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Are we there yet? Adjustment paths in response to Tariff shocks: a CGE Analysis.

Cedric Hodges and Tony Wiskich

This paper takes the mini USAGE model developed by Dixon and Rimmer (2005) and modifies it in order to better mimic the expected adjustment path following a tariff reduction. Results from the adjusted model are compared against the standard model. It is found that while the standard model does a good job of capturing the expected long-run behaviour of the economy in response to this shock, the adjustment path is not appropriate. However, with a few relatively straight forward changes, the standard model can produce both satisfactory long-run outcomes and a more plausible adjustment path. These changes are documented in an appendix and are considered applicable to a wide range of models currently in use.

Introduction

This paper uses a simplified CGE model of the United States (US) to explore the impact of different assumptions on the projected impact of tariff reform. CGE models have long been applied to assess possible impacts of changing tariff rates. However, like many real models with recursive dynamics there are questions over the projected impact of shocks on variables like employment.

The empirical evidence for the impact of tariff changes on aggregate employment is mixed. Meta-analysis undertaken by Cirera et al (2011) reports that in some cases tariffs increase employment and in others they reduce it. In contrast, they report a clear-cut result for CGE analysis which allows for variations in the level of aggregate employment in response to trade policy shocks: the reduction or removal of tariff barriers has a moderately positive effect on employment. This is due to an assumed positive link between real wages and employment (a wage curve) in the CGE models. Cicero et al. explain that the theoretical justification for the wage curve is either based on a collective bargaining model, in which the bargaining power of workers is inversely related to the unemployment rate, or on efficiency wage theory, which suggests that the reservation wage of workers depends inversely on the rate of unemployment, or on a standard microeconomic household labour-leisure choice model. They also explain that this closure is commonly associated with a short-run time horizon.

Cirera suggest that a way of reconciling the differing results between the CGE models and the empirical evidence is that they represent different time horizons: econometric short run and CGE long run. In this case, it is unclear how useful the CGE evidence is when considering adjustment costs in the short and medium run. Dee et al (OECD) use a CGE model and find consistent positive short run employment impacts of under trade liberalisation.

In practice, the rise in imports following a tariff reduction could be expected to displace domestic demand and thereby reduce domestic production and employment. In standard CGE models this cannot occur as the exchange rate adjusts lifting exports, and aggregate output increases as described above.

This paper takes the mini USAGE model developed by Dixon and Rimmer (2005) and modifies it following the approach outlined in TWL (forthcoming). Nominal variables are introduced; the exchange rate is determined via forward looking interest parity; employment is determined via a Philips-curve type relationship; a portion of consumption is based on current policy settings and a portion is recursive; the interest rate is determined by a central bank who follows a modified Taylor rule; and Armington elasticities are more rigid in the short run but shift over time as agents adjust.

The remainder of the paper is organised as follows: the next section (section 1) sets out the results from reducing tariffs in the standard model; section 2 describes how key modifications have been derived; section 3 outlines the impact of running the same scenario through the modified model, contrasting the differences; and section 4 concludes.

