CAPITAL	150	**0.16**
Other	23	**0.01**	LAND	0	**0.00**
Production Taxes	6	**0.00**	**Total**	**916**	
Total	**1689**				

Source	c. Intermediate Inputs				Proportion
Domestic	445 EngineerSer: 574	433 MiscRepair: 26	Rest: 136	Total: 736	**Total: 0.991**
Imported	445 EngineerSer: 5	350 ElecteqICE: 2	Rest: 0	Total: 7	**Total: 0.009**
Total	**445 EngineerSer: 580**	**433 MiscRepair: 26**	**Rest: 138**	**Total: 743**	
Proportion	**445 EngineerSer: 0.780**	**433 MiscRepair: 0.035**	**Rest: 0.185**		

Table 34: The key attributes of *AccStrucSMD* in 1998

1. Why did the model erroneously give poor prospects to *AccStrucSMD*?

AccStrucSMD had a USAGE error of 39% versus the smaller trend forecast error of 5%; hence it was situated well above the 45 degree line. The key results for this commodity and its main user (*Coal*) are shown in Tables 33a and 33b. The actual outcome for *AccStrucSMD* output (*x0dom*) was a 41.5% expansion over the 1998-2005 period. This followed 28.5% growth from 1992-1998. The extrapolated trend was therefore a further 34% expansion versus the USAGE forecast of a 13.1% contraction. Table 34 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- This commodity was used solely for investment purposes (Section 3 of Table 34).
- There were no imports or exports (Section 3 of Table 34).
- The Coal industry was the main buyer of the commodity, accounting for 57.2% of sales (Section 4b of Table 34).
- Labour and Engineering Services were the two main production inputs (Sections 6b and 6c of Table 34).

To understand the key drivers behind the erroneous forecast there must be an examination of the Coal industry's expected rate of return (*lev_eror*) and its subsequent investment (*y*). Over the period 1992-1998 investment in *Coal* increased by 51.5% (see bottom of Table 33). This drove the 28.5% rise in *AccStrucSMD* output during that period. In 1998, the capital-weighted average expected rate of return for all industries was 8.9% – for *Coal* it was just 4.1%. With only modest growth of 6.0% predicted for the coal industry, USAGE translated the low rate of return into what turned out to be relatively weak investment (up 11.4%) for the 1998-2005 period. This led the model to incorrectly forecast a 13.1% contraction in output for *AccStrucSMD*. In reality, there was a strong increase in coal prices (*p0dom* increased 41.9%), which led to surging investment in *Coal* (*y* rose 117.5%).

Investing Industry (*j*)	Sales (*BAS2*) 1998		Growth in industry demand for *AccStrucSMD* as input to capital creation (*x2csi*)			Weighted contribution to growth of *AccStrucSMD* 1998-2005	
	$M	Share	1992-1998	1998-2005 Actual	1998-2005 Forecast	Actual	Forecast
25 Coal	**961**	**57%**	**26%**	**93%**	**-8%**	**53%**	**-5%**
23 Copperore	183	11%	-41%	-48%	10%	-5%	1%
28 crushedstone	152	9%	178%	-4%	-34%	0%	-3%
32 Chemfertiliz	122	7%	160%	-29%	-45%	-2%	-3%
29 SandGravel	93	6%	196%	-11%	-36%	-1%	-2%
24 Nonferrores	86	5%	9%	-46%	14%	-2%	1%
30 ClayCeramic	43	3%	166%	-38%	-35%	-1%	-1%
22 Ironmetlores	22	1%	83%	-49%	-1%	-1%	0%
31 Nonmetminsrv	20	1%	157%	102%	-42%	1%	0%
Total Demand for Inputs of *AccStrucSMD* into Capital Creation (sum of contributions)						**+42%**	**-13%**

Table 35: Demand for *AccStrucSMD* inputs for capital creation by all *AccStrucSMD*-using industries (*x2csi*)

Table 35 shows predicted and actual demand for inputs to capital creation (*x2csi*) in the industries that use *AccStrucSMD*. As this commodity is used only for investment, and there are no imports, the total demanded from domestic sources (*x2csi_dom*) closely reconciles with overall commodity output (*x0dom*). The first row is for the Coal industry. The last two columns effectively show the

impact on the growth of *AccStrucSMD* as a result of the investment demand projections. In the case of *Coal*, the weak investment projection was expected to contribute -5 percentage points to the circa 13% reduction in output of *AccStrucSMD*. However, as seen earlier, investment in the coal industry turned out to be quite strong, and made a 53 percentage points contribution to the circa 42% output growth in *AccStrucSMD*. Almost all other *AccStrucSMD*-using industries reduced their demand for the commodity.

2. Macro perspective

The general commentary emerging from this sector in the late 1990s was that there was an increase of mining services as an industry in its own right largely due to cost-cutting measures on the part of the mining industry. With specific services contracted out, firms could avoid a large commitment of capital investment. Thus, faced with erratic demand conditions, the sector experienced an increase in flexible conditions of production, including just-in-time methods, which created smoother production, reduced turnover times, and reduced down-time. Flexible work rules involving eradication of union work rules – or at the very least, union cooperation – contributed to mine efficiency.[53] [54] [55]

The outlook for the coal industry (the main purchaser of mining services) adds further colour. According to the EIA's Annual Energy Outlook for 1998 (published January 1997), the forecast for *Coal* was follows:

> "Average minemouth prices fall steadily to $13.27 per ton in 2020. Consumption increases about 22 percent, to 26 quadrillion Btu per year, from 1996 levels. Driven by increasing exports and domestic demand, coal production grows 1.1 percent per year to 1,376 million tons in 2020."[56]

This talked about long term price pressures. Discussion about renewable energy was also taking place. The EIA's view was:

> "Renewable fuel use increases by an average of 0.5 percent per year. Total production, including hydropower, rises from 6.9 quadrillion Btu in 1996 to 7.7 quadrillion Btu in 2020, mainly because of increases in industrial biomass consumption."[57]

In the 1999 Annual Energy Outlook (published December 1998) the modeller would have gauged a downward revision to the outlook for coal:

> "Coal prices...drop significantly; increases in productivity, greater reliance on cheaper western coal, and flat labour costs combine to drive down the average minemouth price of coal 30 percent to $12.74 per ton ... In this environment of declining or modestly increasing energy prices, U.S. total consumption rises about 28 percent in 2020 from

[53] http://www.answers.com/topic/metal-mining-services, visited 8 September 2009.
[54] http://www.answers.com/topic/coal-mining-services, visited 8 September 2009.
[55] http://www.answers.com/topic/nonmetallic-minerals-services-except-fuels, visited 8 September 2009.
[56] http://www.eia.doe.gov/emeu/plugs/plaeo98.html, visited 9 September 2009.
[57] http://www.eia.doe.gov/emeu/plugs/plaeo98.html, visited 9 September 2009.

the 1997 level. Coal consumption rises 0.9 percent annually, reflecting (like natural gas) increased electricity generation." [58]

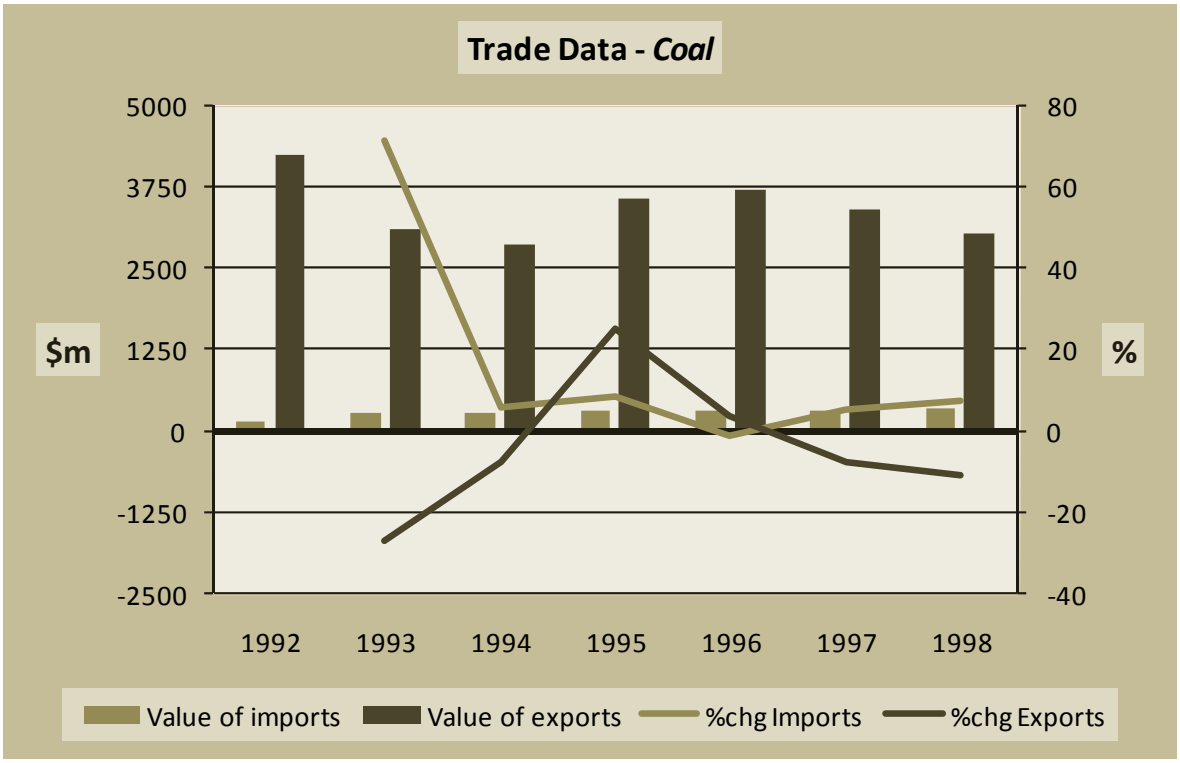

Figure 15: 1992-1998 – U.S. trade by the *Coal* industry in nominal dollars

Figure 15 shows the trade data for *Coal*. Exports were the main component and they were clearly falling from the mid-1990s; overall output (*x0dom*) rose modestly during the period.

3. Conclusion

Whilst the resources sector is cyclical by nature, it probably would have been too tough for the modeller to form a reliable long term view without taking in external forecasts. Furthermore, as seen in the EIA outlook statements from that time, alternative energy sources to coal were being touted, so the forecast is unlikely to have appeared unreasonable. In reality there was overall strong demand for the coal industry, due mostly to the resources boom that occurred during the latter part of the forecast period. Overall, it would be unlikely that the modeller could have produced a better forecast.

[58] http://www.eia.doe.gov/emeu/plugs/plaeo99.html, visited 9 September 2009.

PetNgExplor → Petroleum, Natural Gas, and Solid Mineral Exploration

This comprises parts of four different SIC industries:

- ***1081 Metal Mining Services***

  Establishments primarily engaged in performing metal mining services for others on a contract or fee basis, such as the removal of overburden, strip mining for metallic ores, prospect and test drilling, and mine exploration and development.

- ***1241 Coal Mining Services***

  Establishments primarily engaged in performing coal mining services for others on a contract or fee basis.

- **138: Oil And Gas Field Services**
  - *1381 Drilling Oil and Gas Wells* – Establishments primarily engaged in drilling wells for oil or gas field operations for others on a contract or fee basis. This industry includes contractors that specialize in spudding in, drilling in, redrilling, and directional drilling.
  - *1382 Oil and Gas Field Exploration Services* – Establishments primarily engaged in performing geophysical, geological, and other exploration services for oil and gas on a contract or fee basis.
  - *1389 Oil and Gas Field Services, Not Elsewhere Classified* – Establishments primarily engaged in performing oil and gas field services, not elsewhere classified, for others on a contract or fee basis.

- ***1481 Nonmetallic Minerals Services, Except Fuels***

  Establishments primarily engaged in the removal of overburden, strip mining, and other services for nonmetallic minerals, except fuels, for others on a contract or fee basis.

PetNgExplor - Petroleum, Natural Gas, and Solid Mineral Exploration	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-7.7	-14.8	-1.4	
All-factor augmenting technical change	*a1prim*	-9.3	-21.3	-10.3	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-7.5	-18.2	-8.7	
Commodity-using technical and taste change	*ac*	-53.1	-49.7	-58.8	
Contribution to output of commodity-using technical & taste change	*cont_ac*	-53.1	-49.5	-58.6	
Neutral technical change - capital creation	*a2*	-1.3	10.9	-0.0	N/A
Average i-augmenting tech change in capital formation	*ac2_tot*	-24.2	-21.3	-30.6	
Basic price of domestic goods	*p0dom*	10.2	6.1	18.7	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	45.8	43.4	-18.0	
Total supplies of domestic goods	*x0dom*	**45.8**	**43.4**	**-18.0**	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	45.1	43.8	-17.6	

Table 36a: Key results for *PetNgExplor*

NatGas - Natural Gas	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Basic price of domestic goods	*p0dom*	12.6	317.4	22.3	
Total supplies of domestic goods	*x0dom*	6.7	-5.8	16.0	
Level of expected rate of return in period t-1	*lev_eror_l*	-3.5%	5.8%	5.8%	N/A
Level of actual rate of return in period t-1	*lev_ror_act_l*	5.9%	29.2%	3.5%	
Level of expected rate of return in period t	*lev_eror*	1.8%	8.3%	6.3%	
Capital creation by using industry	*y*	139.5	75.4	29.8	
Crude **- Crude Petroleum**	**Model Notation**	**1992-1998 % chg**	**1998-2005 % chg**	**Original Forecast 1998-2005**	**Improved Forecast 1998-2005**
Basic price of domestic goods	*p0dom*	-32.0	371.2	33.9	
Total supplies of domestic goods	*x0dom*	-13.1	-15.9	-9.5	
Level of expected rate of return in period t-1	*lev_eror_l*	-1.8%	4.8%	4.8%	N/A
Level of actual rate of return in period t-1	*lev_ror_act_l*	4.9%	26.3%	0.4%	
Level of expected rate of return in period t	*lev_eror*	1.1%	6.8%	3.4%	
Capital creation by using industry	*y*	47.6	65.1	-7.1	

Table 36b: Key results for *NatGas* and *Crude*

1. **Why did the model erroneously give poor prospects to *PetNgExplor*?**

PetNgExplor had a USAGE error of 42% versus the smaller trend forecast error of 9%; hence it was situated well above the 45 degree line. The key results for this commodity and its main users (*NatGas* and *Crude*) are shown in Tables 36a and 36b. These industries use *PetNgExplor* to create capital to expand future production. The actual outcome for *PetNgExplor* output (*x0dom*) was a 43.4% expansion over the 1998-2005 period. This followed 45.8% growth from 1992-1998. The extrapolated trend was therefore a further 55% expansion versus the USAGE forecast of an 18.0% contraction. Table 37 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- Virtually all output was sold to investors (97%) (Section 3 of Table 37).
- There were two main buyers; Natural Gas (52.3%) and Crude Petroleum (46.6%) (Section 4b of Table 37).
- There were no imports or exports (Section 3 of Table 37).
- Labour was by far the main input cost (Section 6b of Table 37).

To understand the key drivers behind the erroneous forecast there must be an examination of the Natural Gas and Crude Petroleum industries' expected rates of return (*lev_eror*) and subsequent investment (*y*). Over the period 1992-1998 investment in *NatGas* increased by 139.5%, while investment in *Crude* rose 47.6% (see Table 33b). This drove the 45.8% rise in *PetNgExplor* output during that period. In 1998, the capital-weighted average expected rate of return for all industries was 8.9% – for *NatGas* and *Crude* it was 1.8% and 1.1%, respectively. With growth rates of 16.0% predicted for *NatGas* and -9.5% for *Crude*, USAGE translated the low expected rates of return into a vast slowdown in the pace of investment overall across those two industries for the 1998-2005 period. In fact, investment was predicted to be negative in the Crude Petroleum industry. This led the model to incorrectly forecast an 18.0% contraction in output for *PetNgExplor*.

In reality, there was a huge spike in natural gas prices (*p0dom* increased 317.4%) as the industry was starting to benefit from market deregulation in the early 1990s. This led to stronger than expected investment in *NatGas* (*y* rose 75.4%). Crude petroleum prices rose stronger still – up 371.2% – which led to a 65.1% increase in investment as opposed to the predicted contraction of 7.1%.

Petroleum, Natural Gas, and Solid Mineral Exploration (*PetNgExplor*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	40 PetNgExplor: 2543	**Total: 2543**
Proportion	40 PetNgExplor: 2543	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	39 PetNgExplor: 2543	**Total: 2543**
Proportion	39 PetNgExplor: 2543	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	58	0	58	**0.02**
Industry Investment	BAS2	2472	0	2472	**0.97**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	0	0	0	**0.00**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	12	0	12	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**2543**	**0**	**2543**	
Source/Total		**1.00**	**0.00**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic			40 PetNgExplor: 58	Total: 58	**Total: 1.000**
Imported			0	Total: 0	**Total: 0**
Total			**40 PetNgExplor: 58**	**Total: 58**	
Proportion			**40 PetNgExplor: 1.000**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	27 NatGas: 1292	26 Crude: 1153	Rest: 28	Total: 2472	**Total: 1.000**
Imported	0	0	0	Total: 0	**Total: 0**
Total	27 NatGas: 1292	26 Crude: 1153	Rest: 28	**Total: 2472**	
Proportion	**27 NatGas: 0.523**	**26 Crude: 0.466**	**Rest: 0.011**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	58	0	58	**0.02**	**0.02**
Industry Investment	2472	0	2472	**0.97**	**0.97**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	12	0	12	**0.00**	**0.01**
Total	**2543**	**0**	**2543**		
Source/Total	**1.00**	**0.00**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	364	**0.14**	LABOUR	1780	**0.84**
Factor	2128	**0.84**	CAPITAL	348	**0.16**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	50	**0.02**	**Total**	**2128**	
Total	**2543**				

Source	c. Intermediate Inputs				Proportion
Domestic	39 PetNgExplor: 58	194 PetrolRefin: 36	Rest: 240	Total: 334	**Total: 0.918**
Imported	285 ConstMachin: 11	238 BlastFurnace: 5	Rest: 14	Total: 30	**Total: 0.082**
Total	**39 PetNgExplor: 58**	**194 PetrolRefin: 39**	**Rest: 267**	**Total: 364**	
Proportion	**39 PetNgExplor: 0.160**	**194 PetrolRefin: 0.106**	**Rest: 0.734**		

Table 37: The key attributes of *PetNgExplor* in 1998

2. Macro perspective

Most of the discussion in the section relating to *AccStructSMD* applies here, except the focus is on exploration rather than development. As has been discussed, it is not easy to forecast commodity cycles without the expertise of dedicated outlook providers. Again turning to the EIA's Annual Energy Outlook for 1998 (published December 1997), it is found that total U.S. energy consumption was projected to increase 26 percent by 2020 from its 1996 level.[59] Looking at petroleum and natural gas, the EIA was predicting:

> "**Petroleum:** World average crude oil prices rise in the reference case to $22.32 per barrel (1996 dollars) in 2020. Global demand reaches 117 million barrels per day (up from about 71 million barrels per day in 1996). U.S. crude oil production declines 1.1 percent per year to 4.9 million barrels per day in 2020, while demand for petroleum products grows 1.2 percent per year. The share of petroleum consumption met by net imports rises from 46 percent in 1996 to 66 percent in 2020.
>
> **Natural gas:** The average wellhead price of natural gas rises to $2.54 per thousand cubic feet as demand increases by 1.6 percent per year. Production increases 44 percent to 27 trillion cubic feet and net imports rise more than 80 percent to 4.9 trillion cubic feet in 2020. Consumption by electricity generators more than triples, to over 10 quadrillion Btu in 2020, as does the natural-gas-fired share of electricity generation (excluding cogenerators), which reaches 31 percent in 2020."[60]

The forecasts were then updated in the Annual Energy Outlook for 1999 (published December 1998):

> "The AEO99 reference case projects U.S. average wellhead prices of natural gas to rise 0.8 percent per year on average through 2020, reaching $2.68 per thousand cubic feet ... In this environment of declining or modestly increasing energy prices ... Natural gas consumption rises 1.7 percent per year...with the greatest gains occurring in the electricity generating sector, where the natural gas share expands from 14 percent to 33 percent by 2020. Petroleum consumption increases 1.2 percent per year, led by continued growth in transportation demand."[61]

3. Conclusion

The EIA forecasts can hardly be interpreted as being bullish. In addition, Figure 16 shows the trade data for the main users of *PetNgExplor*. In particular, falling import demand for Natural Gas and Crude Petroleum can be seen. From a trade balance perspective, exports were relatively insignificant for both industries.[62] Figure 17 shows that crude oil prices were trending downward throughout 1997 and 1998 and prior to this crude oil had traded within a relatively narrow band. Overall, Figures 16 and 17 indicate that the key users of *PetNgExplor* were faced with lower prices and weakening demand. It is likely that the modeller would have been satisfied with a weak forecast

[59] http://www.eia.doe.gov/emeu/plugs/plaeo98.html, visited 9 September 2009.
[60] http://www.eia.doe.gov/emeu/plugs/plaeo98.html, visited 9 September 2009.
[61] http://www.eia.doe.gov/emeu/plugs/plaeo99.html, visited 9 September 2009.
[62] In the case of Crude we have not shown export data as exports were small and % changes were very volatile.

for the commodity. Figure 18 shows the sharp reversal in oil prices post-1998. Overall, it would be unlikely that the modeller could have produced a better forecast.

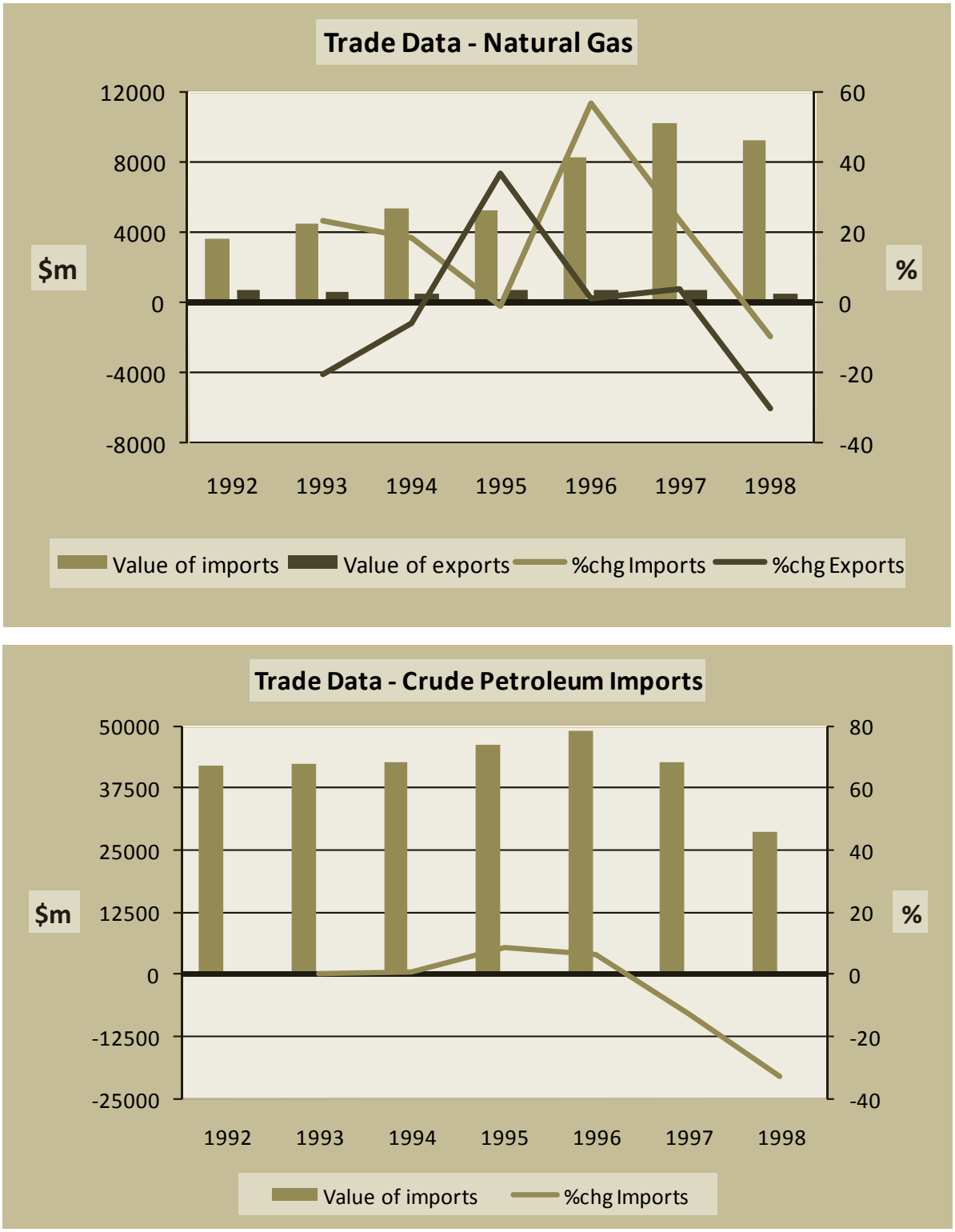

Figure 16: 1992-1998 – U.S. trade by the Natural Gas industry and Crude Petroleum imports