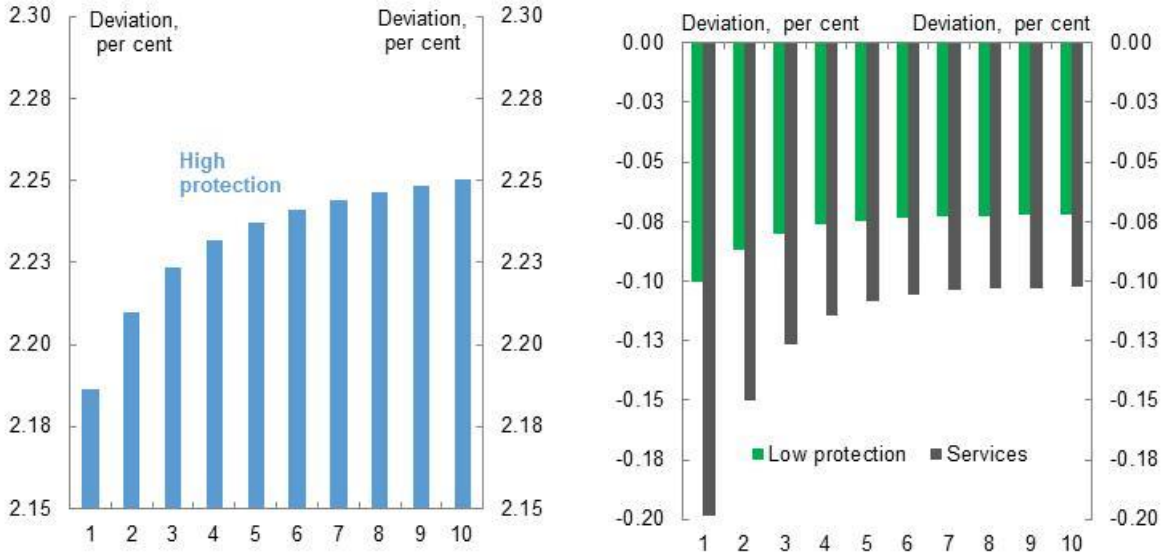
1. The standard model

The US Applied General Equilibrium (USAGE) model is a recursively dynamic CGE model of the US economy featuring around 500 industries. Mini-USAGE keeps the theoretical features of the traditional model and its macro level results are a good guide to those obtained from the traditional model but it is run with a highly aggregated database featuring only 2 regions (US and rest of world) and 5 sectors (high-protection and low-protection traded sectors, construction and services). This makes the model easier to understand, work with and a good vehicle for model development..

We shock the tariff rate of highly protected goods down by around 5 percentage points from close to 10 per cent in the baseline, to 5 per cent in the policy.

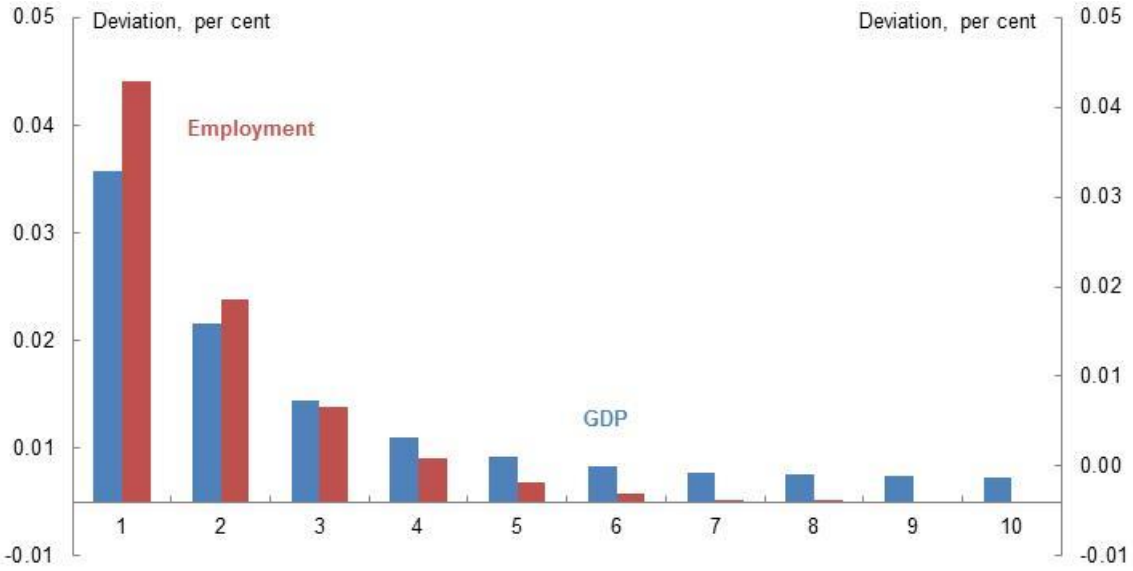
This encourages the import of goods from this sector as shown in the chart below. There is some offsetting decline in the import of other less protected goods and services.