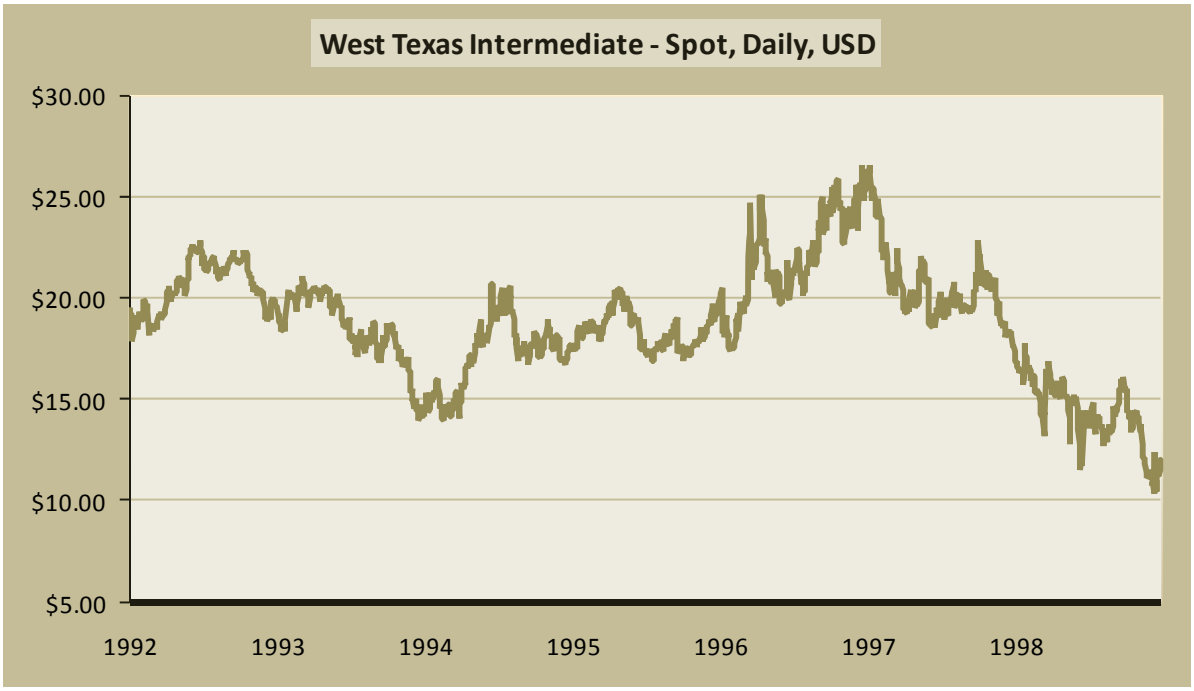

Figure 17: Crude oil prices from 1 January 1992 to 31 December 1998 via NYMEX

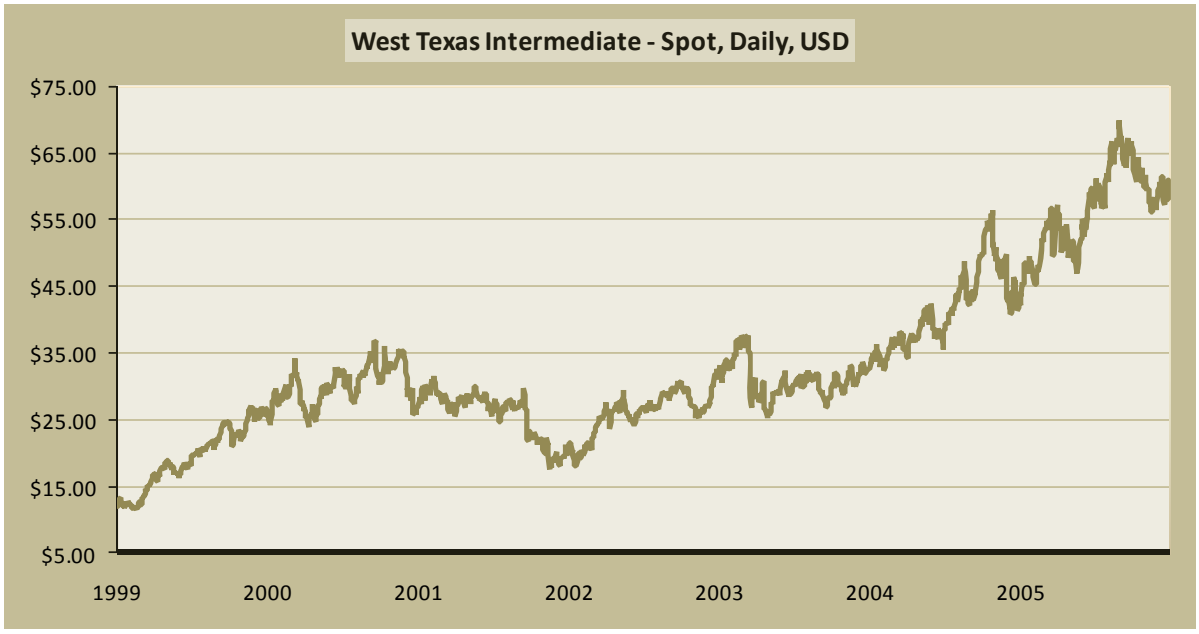

Figure 18: Crude oil prices from 1 January 1999 to 31 December 2005 via NYMEX

PetNgDrill → Petroleum & Natural Gas Well Drilling (SIC 138)

- 138: Oil And Gas Field Services
  - *1381 Drilling Oil and Gas Wells* – Establishments primarily engaged in drilling wells for oil or gas field operations for others on a contract or fee basis. This industry includes contractors that specialize in spudding in, drilling in, redrilling, and directional drilling.
  - *1382 Oil and Gas Field Exploration Services* – Establishments primarily engaged in performing geophysical, geological, and other exploration services for oil and gas on a contract or fee basis.
  - *1389 Oil and Gas Field Services, Not Elsewhere Classified* – Establishments primarily engaged in performing oil and gas field services, not elsewhere classified, for others on a contract or fee basis.

PetNgDrill **- Petroleum & Natural Gas Well Drilling**	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-11.3	-8.5	-6.8	
All-factor augmenting technical change	*a1prim*	-30.8	-20.3	-34.3	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-22.1	-14.6	-25.3	
Commodity-using technical and taste change	*ac*	-52.5	-47.8	-58.2	
Contribution to output of commodity-using technical & taste change	*cont_ac*	-52.5	-47.6	-58.0	
Neutral technical change - capital creation	*a2*	-1.3	10.9	-0.1	N/A
Average i-augmenting tech change in capital formation	*ac2_tot*	-23.2	-18.4	-29.6	
Basic price of domestic goods	*p0dom*	8.6	18.1	9.7	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	49.8	45.3	-14.9	
Total supplies of domestic goods	*x0dom*	**49.8**	**45.3**	**-14.9**	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	49.1	45.8	-14.5	

Table 38a: Key results for *PetNgDrill*

NatGas **- Natural Gas**	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Basic price of domestic goods	*p0dom*	12.6	317.4	22.3	
Total supplies of domestic goods	*x0dom*	6.7	-5.8	16.0	
Level of expected rate of return in period t-1	*lev_eror_l*	-3.5%	5.8%	5.8%	N/A
Level of actual rate of return in period t-1	*lev_ror_act_l*	5.9%	29.2%	3.5%	
Level of expected rate of return in period t	*lev_eror*	**1.8%**	**8.3%**	**6.3%**	
Capital creation by using industry	*y*	**139.5**	**75.4**	**29.8**	
Crude **- Crude Petroleum**	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Basic price of domestic goods	*p0dom*	-32.0	371.2	33.9	
Total supplies of domestic goods	*x0dom*	-13.1	-15.9	-9.5	
Level of expected rate of return in period t-1	*lev_eror_l*	-1.8%	4.8%	4.8%	N/A
Level of actual rate of return in period t-1	*lev_ror_act_l*	4.9%	26.3%	0.4%	
Level of expected rate of return in period t	*lev_eror*	**1.1%**	**6.8%**	**3.4%**	
Capital creation by using industry	*y*	**47.6**	**65.1**	**-7.1**	

Table 38b: Key results for *NatGas* and *Crude*

1. **Why did the model erroneously give poor prospects to *PetNgDrill*?**

PetNgDrill had a USAGE error of 41% versus the smaller trend forecast error of 11%; hence it was situated well above the 45 degree line. The key results for this commodity and its main users (*NatGas* and *Crude*) are shown in Tables 38a and 38b. These industries use *PetNgDrill* to create capital to expand future production. The actual outcome for *PetNgDrill* output (*x0dom*) was a 45.3% expansion over the 1998-2005 period. This followed 49.8% growth from 1992-1998. The extrapolated trend was therefore a further 60% expansion versus the USAGE forecast of a 14.9% contraction. Table 39 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- Virtually all output was sold to investors (99%) (Section 3 of Table 39).
- There were two main buyers; Natural Gas (52.3%) and Crude Petroleum (46.6%) (Section 4b of Table 39).
- There were no imports or exports (Section 3 of Table 39).
- Labour was by far the main input cost (Section 6b of Table 39).

The same analysis used in explaining the nature of the error for *PetNgExplor* applies here. In particular, *PetNgDrill* derives its demand soley from investment demand by industries in the resource sector – mainly Natural Gas (*NatGas*) and Crude Petroleum (*Crude*). Over the period 1992-1998 investment in *NatGas* more than doubled, while in *Crude* it grew solidly. This drove the strong rise in *PetNgDrill* output. In 1998, the capital-weighted average expected rate of return for all industries was considerably higher than for *NatGas* and *Crude*. With only modest growth predicted for *NatGas* and a decline in *Crude*, USAGE translated the low expected rates of return into a vast slowdown in investment overall across those industries. In fact, investment was predicted to be negative in *Crude*. On this basis the model forecast a 14.9% contraction in output for *PetNgDrill*. In reality, there was a huge spike in natural gas prices. This led to stronger than expected investment in *NatGas*. Crude petroleum prices rose stronger still, which led to an acceleration in investment demand growth as opposed to the predicted modest contraction.

2. **Macro perspective**

The discussion in the analogous section relating to *PetNgExplor* applies here, except the focus is on oil and gas well drilling rather than exploration. Again turning to the EIA's Annual Energy Outlook for 1998 (published December 1997), it is found that total U.S. energy consumption was projected to increase just 26 percent by 2020 from its 1996 level, with world average crude oil prices rising (in the reference case) to $22.32 per barrel (1996 dollars) in 2020. As expected, growing demand and falling production would be met by rising net imports. The forecasts were then updated in the Annual Energy Outlook for 1999 (published December 1998) and again did not predict an impending surge in energy prices. The trade data for the main users of *PetNgExplor* showed falling import demand for Natural Gas and Crude Petroleum. Separately, it is noted that crude oil prices were trending downward throughout 1997 and 1998 and prior to this had traded within a relatively narrow band.

Petroleum & Natural Gas Well Drilling (*PetNgDrill*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	39 PetNgDrill: 18878	**Total: 18878**
Proportion	39 PetNgDrill: 1.000	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	38 PetNgDrill: 18878	**Total: 18878**
Proportion	38 PetNgDrill: 1.000	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	113	0	113	**0.01**
Industry Investment	BAS2	18678	0	18678	**0.99**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	0	0	0	**0.00**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	87	0	87	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**18878**	**0**	**18878**	
Source/Total		**1.00**	**0.00**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	39 PetNgDrill: 113			Total: 113	**Total: 1.000**
Imported	0			Total: 0	**Total: 0**
Total	**39 PetNgDrill: 113**			**Total: 113**	
Proportion	**39 PetNgDrill: 1.000**				

Source	b. Industry Investment			BAS2	Proportion
Domestic	27 NatGas: 9763	26 Crude: 8706	Rest: 208	Total: 18678	**Total: 1.000**
Imported	0	0	0	Total: 0	**Total: 0**
Total	27 NatGas: 9763	26 Crude: 8706	Rest: 208	**Total: 18678**	
Proportion	**27 NatGas: 0.523**	**26 Crude: 0.466**	**Rest: 0.011**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	113	0	113	**0.01**	**0.01**
Industry Investment	18678	0	18678	**0.99**	**0.99**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	87	0	87	**0.00**	**0.01**
Total	**18878**	**0**	**18878**		
Source/Total	**1.00**	**0.00**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	5366	**0.28**	LABOUR	10184	**0.78**
Factor	13139	**0.70**	CAPITAL	2954	**0.23**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	373	**0.02**	**Total**	**13139**	
Total	**18878**				

Source	c. Intermediate Inputs				Proportion
Domestic	175 IndustChem: 569	194 PetrolRefin: 455	Rest: 3512	Total: 4535	**Total: 0.845**
Imported	175 IndustChem: 215	285 ConstMachin: 180	Rest: 437	Total: 831	**Total: 0.155**
Total	**175 IndustChem: 784**	**194 PetrolRefin: 492**	**Rest: 4090**	**Total: 5366**	
Proportion	**175 IndustChem: 0.146**	**194 PetrolRefin: 0.092**	**Rest: 0.762**		

Table 39: The key attributes of *PetNgDrill* in 1998

3. Conclusion

The difficulty in forecasting commodity cycles without the expertise of dedicated outlook providers is reiterated. However, even with expert input it seems that extra caution should be placed on such forecasts. On balance, it is likely that the modeller would have been satisfied with a weak forecast for the commodity as there was nothing to suggest good prospects. A cursory glance at oil prices post-1998 shows the sudden, sharp reversal that occurred. In the case of natural gas prices, there was a huge spike post-1998, perhaps as the industry began to benefit from market deregulation in the early 1990s. Again, this would have been difficult to predict. Overall, it would be unlikely that the modeller could have produced a better forecast.

Nonferrores → Nonferrous Metal Ores, except Copper

This comprises 4 different SIC industries:

- *1031 Lead and Zinc Ores*

  Establishments primarily engaged in mining, milling, or otherwise preparing lead ores, zinc ores, or lead-zinc ores.

- 104: Gold And Silver Ores
  - *1041 Gold Ores*
  - *1044 Silver Ores*

- *1081 Metal Mining Services*

  Establishments primarily engaged in performing metal mining services for others on a contract or fee basis, such as the removal of overburden, strip mining for metallic ores, prospect and test drilling, and mine exploration and development.

- *1094 Uranium-Radium-Vanadium Ores*

  Establishments primarily engaged in mining, milling, or otherwise preparing uranium-radium-vanadium ores.

Nonferrores - Nonferrous Metal Ores, except Copper	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-0.5	7.2	2.7	
All factor augmenting technical change	*a1prim*	8.6	14.9	8.8	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	2.6	5.0	3.0	
Combined change in household tastes	*a3com*	4.2	-2.7	5.0	
Commodity-using technical and taste change	*ac*	14.6	3.9	15.6	
Contribution to output of commodity-using technical & taste change	*cont_ac*	5.8	1.8	6.8	
Vertical shift of the export demand curve	*cont_fepc*	9.1	20.0	10.7	
Import/domestic twist by commodity	*ftwist_src*	-2.4	-46.5	-1.6	
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	0.1	3.8	0.2	
Twist caused by strong growth	*twist_eff*	-6.5	-15.4	-1.4	N/A
Basic price of domestic goods	*p0dom*	25.5	59.4	27.7	
Basic price of imported goods	*p0imp*	7.3	7.3	20.5	
Ratio of basic prices: domestic to import	*fpdm*	17.0	48.8	6.0	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	9.8	-25.3	15.2	
Total supplies of domestic goods	*x0dom*	**-4.5**	**-38.0**	**9.2**	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	4.7	-28.2	13.4	
Total supplies of imported goods	*x0imp*	61.1	17.1	56.4	
Household demands undifferentiated by source	*x3*	28.1	21.5	21.7	
Export volumes	*x4*	-12.0	-45.3	6.9	
Change in net import share to domestic output	*dtradeshare*	5.6	7.1	2.3	

Table 40: Key results for *Nonferrores* results

Nonferrous Metal Ores, except Copper (*Nonferrores*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	24 Nonferrores: 6238	Rest: 40	**Total: 6278**
Proportion	24 Nonferrores: 0.994	Rest: 0.006	

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	23 Nonferrores: 6238	Rest: 31	**Total: 6269**
Proportion	23 Nonferrores: 0.995	Rest: 0.005	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	2680	183	2864	**0.43**
Industry Investment	BAS2	75	7	82	**0.01**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	3492	0	3492	**0.56**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	30	0	30	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**6278**	**190**	**6468**	
Source/Total		**0.97**	**0.03**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	24 Nonferrores: 1856	23 Copperore: 264	Rest: 560	Total: 2680	**Total: 0.936**
Imported	24 Nonferrores: 61	243 BlastFurnace: 59	Rest: 64	Total: 183	**Total: 0.064**
Total	**24 Nonferrores: 1918**	**23 Copperore: 270**	**Rest: 676**	**Total: 2864**	
Proportion	**24 Nonferrores: 0.670**	**23 Copperore: 0.094**	**Rest: 0.236**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	421 Electricserv: 61	470 Hospitals: 8	Rest: 7	Total: 75	**Total: 0.914**
Imported	421 Electricserv: 6	470 Hospitals: 1	Rest: 1	Total: 7	**Total: 0.086**
Total	421 Electricserv: 66	470 Hospitals: 9	Rest: 7	**Total: 82**	
Proportion	**421 Electricserv: 0.806**	**470 Hospitals: 0.105**	**Rest: 0.089**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	2743	194	2937	**0.95**	**0.89**
Industry Investment	107	11	118	**0.04**	**0.04**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	30	0	30	**0.01**	**0.01**
Total	**2880**	**204**	**3085**		
Source/Total	**0.93**	**0.07**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	3651	**0.58**	LABOUR	1473	**0.66**
Factor	2218	**0.35**	CAPITAL	745	**0.34**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	400	**0.06**	**Total**	**2218**	
Total	**6269**				

Source	c. Intermediate Inputs				Proportion
Domestic	23 Nonferrores: 1881	175 IndustChem: 187	Rest: 1271	Total: 3339	**Total: 0.915**
Imported	285 ConstMachin: 82	175 IndustChem: 63	Rest: 166	Total: 311	**Total: 0.085**
Total	**23 Nonferrores: 1944**	**175 IndustChem: 250**	**Rest: 1457**	**Total: 3651**	
Proportion	**23 Nonferrores: 0.532**	**175 IndustChem: 0.069**	**Rest: 0.399**		

Table 41: The key attributes of *Nonferrores* in 1998

1. Why did the model erroneously give good prospects to *Nonferrores*?

Nonferrores had a USAGE error of 75% versus the smaller trend forecast error of 52%; hence it was situated well above the 45 degree line. The key results for this commodity are shown in Table 40. The actual outcome for *Nonferrores* output (*x0dom*) was a 38.0% decline over the 1998-2005 period. This followed a 4.5% contraction from 1992-1998. The extrapolated trend was therefore a further 5% output reduction versus the USAGE forecast of a 9.2% expansion. Table 41 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- Producers purchased 43% of domestic output, and investors 1% (Section 3 of Table 41).
- Intermediate demand was driven by *Nonferrores* at 67.0% of total purchases, followed by *Copperore* at 9.4% (Section 4a of Table 41).
- 56% of production was exported (Section 3 of Table 41).
- Imports made up just 7% of the domestic market (Section 5 of Table 41).

There were two main factors contributing to the erroneous forecast. Firstly, despite a larger than projected outward shift of the export demand curve, the strong rise in export prices had an overwhelmingly negative impact on volumes. In particular, the export demand function (*cont_fepc*) was expected to shift 10.7% higher, yet it actually rose 20.0% higher. However, the basic price of domestic goods (*p0dom*) rose by more than double the projected amount (57.4% versus 27.7%). Secondly, Table 42 shows that intermediate use of *Nonferrores* was much lower than expected. The *Nonferrores* industry purchased a significant portion of its own output. The overall 30% fall in intermediate demand versus the predicted 13% increase explains why *x0dom_dom* behaved the way it did.

Purchasing Industry (*j*)	Sales (*BAS1*) 1998		Growth in industry demand for *Nonferrores* as input to production (*x1csi*)			Weighted contribution to growth of *Nonferrores* 1998-2005	
	$M	Share	1992-1998	1998-2005 Actual	1998-2005 Forecast	Actual	Forecast
24 Nonferrores	**1856**	**69%**	**2%**	**-36%**	**15%**	**-24.9%**	**10.4%**
23 Copperore	264	10%	-3%	-19%	9%	-1.9%	0.9%
254 PrimNfMetnec	190	7%	2%	-26%	7%	-1.8%	0.5%
243 BlastFurnace	187	7%	33%	-7%	11%	-0.5%	0.8%
179 IndustChem	53	2%	3%	-11%	-6%	-0.2%	-0.1%
22 Ironmetlores	32	1%	25%	-24%	16%	-0.3%	0.2%
Rest	99	4%	1%	-14%	13%	-0.5%	0.5%
Total Demand for Inputs of *Nonferrores* into Production (sum of contributions)						**-30%**	**+13%**

Table 42: Intermediate Demand composition for *Nonferrores* inputs by *Nonferrores*-using industries

2. Macro perspective

At noted in previous discussions, metals and mining-related commodities exhibit volatile cyclical demand patterns. This was certainly the case from 1992 to 1998 for *Nonfoerrores*. Figure 19 maps gold and silver prices. It shows that gold had been trending downwards from about 1996, whereas silver, exhibited a sharp price spike in early 1998. Gold prices moved sharply higher in the forecast period. Figure 20 highlights the volatility of the trade data, with very large movements in the growth rate of the dollar value of exports.

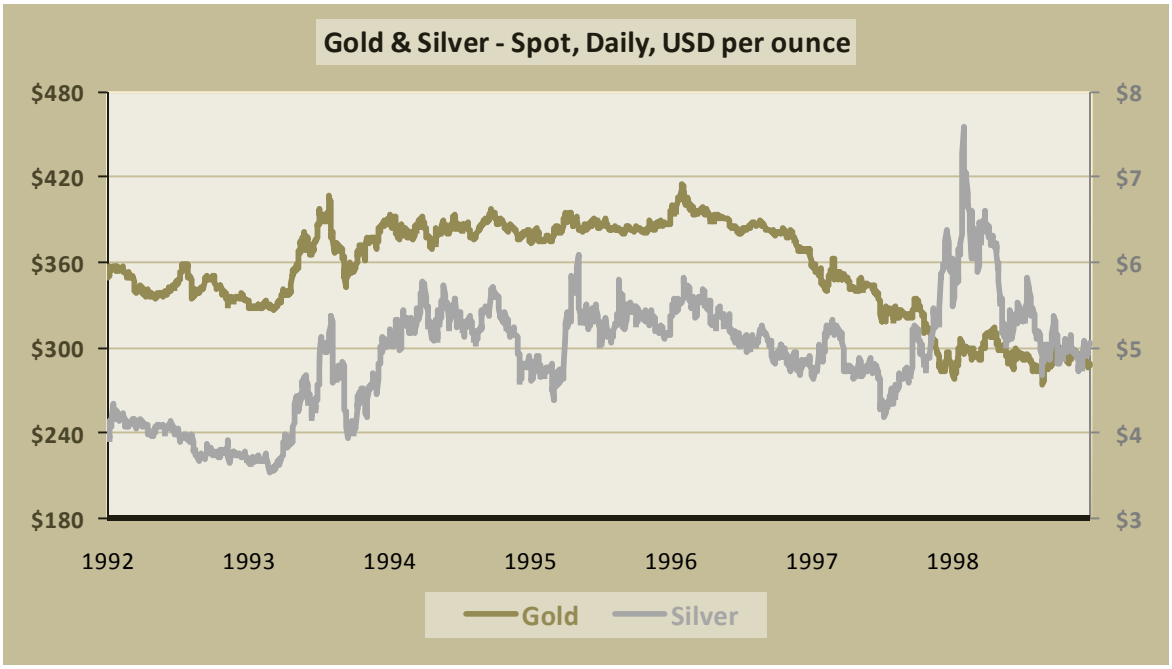

Figure 19: Spot gold and spot silver prices from 1 January 1992 to 31 December 1998

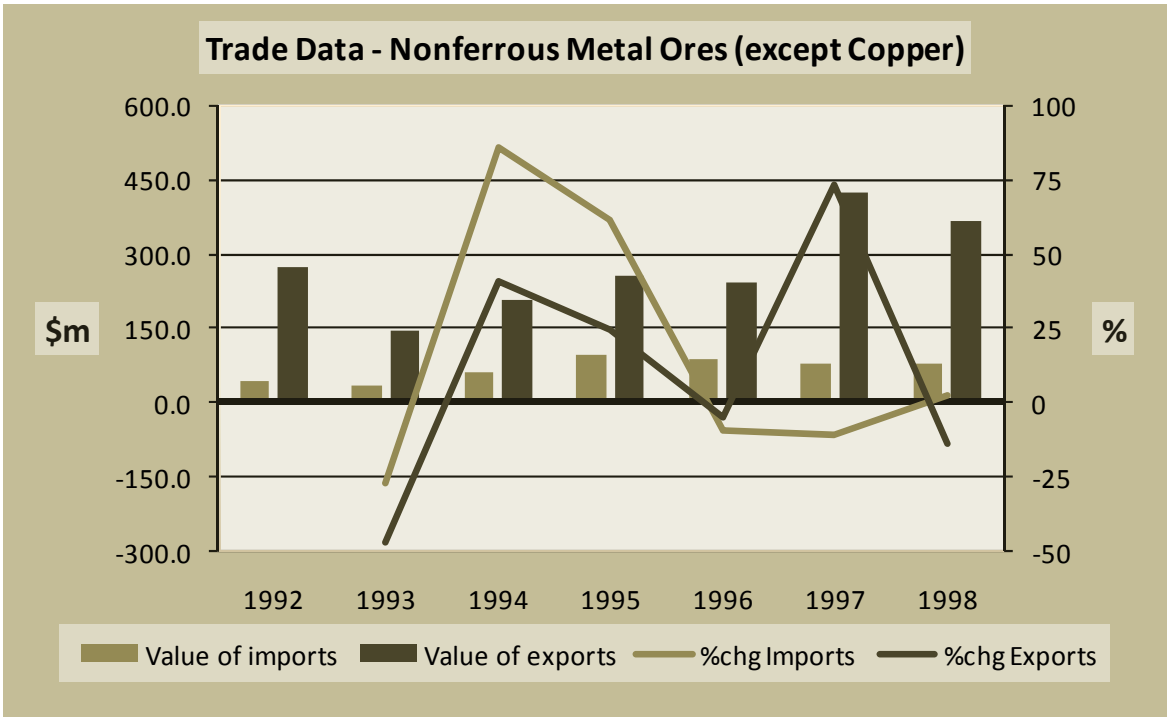

Figure 20: 1992-1998 – U.S. trade by the *Nonferrores* industry

3. Conclusion

This is another example of where the modeller is unlikely to have been able to do much better in forecast. As mentioned previously, the modeller would have been hard pressed to predict the resources boom that had a very big impact on the tail end of the forecast. Furthermore, exports were the largest share of domestic output. The value of exports for the commodity often moved quite dramatically during the period from 1992 to 1998.

Copperore → Copper Ores (SIC 1021)

Part of Major Group 10: Metal Mining, this covers establishments primarily engaged in mining, milling, or otherwise preparing copper ores. This industry also includes establishments primarily engaged in the recovery of copper concentrates by precipitation and leaching of copper ore.

Copperore - Copper Ores	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-4.4	-6.1	0.9	
All factor augmenting technical change	*a1prim*	6.4	-17.1	5.9	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	2.9	-10.4	3.4	
Combined change in household tastes	*a3com*	6.7	-12.8	7.8	
Commodity-using technical and taste change	*ac*	26.2	-2.7	26.6	
Contribution to output of commodity-using technical & taste change	*cont_ac*	21.9	-2.6	26.0	
Vertical shift of the export demand curve	*cont_fepc*	-20.6	0.9	0.0	
Import/domestic twist by commodity	*ftwist_src*	-7.0	-81.8	-3.8	
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	0.3	4.1	0.4	
Twist caused by strong growth	*twist_eff*	-8.1	-9.6	-2.3	N/A
Basic price of domestic goods	*p0dom*	37.4	5.6	22.8	
Basic price of imported goods	*p0imp*	7.3	7.3	20.5	
Ratio of basic prices: domestic to import	*fpdm*	28.2	-1.5	1.9	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	5.3	-24.6	6.4	
Total supplies of domestic goods	*x0dom*	**-10.9**	**-18.7**	**5.2**	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	3.3	-21.0	5.8	
Total supplies of imported goods	*x0imp*	82.3	-88.3	29.1	
Household demands undifferentiated by source	*x3*	30.6	11.0	25.1	
Export volumes	*x4*	-90.1	127.2	0.8	
Change in net import share to domestic output	*dtradeshare*	14.9	-7.3	1.1	

Table 43: *Copperore* results

1. **Why did the model erroneously give good prospects to *Copperore*?**

Copperore had a USAGE error of 29% versus the smaller trend forecast error of 7%; hence it was situated well above the 45 degree line. The key results for this commodity are shown in Table 43. The actual outcome for *Copperore* output (*x0dom*) was an 18.7% decline over the 1998-2005 period. This followed a 10.9% contraction from 1992-1998. The extrapolated trend was therefore a further 13% output reduction versus the USAGE forecast of a 5.2% expansion. Table 44 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- Producers purchased 98% of domestic output (Section 3 of Table 44).
- Intermediate demand was driven by *PrimSmelting* at 69.0% of total purchases, followed by *IndustChem* at 25.2% (Section 4a of Table 44).
- There was just 5% import penetration (Section 5 of Table 44).

Copper Ores (*Copperore*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	23 Copperore: 4110	Rest: 18	**Total: 4129**	
Proportion	23 Copperore: 0.996	Rest: 0.004		

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	22 Copperore: 4110	21 Ironmetlores: 128	Rest: 20	**Total: 4258**
Proportion	22 Copperore: 0.965	21 Ironmetlores: 0.030	Rest: 0.005	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	4039	212	4251	**0.98**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	0	0	0	**0.00**
Exports	BAS4	70	0	70	**0.02**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	20	0	20	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**4129**	**212**	**4341**	
Source/Total		**0.95**	**0.05**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	252 PrimSmelting: 2784	179 IndustChem: 1020	Rest: 235	Total: 4039	**Total: 0.950**
Imported	252 PrimSmelting: 147	179 IndustChem: 53	Rest: 12	Total: 212	**Total: 0.050**
Total	**252 PrimSmelting: 2931**	**179 IndustChem: 1073**	**Rest: 247**	**Total: 4251**	
Proportion	**252 PrimSmelting: 0.690**	**179 IndustChem: 0.252**	**Rest: 0.058**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	4142	221	4363	**1.00**	**0.95**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	0	0	0	**0.00**	**0.00**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	20	0	20	**0.00**	**0.01**
Total	**4162**	**221**	**4383**		
Source/Total	**0.95**	**0.05**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	1596	**0.38**	LABOUR	564	**0.23**
Factor	2485	**0.58**	CAPITAL	1920	**0.77**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	178	**0.04**	**Total**	**2485**	
Total	**4258**				

Source	c. Intermediate Inputs				Proportion
Domestic	23 Nonferrores: 266	411 Electricserv: 242	Rest: 902	Total: 1409	**Total: 0.883**
Imported	285 ConstMachin: 56	479 NoncompImps: 29	Rest: 102	Total: 186	**Total: 0.117**
Total	**23 Nonferrores: 272**	**411 Electricserv: 243**	**Rest: 1081**	**Total: 1596**	
Proportion	**23 Nonferrores: 0.171**	**411 Electricserv: 0.152**	**Rest: 0.677**		

Table 44: The key attributes of *Copperore* in 1998

The explanation of this error has some similarities to that of Asbestos Products in the validation paper. Most of the sales of this commodity were to copper manufacturers and chemical producers. In 1992, exports comprised 15% of sales. Between 1992 and 1998 exports slumped by 90%. In the USAGE simulation for 1992-1998, there was a significant inward movement of the foreign demand curve, and this was accompanied by rising export prices. At the same time there was strong growth in imports, albeit off a low base. Output of the commodity between 1992 and 1998 fell by 11%. However, with strong import growth and apparent diversion of exports back to the domestic market, the USAGE simulation for 1992-1998 showed weak growth in supplies on the domestic market (*x0dom_dom*) relative to demands by the using industries. In these circumstances, the model implied that during the period 1992 to 1998 there was *Copperore*-using technical change in the using industries (positive *ac(i)* for *i* = 22). In the forecast for 1998 to 2005, this *Copperore*-using technical change was projected forward. The inward movement in the export demand curve was also projected forward, but with exports in 1998 at very low levels, this did not significantly affect the forecast output for *Copperore*. The *Copperore*-using industries in the 1998-2005 forecast showed moderate contractions. This provided some offset to the projected *Copperore*-using technical change, but not enough to predict a contraction in the USAGE forecasts.

2. Macro perspective

A decade ago, the U.S. was the world's second largest copper producer and a net importer of copper, obtaining 37 percent of refined copper from abroad at the turn of the twenty-first century. Furthermore:

> "World demand for copper has grown steadily since the late 1970s, but in the late 1990s ambitious copper producers, including many located in Chile, the world's largest copper-producing country, ramped up new mining capacity faster than the market could absorb their production. In addition, economic weakness in Asia and Latin America in the late 1990s left global demand growth at a slower pace than some producers anticipated. As a result, copper supplies ran heavy, and copper prices slumped by as much as 50 percent in the latter half of the 1990s, especially during 1998 and 1999, reaching Great Depression-era levels when adjusted for inflation. Soft prices decimated copper companies' profits and triggered a frantic round of consolidation among major producers."[63]

Figure 21 shows downward trend in copper prices from the mid-1990s. By the late 1990s this started to translate into rising stockpiles. Also significant is that in 1998 the U.S. went from being a net exporter to a net importer. (This can be seen in Figure 22.) However, by 1998 exports became a relatively insignificant component of total sales of domestic output.

3. Conclusion

The longevity of falling prices and the higher stockpiles might have indicated to the modeller that *Copperore* faced a bleak outlook. The USAGE forecast of 5.2% growth was perhaps bullish. Given the way copper prices were trending in the late 1990s it is not clear why demand would shift so strongly away from copper – particularly given that price reductions were being driven by boosted

[63] http://www.answers.com/topic/copper-ores, visited 13 September 2009.

mining capacity. The most obvious copper substitutes are aluminium, plastics and fibre. The Primary aluminium industry (*Primaluminum*) was also facing a bleak outlook with USAGE predicting a steady decline in output of that commodity. The various plastics and fibre commodities in USAGE all exhibited relatively modest outlooks. On balance it is reasonably arguable that the modeller could have done better. However, in all likelihood any strategy would have revolved around setting domestic output growth to zero. Hence, the gains from such an exercise would have been minimal.

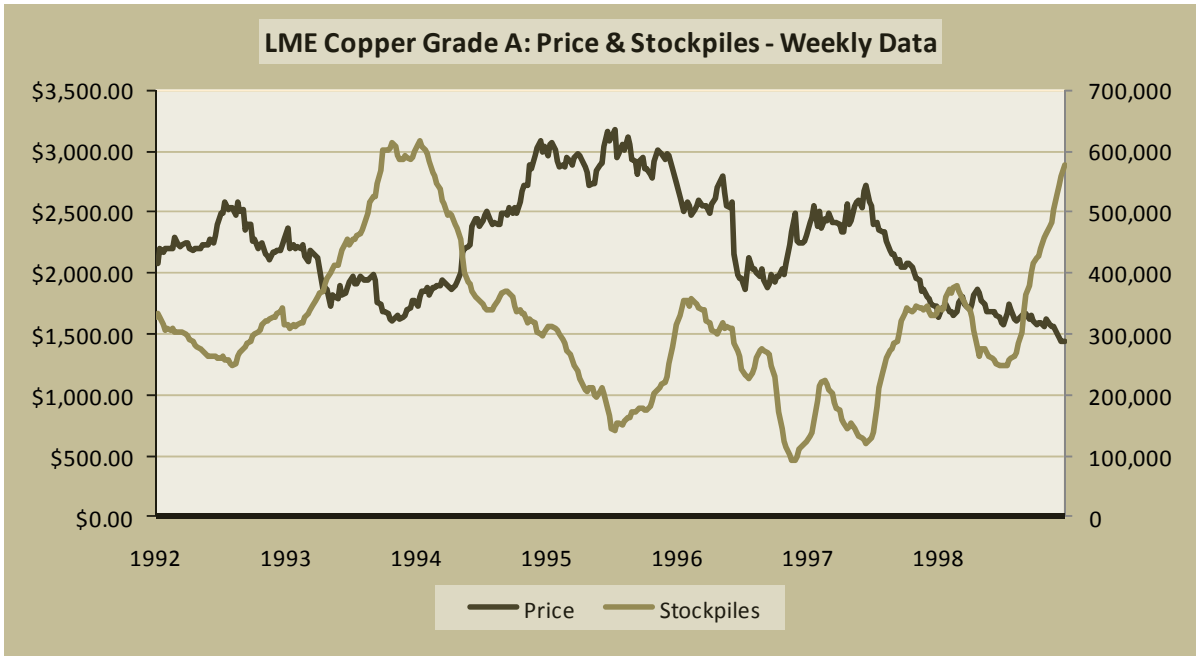

Figure 21: 1992-1998 – LME Copper Grade A: Price (US$/tonne) and Stockpiles (tonnes)

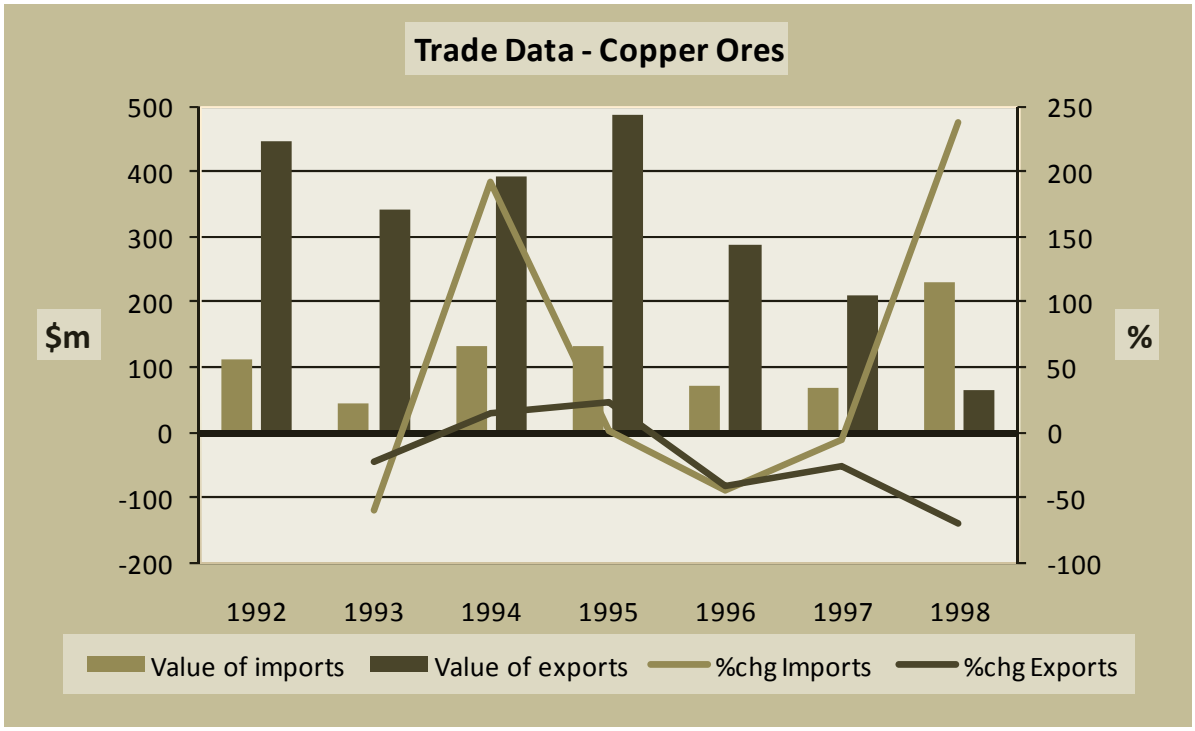

Figure 22: 1992-1998 – U.S. trade by the *Copperore* industry in nominal dollars

CutStone → Cut Stone and Stone Products (SIC 3281)

Part of Major Group 32: Stone, Clay, Glass, And Concrete Products, CutStone covers establishments primarily engaged in cutting, shaping, and finishing granite, marble, limestone, slate, and other stone for building and miscellaneous uses.

CutStone - Cut Stone and Stone Products	Model Notation	1992-1998 % chg	1998-2005 % chg	Original Forecast 1998-2005	Improved Forecast 1998-2005
Average of technical change terms, production	*a*	-5.4	4.1	-2.6	
All factor augmenting technical change	*a1prim*	-23.7	33.4	-27.7	
Contribution to output of all factor augmenting technical change	*cont_a1prim*	-12.9	15.5	-14.9	
Combined change in household tastes	*a3com*	5.1	48.9	6.0	
Commodity-using technical and taste change	*ac*	3.6	30.6	4.2	
Contribution to output of commodity-using technical & taste change	*cont_ac*	2.7	22.5	3.2	
Vertical shift of the export demand curve	*cont_fepc*	-0.4	2.4	-0.4	
Import/domestic twist by commodity	*ftwist_src*	105.2	167.4	100.2	
Twist trends impact on non-marg, non-invent domestic demand	*impftwist*	-20.0	-29.9	-22.9	
Twist caused by strong growth	*twist_eff*	-2.2	-2.0	-7.2	N/A
Basic price of domestic goods	*p0dom*	6.3	30.1	15.7	
Basic price of imported goods	*p0imp*	3.1	5.2	16.2	
Ratio of basic prices: domestic to import	*fpdm*	3.1	23.8	-0.4	
Quantity of sales (domestic and imported) in U.S. - Absorption	*x0*	45.3	82.6	18.1	
Total supplies of domestic goods	*x0dom*	**13.9**	**12.2**	**-14.3**	
Quantity of sales of domestically produced in U.S.	*x0dom_dom*	14.0	10.9	-14.2	
Total supplies of imported goods	*x0imp*	103.4	142.6	49.6	
Household demands undifferentiated by source	*x3*	50.6	114.7	25.1	
Export volumes	*x4*	3.6	64.3	-4.6	
Change in net import share to domestic output	*dtradeshare*	34.0	58.8	58.3	

Table 45: *CutStone* results

1. **Why did the model erroneously give poor prospects to *CutStone*?**

CutStone had a USAGE error of 24% versus the smaller trend forecast error of 3%; hence it was situated well above the 45 degree line. The key results for this commodity are shown in Table 45. The actual outcome for *CutStone* output (*x0dom*) was a 12.2% rise over the 1998-2005 period. This followed 13.9% growth from 1992-1998. The extrapolated trend was therefore a further 16% output expansion versus the USAGE forecast of a 14.3% contraction. Table 46 shows the main users, cost structure and other information of interest of the 1998 database used in the forecast. The following observations can be made:

- Producers purchased 60% of domestic output (Section 3 of Table 46).
- Households purchased 37% of domestic output (Section 3 of Table 46).
- Intermediate demand was driven by building and construction industries (Section 4a of Table 46).
- There was 33% import penetration (Section 5 of Table 46).
- Labour was the main factor input cost (Section 6b of Table 46).

Cut Stone and Stone Products (*CutStone*) - 1998 Database

1. Main Producers of the Commodity at Basic Prices

Industries	236 CutStone: 1181	Rest: 30	**Total: 1212**	
Proportion	236 CutStone: 0.975	Rest: 0.025		

2. Output Composition of the Main Producing Industry at Basic Prices

Commodities	231 CutStone: 1181	416 WholesleTrde: 18	Rest: 25	**Total: 1224**
Proportion	231 CutStone: 0.965	416 WholesleTrde: 0.015	Rest: 0.020	

3. Total Sales of Domestic Output & Imports at Basic Prices

Demand Type		Domestic	Imported	Total	Dom/Total Dom
Current Production	BAS1	725	919	1644	**0.60**
Industry Investment	BAS2	0	0	0	**0.00**
Private Consumption	BAS3	444	35	479	**0.37**
Exports	BAS4	36	0	36	**0.03**
Government Demand	BAS5	0	0	0	**0.00**
Inventory Changes	BAS6	6	0	6	**0.01**
Total Margins	TOTMARGINS	0	0	0	**0.00**
Total		**1212**	**954**	**2165**	
Source/Total		**0.56**	**0.44**		

4. Sales of Commodity to Domestic Industrial Users via the Absorption Matrix

Source	a. Current Production			BAS1	Proportion
Domestic	43 OthrConstruc: 302	42 IndComBuild: 201	Rest: 222	Total: 725	**Total: 0.441**
Imported	43 OthrConstruc: 309	33 Nresident1: 283	Rest: 327	Total: 919	**Total: 0.559**
Total	**43 OthrConstruc: 611**	**42 IndComBuild: 415**	**Rest: 618**	**Total: 1644**	
Proportion	**43 OthrConstruc: 0.371**	**42 IndComBuild: 0.253**	**Rest: 0.376**		

Source	b. Industry Investment			BAS2	Proportion
Domestic	0	0	0	Total: 0	**Total: 0**
Imported	0	0	0	Total: 0	**Total: 0**
Total	0	0	0	**Total: 0**	
Proportion	**0**	**0**	**0**		

5. Market Share - Purchasers' Values of All Sales in the U.S.

Demand Type	Domestic	Imported	Total	Dom/Total Dom	Dom/Total
Current Production	924	1194	2118	**0.34**	**0.23**
Industry Investment	0	0	0	**0.00**	**0.00**
Private Consumption	1750	143	1893	**0.65**	**0.44**
Government Demand	0	0	0	**0.00**	**0.00**
Inventory Changes	6	0	6	**0.00**	**0.00**
Total	**2680**	**1337**	**4017**		
Source/Total	**0.67**	**0.33**			

6. Total Costs of the Main Producing Industry - Intermediate & Factor Input Breakdown at Basic Prices

a. All Inputs		Proportion	b. Factor Inputs		Proportion
Intermediate	618	**0.51**	LABOUR	529	**0.87**
Factor	610	**0.50**	CAPITAL	81	**0.13**
Other	0	**0.00**	LAND	0	**0.00**
Production Taxes	-4	**0.00**	**Total**	**610**	
Total	**1224**				

Source	c. Intermediate Inputs				Proportion
Domestic	27 crushedstone: 86	271 Handtools: 40	Rest: 387	Total: 513	**Total: 0.830**
Imported	27 crushedstone: 51	271 Handtools: 17	Rest: 37	Total: 105	**Total: 0.170**
Total	**27 crushedstone: 137**	**271 Handtools: 58**	**Rest: 423**	**Total: 618**	
Proportion	**27 crushedstone: 0.222**	**271 Handtools: 0.093**	**Rest: 0.685**		

Table 46: The key attributes of *CutStone* in 1998

From 1992 to 1998 growth in domestic demand for *CutStone* was driven by households. The total rise in household demand for the commodity was 50.6% (see Table 45). Household demand for domestically produced *CutStone* (*x3cs*) increased 44.8% (this is not shown the results table). Intermediate input demand for the domestically produced commodity (*x1csi*) on the whole was relatively flat during this period. USAGE calculated modest rises in the taste and preference indicators for households and producers (*a3com and cont_ac*), which were projected forward. In the case of households, USAGE predicted total demand (undifferentiated by source) to grow by 25.1% over the seven year forecast horizon. However, household demand for domestically produced *CutStone* was expected to increase by a slower 14.5%. Where producer demand is concerned, Table 47 shows that USAGE underestimated the growth of the four largest intermediate purchasers of *CutStone*. (The USAGE error was far greater than the trend error for the two largest of these.) Given that production demand was the larger share of output, the model forecast an overall 14.3% reduction in *x0dom* for *CutStone*.

SIC Name	USAGE Commodity	*BAS1*	x0dom 1998-2005		Above/(Below)
		Proportion	Actual	Forecast	45° Line
Other new construction	43 OthrConstruc	42%	10%	-1%	**16**
New office, industrial and commercial buildings construction	42 IndComBuild	28%	2%	-17%	**15**
New residential 1 unit structures, nonfarm	33 Nresident1	11%	40%	13%	**(21)**
New residential garden and high-rise apartments construction	36 GardHighrise	5%	39%	13%	**(2)**

Table 47: Key results for the main purchasing industries of *CutStone*

The actual result was 12.2% output growth, which was largely driven by a strong increase in tastes and preferences for *CutStone* by producers and households. Recall that the combined change in household tastes (*a3com*) was projected forward to be 6.0%. This essentially means that at any given set of prices and per capita income, consumption per household of *CutStone* would be 6.0% higher in 2005 than in 1998.[64] In reality, household tastes towards *CutStone* soared by 48.9%; driving an 88.5% increase in consumption demand for the domestically produced commodity. A similar story emerges for the contribution to output of *CutStone*-using technical and taste change (*ac*). This was projected to be 3.2% higher in the forecast, when in fact the increase was 22.5%. These were clearly the key drivers behind the error.

It is also worth noting the significant difference in technological change parameters. On the supply side, primary factors comprised 50% of total input costs (Section 6a of Table 46). In the forecast, all primary factor augmenting technical change (*a1prim*) indicated a 27.7% improvement in primary factor efficiency. This meant that the *CutStone* industry was projected to require 27.7% less primary factors to produce the same level of output whilst holding all other inputs constant. The contribution of all primary factor augmenting technical change to total input costs (*cont_a1prim*) was estimated to be an overall cost reduction of 14.9%. In reality, this efficiency measure deteriorated by 33.4%, and its contribution to total input costs rose 15.5%.

[64] More precisely, the consumption per household of *CutStone* in 2005 would be 6*(1 – share of *CutStone* in household expenditure) percent higher than in 1998.

2. Macro perspective

Although stone remains an important building material, new construction materials and methods developed during the twentieth century have limited its use almost entirely to a finishing element of mostly decorative value.[65] In addition, any forward looking comments made around the 1990s were reasonably cautious:

> "The long-term industry outlook was generally lackluster for the early 2000s. Limited opportunities for further productivity gains, coupled with greater foreign competition, were expected to hurt many industry sectors. Although traditional domestic markets, such as construction, experienced expansive growth in the booming economy of the late 1990s, superior synthetic substitutes continued to make gains. Due to the strength of the construction industry in the late 1990s, the cut stone industry did experience steady growth between 1997 and 2000, when the value of shipments increased from $1.24 billion to $1.63 billion.
>
> Because of stone's weight-to-value ratio, moreover, opportunities for U.S. export growth are slim with the exception of niche specialty stones. U.S. producers exported about 2 percent of production in the late 1990s. A bright spot on the horizon for the industry is the expected continued surge in historical restoration projects that require considerable amounts of stone to replace damaged pieces from the original construction."[66]

3. Conclusion

The modeller may have viewed this overall cautious outlook as being consistent with the downbeat USAGE forecast for the commodity. Moreover, the building and construction boom that occurred mostly during the second half of the forecast period played a key role in the forecast error. Excessive borrowing across many sectors was fuelled by exceptionally low interest rates post the events of "September 11"; lax lending standards; piecemeal regulation; and financial product innovation. The extent and longevity of this boom did not seem to have been expected by industry experts. However, a track record of overly accommodative monetary policy from the mid-1990s and steady industry growth in 1997 and 1998 may have provided some clues that the general outlook was overly guarded. On balance, it is difficult to say, conclusively, that the modeller could have produced a better forecast for *CutStone*. Perhaps, if negative growth was seen to be too pessimistic, a zero growth forecast – at most – might have been worked into the model.

[65] http://www.answers.com/topic/cut-stone-and-stone-products, visited 11 September 2009.
[66] http://www.answers.com/topic/cut-stone-and-stone-products, visited 11 September 2009.

CONCLUDING REMARKS

Economic forecasting is a challenging pursuit. The likelihood of inaccurate predictions is magnified where underlying structural change is occurring. Therefore, it is important to consider the likely future structure of the economy when analysing the impact of potential policy changes. Where structural change is predicted in a baseline forecast the effects of policy changes can widely differ from a *status quo* assumption about the future structure of the economy. This paper examines methods aimed at improving baseline economic forecasts using a dynamic CGE model. Forecasting can be used to test the validity of such models, as well as to highlight possible improvements, by investigating the discrepancies between the forecast and actual outcomes. The model that is employed in this paper is USAGE – a recursive dynamic, 500-industry CGE model of the U.S. USAGE generates baseline forecasts by incorporating expert forecasts for certain macro variables and extrapolating historical trends in technology, consumer preferences, positions of foreign demand curves for U.S. products, and numerous other naturally exogenous variables. In instances where important trends either dissipate or reverse, large forecast errors can arise. This paper provides explanations and guidance as to whether these various trends from the period 1992 to 1998 would continue for the 1998 to 2005 USAGE forecast.

It is found that for some commodities, certain important trends should not have been expected to continue, and hence a better forecast could have been generated had all publicly available information at 31 December 1998 (the end of the base year of the forecast) been appropriately utilised. In examining the largest of the forecast errors, macro and industry-specific commentary is included. It is shown that a much-improved forecast for certain commodities would have arisen had specialist knowledge of industry trends and conditions been properly accounted for. This sometimes meant nullifying the projection of certain trends. This was the case for USAGE commodities: *AsbestosPrd, ComFishing, ElectronTube, Dolls, Theatres,* and *Recordmedia.* More generally, the findings suggest that there is a case to be argued against projecting forward large values relating to import-domestic preference twist factors in particular.

It is shown that for commodities in the trade-exposed textile, clothing and footwear industries moderately better results could have been produced by implementing import price forecasts in a way that is more in line with historical trade policy. This was achieved by projecting forward real basic import prices. There are 31 commodities in this space, and 8 of these featured among the 20 largest USAGE forecast errors. However, the key drivers behind these errors were usually the significant underestimation of the impact of import-domestic preference twist factors, as well as the overestimation of factor input cost savings. In most cases, a lack of convincing evidence (available by 1998) in this sector meant that additional error correction strategies might not have been implemented.

It is concluded that forecasts for commodities in the oil and mining sectors as well as companies that service these cyclical industries typically could not have been improved in the absence of strong convictions (in 1998) about an impending mining "super-cycle" or extended boom. These USAGE commodities are: *AccStrucSMD, PetNgExplor, PetNgDrill, Nonferrores, Copperore.* For the construction-related commodities, such as *CutStone*, demand was fuelled by virtually unprecedented low borrowing costs. In these instances, it is difficult to conclusively argue that the modeller could have produced a better forecast.

Furthermore, it is noted that where commodities have large import shares (e.g., *Dolls*, and *Luggage*), it is always going to be difficult to accurately forecast domestic output in the absence of specialised knowledge given that total supplies of domestic goods will move off a low base. In this instance, the model does a better job at predicting the commodity's absorption, i.e., all U.S. sales of the commodity irrespective of source.

Moreover, while large improvements in forecast accuracy can be obtained for some industries and sectors, the overall economy-wide forecast error does not fall greatly due to the sheer volume of commodities. While it is disappointing that the error is not very reducible, it is also reassuring because it implies that the default implementation of the model is quite powerful. In all the twenty worst errors on a relative and/or absolute basis (about 4% of all commodities) were specifically examined to assess the potential for error reduction. However, after due consideration about 7.5% of commodities were in some way directly re-projected. To generate a large reduction in the forecast error (and hence improvement in model performance) would require an extensive amount of work and probably necessitate the input of numerous industry specialists.

An important contribution to this paper was made by Marnie Griffith. This is available in the form of an appendix, which is in two parts. The first part discusses options for achieving more accurate sectoral-level forecasts with the USAGE model. This includes ideas such as analysing year-by-year trends rather than extrapolating the overall period; a discussion of 'future studies' methodologies; and an extensive list of sources of useful information, including organisations, people of expertise and publications. The second part of the appendix provides an examination as to whether the magnitude of China's rise could have been predicted. This concludes that to the extent that the USAGE forecasts incorporated the extrapolation of previous trends in world prices, this might have been best possible practice. The exception is for the TCF sector, for which a known blockage to trade (import quotas) was removed. However, in 1998 the extent to which this would occur by 2005 was unclear.

APPENDIX

Forecasting sectors with USAGE

The aim of this section is to explore options for achieving more accurate sectoral-level forecasts with the USAGE model. Although no one can predict the future with certainty, there is generally a long time between inception and widespread adoption of new tastes and technologies. This means that many of trends that will impact on the future are not unknown at the time of forecast.

In USAGE, these trends are mostly effected through the technology and preference variables which are treated as exogenous for forecast simulations:

- primary factor saving technical change in industry *j*;
- shift in industry *j* towards labour and away from capital;
- output-*i* augmenting technical change in industry *j*;
- input-*i* saving technical change in production, capital creation and margin use through the economy;
- household preference shift against commodity *i*;
- shifts in foreign demand for U.S. exports;
- foreign-currency import prices and tariffs;
- import/domestic preferences.

These might be loosely grouped as changes in technology; changes in taste; and changes in foreign demands and prices. In other cases, such as change in the law, forecast changes may need to be inserted directly into the model.

Thus the information needed for USAGE forecasts is very specific – changes in the parameters specified above, for each given industry, after accounting for other price and income factors.

Having surveyed the literature, albeit briefly, while there is a plethora of information, forecasts that apply directly to the specific USAGE industries and parameters are not readily available. The literature tends to include examples of research which is either too abstract or too specific to be of use. For example, in terms of modelling consumer tastes, Karni and Schmeidler (1998) formulate a game-theoretic model of how two groups of consumers choose between red, blue and white, while Truyts (2010) surveys the literature on how desire for social status affects consumption demand, and Conlisk (2003) explores how peoples' tastes evolve over time. At the other end of the spectrum, Ganiere *et al.* (2006) assess attitudes to genetically modified foods, while Kockelman and Zhao (2000) examine the swing towards SUVs as passenger cars.

In terms of forecasting technological change and diffusion through the economy, there are also many models and tools that could be drawn on. Daim *et al.* (2006) summarises and provides references for a number of techniques which can be used, ideally in combination, to forecast the growth in a particular technology, including patent analysis, bibliometrics, system dynamics, and growth curves. Again, while this might be useful in a big picture sense, much work would need to be done to translate this analysis into implications for forecasting with the USAGE model.

It may be possible to distil the vast amount of information available into implications for the USAGE parameters. More work to determine the drivers of trends on an industry-by-industry basis, and the implications of this for the USAGE parameters could certainly be done. However, it might be more efficient and accurate to use, for example, a Delphi approach (see below), and ask a panel of experts for their informed judgement on the exact information required.

Insightful forecasting of these parameters will require a deep understanding of the parameter in question, and the industry examined. For example, a forecast for the parameter *a3com* (for handbags) captures an annual percentage taste change towards (or against) handbags, after price (own and cross-prices) and incomes have already been accounted for.

Forecasting each parameter would be a very large-scale exercise. It could be minimised by:

- Reducing the number of industries by forming groups expected to behave in a similar way with respect to given parameters, e.g., all textiles.
- Performing a preliminary sensitivity analysis to identify which parameters are expected to have a big impact on results of interest.
- Rotate the parameter of interest, that is, one year estimates of taste changes for the next ten years; the next year, estimates of technology changes; and the last year, estimates of foreign conditions.

Historical estimates

A very useful first-step would be to analyse the historical series for these parameters. These could be generated by running a year-by-year historical simulation of the USAGE model over an extended period of time. This is a major exercise which has not yet been attempted. Such a historical series would allow us to assess whether, in the absence of expert forecasts or even in conjunction with expert forecasts, fitting a curve might allow for more reasonable forecasts than mere extrapolation based on average percentage changes. It would also help inform the expert panel on the nature of the exact parameter in question.

Future studies methodologies

Future studies is often summarized as being concerned with 'three P's and a W', or possible, probable, and preferable futures, plus wild cards – low probability but high impact events. Methods of forecasting the future include consensus, extrapolation, historical analogy and systems-based quantitative methods (Lang 1995). Delphi is perhaps the most prominent of the consensus based techniques. A USAGE forecast is an example of a systems-based quantitative forecast, incorporating consensus elements for the macroeconomic forecasts and extrapolation for the exogenous taste and technology parameters.

The Delphi technique was first developed at the RAND Corporation in the 1950s. It is a procedure for eliciting and refining opinion from a group of experts – scientific use of expert opinion. The assumption is that this prediction is more likely to be more accurate than one made by an individual. It is basically an iterative survey process, whereby the monitoring team interprets and reformulates the survey for the next round with the option to reconsider given other responses to date. Early applications emphasised achievement of consensus; in later applications, this has been downplayed, with diversity of opinion also seen as valuable (Landeta 2006).

A substantial methodology has been developed on choosing the expert panel and the monitoring team; structuring group communication so that respondents give honest and on-track opinions; and how to set about achieving a consensus from what might be at first a diverse set of opinions.

Delphi is now over 60 years old, but continues to be employed. Landeta (2006) concludes that the technique may become even more important in future as the acceleration in the speed of change and the increasing ability of humanity to determine its own future means techniques such as extrapolation or historical analogy may become less relevant. New Delphi techniques continue to be developed over time: Gordon and Pease (2006) present a real-time Delphi-based design, called RT Delphi, which makes use of computers, most often incorporating a web interface. There are no explicit "rounds", as in a traditional Delphi, and hence this procedure improves on the timeliness of the Delphi technique.

Criticisms of Delphi include that is overemphasises conformity so that extreme views are ignored; it is unscientific; it relies heavily on the quality of the monitoring team (who ideally are well-trained in the Delphi technique) and the expert panel; new questions cannot be raised if later found to be important; and the survey may exclude people of different cultural backgrounds.

There are many studies published, both theoretical and applied, on the Delphi technique, which would provide a firm foundation for the USITC to devise their own study, if this were to be considered (see for example, (Landeta 2006)).

Another commonly used methodology is emerging issues analysis (and related techniques environmental scanning and issues management, which differ mostly in the time frame of analysis and intent). Emerging issues analysis searches for the seeds of change, scanning the environment for early identification of issues which are likely to become high impact. Emerging issues analysis takes time and skill.

Sources

If the USITC wishes to conduct an emerging issues or similar analysis in-house, there are many potential sources of information to consult. There are also many lists of sources available (for example see the list at the end of Lang (1995) or visit http://www.jimpinto.com/hotlinks.html).

Organisations and people

RAND Corporation, http://www.rand.org/

SRI (formally Stanford Research Institute), http://www.sri.com/ and former business intelligence arm, http://www.strategicbusinessinsights.com/

The World Future Society, http://www.wfs.org/

Hawaii Research Centre for Future Studies, http://www.futures.hawaii.edu/index.php

John Naisbitt, an influential futurologist, http://www.naisbitt.com/

Jim Pinto, an industry expert in manufacturing, http://www.jimpinto.com/

Scholarly journals

Journal of Future Studies

Journal of Forecasting

International Journal of Forecasting

Technological Forecasting & Social Change

long range planning (International Journal of Strategic Planning)

foresight ***The journal of future studies, strategic thinking and policy***

Popular publications

New Scientist

The Economist

The New Yorker

Relationship between the macro and the sectoral forecasts

The USAGE forecasting approach uses macroeconomic forecasts from other agencies that specialise in generating these forecasts. Integrating sector-specific forecasts with external macro forecasts may present a problem because we don't always know what is behind those forecasts, and hence, we don't tailor sector forecasts to reflect the drivers of the macro trends. For instance, there may be a conflict between the macro forecast (directly inserted) and historical trends on technology and tastes that are being projected forward.

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Case study of a trend: China

China's growth over the period 1998-2005

Perhaps the biggest influence on the world economy between 1998 and 2005, and since, has been the ongoing rapid growth of China. Over the 1990s and 2000s, China's economy grew by at least 7.5 percent in real terms every year – in some years, by substantially more.

Trade has been growing substantially faster than GDP. China accounted for only about 1 percent of world exports in 1980; but 1.9 percent in 1990; 3.9 percent in 2000; and 8.9 percent in 2008. China is currently the world's biggest exporter and second-largest importer. Export growth during the years 1998-2005 represents an acceleration on previous years: while from 1992-1998, exports grew in nominal terms at an average of around 14 percent, during 1999-2005, they grew at an amazing average rate of almost 25 percent per annum (Feenstra and Wei 2009).

While the scope and speed of the growth in trade were not unprecedented (for example, the export-oriented growth of Japan and Korea decades earlier), the size of China means that is has been the dominating force of the world economy over this decade. The emergence of China has had a major impact on the U.S. economy. By 2005, the U.S. was China's most important export market, accounting for around 25 percent of Chinese exports; while China was the second-largest merchandise import source for the U.S. (Lum and Nanto 2007).

To what extent was China a driver for the fate of the U.S. manufacturing from 1998-2005?

This paper has focused on sectors of the U.S. economy for which either: (i) USAGE did a poor job of forecasting relative to actual growth; or (ii) USAGE did a poor job of forecasting relative to trend. To what extent were these sectoral outcomes a reflection of a failure to adequately incorporate the emergence of China into the forecasts?

Certainly, the explosion in exports from China was not the only factor in play in the decline of U.S. manufacturing between 1998-2005. The 2000 recession, though mild in general, hit manufacturing first, hardest and for longest (Mankiw 2003), driven as it was by a fall in business investment and exports (heavily linked to manufacturing) rather than consumer spending. By 2004, while the economy overall had recovered, manufacturing was still operating below its previous peak.

In addition, while the U.S.'s bilateral trade deficit with China increased rapidly over the forecast period, and has in fact been the U.S.'s largest bilateral trade deficit since 2000, China is not the only country the U.S. runs a trade deficit with. China's share of the U.S. trade deficit was not significantly higher in 2005 (26 percent) than it had been just preceding the forecast period (an average of 24 percent over 1996-98) (Lum and Nanto 2007). By 2009, however, despite a dip in the actual bilateral trade deficit, China's share of the total U.S. trade deficit had increased to 41 percent (Morrison 2010).

However, there is no doubting the impact of the emergence of China as a source of low-cost imports that U.S. (and indeed other) manufacturers were unable to compete with. Exports from China are cheap for a number of reasons: low labour costs; lower compliance/regulatory costs; an undervalued renminbi; and a number of other factors that confer advantage, for example, willingness to accept low margins, access to cheap capital, and tax breaks from government.

Impacts on U.S. manufacturers are moderated to the extent that increased imports from China have replaced imports from elsewhere: Rumbaugh and Blancher (2004) report that while imports of manufactures from China to the U.S. have increased substantially, this has been partially offset by fewer imports from other Asian countries – this is also reported in (Lum and Nanto 2007). However, in many industries, it is clear that manufactures from China not only displaced other imports but displaced American production.

They are also moderated to the extent that exports have increased. U.S. exports to China did increase, though not to the same extent as imports from China did. Also, if China was competing with the U.S. in third-country markets, that might have displaced U.S. exports – but this would depend on the type of goods produced over the period. It was anticipated that accession to the WTO would see China opening its markets to the U.S., as the U.S. and rest of the world were opening their markets to China. The story is highly sectoral. In particular, imports from China are dominated by labour-intensive consumer goods, while U.S. exports to China tend to be capital goods, industrial supplies and agricultural products (Lum and Nanto 2007; Mankiw 2003). Lum and Nanto (2007) report that two-thirds of China's exports to developed economies are 'low-end' manufactures, whereas three-quarters of its imports from developed economies are capital-intensive, technological or natural resource-related goods. There are however pockets of sophistication in China's exports to the U.S., particularly in office and electrical equipment.

In 1998, the highest value category of export from China to the U.S. was by far miscellaneous manufacturing, followed by footwear, then apparel and accessories, then telecommunications, and fifth, office and data processing equipment (Lum and Nanto 2007). Office and data processing machines grew approximately seven-fold, and telecommunications almost six-fold to become the largest category of export by 2005. Miscellaneous manufacturing and apparel and accessories exports approximately doubled in value to take third and fourth positions, while electrical machinery, parts and appliances increased three-fold to take the fifth spot.

Rumbaugh and Blancher (2004) note that China had already started to diversify by 2004, into such things as transport and equipment. This was expected to be more and more important in the future, though perhaps not so much during the forecast period.

What did we know about China in 1998?

It is easy in retrospect to say the world should have anticipated the explosion of China as the world's factory floor, but what did we know in 1998?

China had experienced rapid growth since 1978 when it embarked on economic reform. In the late 1990s, there were questions surrounding China's ability to maintain such strong real growth in the face of the massive structural adjustments that had to take place, including the peaceable absorption of excess labour. A noted China bull, Garnaut (1996) was positive on the continuation of growth in China, suggesting that various pressures capable of derailing it, such as inflationary episodes and the problem of managing the state-owned enterprises, were fading. He noted, however, risks surrounding law and the regulatory environment. Garnaut and Huang (1995) expected real GDP growth to continue at around 8.5 percent per annum, similar to growth since 1978.

It was widely acknowledged that China's growth was not only transforming China but also capable of transforming the rest of the world. As part of its economic reform agenda, China was attempting to join the WTO and open its economy to the world. In 1995, commentators were calling the accommodation of an internationally oriented China the greatest challenge facing the trading system over the next decade (Garnaut and Huang 1995). This was true for both developing and developed economies: Garnaut and Huang (1995) referred to North America as the area which felt most threatened by expansion of China's trade.

As China moved towards its comparative advantage in labour-intensive production, the biggest impacts on the world economy were to come through labour-intensive exports (Garnaut and Huang 1995), and the subsequent adjustment required by large industrial economies with labour-intensive import-competing industries. While it was considered, due to size and disparate growth across the country, that China would continue to provide labour-intensive manufactures for longer than other East Asian success stories, work in the mid to late-1990s was already foreshadowing a time when China's labour surplus was absorbed and the country would lose comparative advantage in labour-intensive manufacturing (Garnaut 1996; Yang and Zhong 1998). Garnaut (1996) argued even in that year, the coastal regions of China were 'graduating rapidly' from labour-intensive production, which was heading inland. However, the general conclusion was that, for China as a whole, labour shortages would not be a factor in the period 1998-2005. We return to this topic below.

At the same time, relative to its overall level of development, China was also ahead in capital-intensive manufacturing, a legacy of central planning and investment in human capital (Garnaut 1996).

In 1998, the textiles and clothing industry was a particular focus. Production and export of textiles and clothing are often associated with industrialisation. In keeping with this, China's textiles and clothing exports increased eight-fold between 1980 and 1994 (Yang and Zhong 1998). While they are heavily traded they are also traditionally heavily protected. Under the Agreement on Textiles and Clothing, quotas on imports were phased out over the period 1995-2005 in four phases. As a member of the WTO, China would receive the benefits of the quota lightening. However, in 1998, there were a number of doubts and uncertainties:

- Whether China would in fact be successful in acceding to the WTO.
- As the phasing out of the multi-fibre agreement (MFA) was heavily end-loaded, the bulk of the impacts might have been deferred until beyond 2005 (Yang and Zhong 1998).
- Importers had recourse to anti-dumping and other special provisions. Yang and Zhong (1998) noted that the removal of MFA might actually be bad for Chinese exports as special provisions applied to China alone whereas import quotas were broad-based.

Apart from textiles and clothing, accession to the WTO was expected to result in improved market access generally, as China was granted most-favoured nation status among WTO countries (Rumbaugh and Blancher 2004). This improved prospects for exports such as electronics.

Given the potential magnitude on the world economy, there was much research and debate in the mid to late-1990s about the implications of a more open China for world trade.

Walmsley and Hertel (2000) predict a big increase in Chinese imports into the U.S., mostly of textiles and clothing, and concentrated between 2000-05. Exports to China from the U.S. also increase but not as much as vice versa. They also predict a terms of trade decline of 3.8 percent for China. Walmsley and Hertel (2000) also includes a list of other studies.

Using a GTAP-based model, Yang and Zhong (1998) predicted growth in Chinese textiles exports of 4.0-5.8 percent per annum over 1992-2005 (depending on trade liberalisation), and in clothing exports of 5.5-12.5 percent. Rumbaugh and Blancher (2004) note that general equilibrium models such as *GTAP* and *G-cubed Asia Pacific* were used to predict the impact of China's accession to the WTO in the late 1990s. They suggest that these models might have underestimated impacts due to difficulties in estimating demand elasticities as the structure of world trade evolved rapidly.

Many commentators expressed doubt over whether China would be able to continue its rapid expansion of trade (Garnaut and Huang 1995). Garnaut and Huang (1995), relative optimists, predicted that China's share of imports and exports would increase rapidly, concentrated in narrow markets, with an upper limit of around 13 percent per year, the same as in the reform period to date. This prediction would have put China's exports at around 6.6 percent of world trade in 2010, less than the 8.9 percent actually estimated for 2008.

To summarise: the emergence of China and particularly its integration into the world economy were noted. There were doubts about whether GDP and export growth could continue as strongly as they had been. The focus was on labour-intensive goods, particularly textiles and clothing. The acceleration of growth and diversification into other areas were perhaps not anticipated.

What are the implications of this review for forecasting with the USAGE model? In this case, it seems there were few in 1998 who predicted the amazing acceleration of Chinese export growth – the bulls (like Garnaut) were predicting a continuation of past trends, with plenty of scope for downward outcomes. To the extent that the USAGE forecasts incorporated the extrapolation of previous trends in world prices, this might have been best possible practice. The exception is for the textiles and clothing industries, for which a known blockage to trade (import quotas) was removed. However, as noted above, in 1998 the extent to which this would occur by 2005 was unclear.

The next step for China

What lies ahead for China?

Many commentators are speculating that China is approaching a Lewis turning point (for example, Garnaut (2010)). The turning point is a concept developed by economist Arthur Lewis to describe the pattern of growth in a labour-surplus economy (Lewis was initially describing Jamaica in the 1950s). It describes the migration of labour from low marginal productivity rural areas to dynamic urban areas. At first, with a rural labour surplus, labour is attracted to urban areas at a low reserve wage with little cost to the rural sector. The urban sector can expand rapidly without increases in wages, encouraging investment and further productivity increases. The country enjoys a comparative advantage in labour-intensive exports. It may be the case, as in China, that the expansion of the urban sector is sufficient to absorb the rural surplus, at which point the country is deemed to have hit the turning point, at which point real wages rise, in both rural and urban areas, the real exchange rate appreciates and consumption starts to gain strength relative to investment. Comparative advantage in trade shifts out of labour-intensive and into capital-intensive goods,

particularly if supported by education, and an appropriate infrastructure and regulatory environment.

The implications for the U.S. of China hitting the Lewis turning point would be: halt to China-driven decline in world prices, though other countries may take up that mantle; increasing diversification of Chinese exports; possibly higher world interest rates as China's savings rate falls; and a rapid real appreciation in the renminbi.

Has China hit the Lewis turning point?

One point which complicates analysis in the case of China is the size and diversity of China. For (Garnaut 2010) this implies a turning period rather than a turning point. Another complication in discerning the advent of a turning point is the global financial crisis and Chinese government's response to this, which included a hefty stimulus program of infrastructure building in central and western China, drawing labour from eastern coastal cities and absorbing labour.

That said there is a reasonable amount of evidence that the structure of Chinese manufacturing is changing. Manufacturing wages have increased by 14 percent in 2009. This has lead several high-profile companies to publicly announce potential shifts to Vietnam or Bangladesh where labour costs are still very low (for example Coach handbags and clothing manufacturers).

In addition to increasing labour costs, land costs are also increasing, helped by the changes to property law of October 2007 which instituted minimum prices for land. Shipping costs are variable, but have been high at times, and may be a factor in the future viability of some industries in China.

The bottom section of Table A1 shows that China's top exports to the U.S. were electrical and machinery equipment ($72.9b), followed by power generation equipment ($62.4b). The sum of apparel, footwear and leather & travel was a distant third ($43.6b).

US-China Trade Statistics and China's World Trade Statistics

China's Trade with the United States ($ billion)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
US exports	16.3	19.2	22.1	28.4	34.7	41.8	55.2	65.2	71.5	69.6
% change	24.4	18.3	15.1	28.5	22.2	20.6	32.1	18.1	9.5	-2.6
US imports	100.0	102.3	125.2	152.4	196.7	243.5	287.8	321.5	337.8	296.4
% change	22.3	2.2	22.4	21.7	29.1	23.8	18.2	11.7	5.1	-12.3
Total	116.3	121.5	147.3	180.8	231.4	285.3	343	386.7	409.2	366.0
% change	22.6	21.4	21.2	22.8	28	23.3	20.2	12.7	5.8	-10.6
US balance	-83.7	-83.0	-103.1	-124.0	-162.0	-201.6	-232.5	-256.3	-266.3	-226.8

Notes: US exports reported on FOB basis; imports on a general customs value, CIF basis
Source: US International Trade Commission

Top US Exports to China 2009 ($ billion)

HS#	Commodity description	Volume	% change over 2008
85	Electrical machinery andand equipment	9.5	-16.8
12	Oil seeds and oleaginous fruits	9.3	26.5
84	Power generation equipment	8.4	-13.8
88	Air and spacecraft	5.3	4.5
39	Plastics and articles thereof	4.4	14.1
90	Optics and medical equipment	4.0	6.0
72, 73	Iron and steel	*3.5	*6.9
47	Pulp and paperboard	2.5	9.4
29	Organic chemicals	2.4	15.1
87	Vehicles, excluding railway	1.9	2.3

*Calculated by USCBC
Source: US International Trade Commission

Top US Imports from China 2009 ($ billion)

HS#	Commodity description	Volume	% change over 2008
85	Electrical machinery and equipment	72.9	-9.2
84	Power generation equipment	62.4	-4.2
61, 62	Apparel	*24.3	*1.5
95	Toys and games	23.2	-14.6
94	Furniture	16.0	-17.4
72, 73	Iron and steel	*8.0	*45.9
64	Footwear and parts thereof	13.3	-7.9
39	Plastics and articles thereof	8.0	-10.1
42	Leather and travel goods	6.0	-18.9
90	Optics and medical equipment	5.6	-9.4

*Calculated by USCBC
Source: US International Trade Commission

Table A1: U.S.-China Trade Statistics and China's World Trade Statistics, sourced from the U.S.-China Business Council (http://www.uschina.org/statistics/tradetable.html)

The future structure of Chinese industry

Will manufacturing collapse in China, fleeing to lower cost countries such as Bangladesh and Vietnam? Consensus is that this may indeed occur for low-value labour-intensive industries such as textiles, clothing and footwear. Heavy industry may also suffer as the Chinese government has recently removed tax breaks for heavy polluters.

However, low labour costs are not the only factor which has made China attractive as a manufacturing base. Jim Pinto, a manufacturing industry 'futurologist', notes that much of manufacturing is not labour-intensive. He points to the low margins that Chinese companies operate on as being an ongoing attractive feature. Other advantages include good infrastructure and clustering of industry which allows local acquisition of components (The Economist Intelligence Unit)

Deloitte (in a *Deloitte Review* article entitled "China: still manufacturing's shining star"[i]) provides a neat conceptualisation of manufacturing industry differences by dividing manufacturers into three groups (of course, there can be overlap between these categories):

> **Cost Cutters** — aim to lower production costs by locating in areas with abundant, low-cost production inputs (typically meaning lower labour costs, but also including lower-cost taxes, utilities, transportation or even enhanced government incentives).
>
> **Market Builders** — aim to establish in areas where they can effectively penetrate a new or growing base of customers, driven by convenient market access, logistics and customer demographics.
>
> **Talent Seekers** — aim to attract and retain specific pools of knowledgeable, creative, technologically advanced talent for R&D or advanced manufacturing and are attracted to destinations with renowned educational institutions, incumbent companies with similarly high talent requirements, and living conditions conducive to attracting highly qualified, educated and mobile talent.

They consider that China may indeed lose the "cost-cutters" as costs there increase; however is gaining in "market builders", due to China's rapidly growing middle-class and better infrastructure to the inland regions; and may eventually attract "talent seekers" as it is working hard to improve quantity and quality of education, though a threat is limited intellectual property protection. Thus, prospects for manufacturing remain strong, but structurally different to ten or even five years ago.

Experimental simulations with the USAGE model: Simulating over 1998-2005

Using actual 1998-2005 data

The basic conclusion from sections above is that, based on this evidence on predictions of future growth in China, the continuation of current trends already implicit in USAGE was perhaps the best we could do. Perhaps we should assess the extent to which our existing 1998-2005 forecasts reflected the China story. However, we could also try adjusting the forecasts to take into account actual trends through 1998-2005, and see if some of the sectoral forecasts improve.

Two things happened *vis-a-vis* China over 1998-2005: first, quotas on textiles and clothing were lifted, and second, average prices continued to decline. In terms of the USAGE model, we might

model the actual impact of China during the period 1998-2005 as a downward shift in the world price of manufactured goods, especially light manufactures such as textiles, apparel, footwear, toys and other miscellaneous manufacturing. We might also model the removal of import quotas as in the WTO schedule in the textiles and clothing industry.

While perhaps not as significant, we might also model the impact of China's growth on U.S. exports. This might entail a downward shift in the export demand curve for goods which the U.S. competes with China in third markets, but an increase in the export demand curves for other goods, such as agricultural and mining goods, plus capital-intensive manufactures, and services. (Rumbaugh and Blancher 2004) note that late 1990s models generally predicted a benefit from China's WTO accession to developed economies from increased capital-intensive and technological exports. Prices in particular for oil, copper and soy beans need to go up (Lum and Nanto 2007).

Over the period 1998-2005, it seems a typical price gap between U.S. and Chinese manufactured goods was considered to be around 40 percent, and growing: Amiti and Freund (2008) found China's export prices to the U.S. fell by an average of 1.5 percent per year over the period 1997-2005.

From 2010 onwards

More recently, the price gap between U.S. and Chinese manufactured goods might be shrinking, with rising labour costs perhaps the biggest driver. For example, one piece of research claims the average price gap over five types of parts has narrowed from 22 percent in 2005 to 5.5 percent in 2008.[ii]

At the same time, China is finding new areas of strength, and thus the pattern of price declines by sector is likely to be different than in the past. It might also be the case that the renminbi appreciates against the U.S. dollar substantially over the next few years. Hence, impacts of China on future U.S. forecast might be through different channels that was the case in over the previous 10 or so years.

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[i] http://www.deloitte.com/view/en_US/us/Insights/Browse-by-Content-Type/deloitte-review/index.htm

[ii] http://www.businessweek.com/magazine/content/09_24/b4135054963557.htm