Figure 1: Change in imports



In the long-run, the effect of reducing tariffs on output tends to be small in CGE models, and this model is no exception. Tariff reductions tend to lower economic distortions, leading to a small increase in productivity. However, in the short-run employment and output increase much more significantly, in line with other CGE models which link real wages and employment.

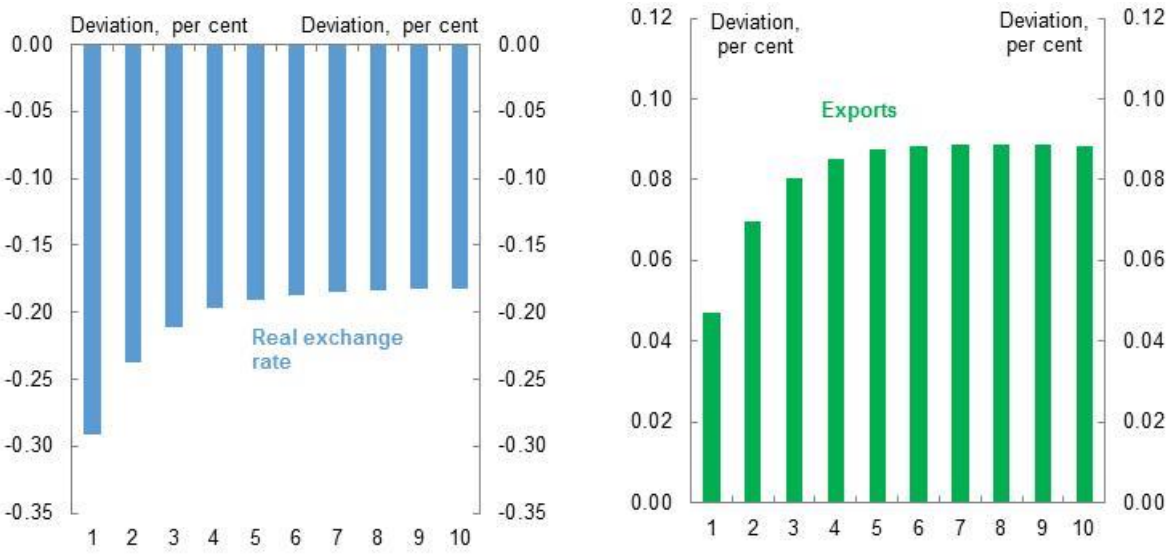
Figure 2: Changes in employment and GDP



Why is employment rising in the short run? The reduction in tariffs lowers the price of the highly protected good, lowering the CPI relative to the prices received by domestic factors of production, including labour. As the real wage rises, so does employment and output. The additional output is

absorbed in the export market, facilitated by a reduction in the real exchange rate, shown in figure 3 below.

Figure 3: Change in real exchange rate and exports



In most dynamic macroeconomic models, the exchange rate is determined by forward looking interest parity. In the standard model and most other CGE models, however, the real exchange rate is endogenous and ensures absorption of all US production. It depreciates in this scenario to boost net exports, absorbing the increase in production brought about by the employment boost.

As described in the introduction, these short run results are typical of CGE models but do not reflect the empirical evidence of the impact of tariff reductions, nor the dynamics of the exchange rate typically used in macroeconomic models. The next section of this paper will outline how the model has been adjusted to remedy this.

2. Modifications

This section describes the modifications made to mini USAGE. While there are a number of them, and some may seem complex, we believe they can be applied to most CGE models currently used.

Price level

CGE models do not generally consider the nominal economy. Instead movements are driven by changes in the relative prices. Indeed, this is the case in mini USAGE where the consumer price index is specified as the numeraire and other price changes are specified relative to this.

There are models which do consider nominal changes with a general equilibrium setting. One example is the small model of the New Zealand economy with inflation and monetary policy described by Szeto (2002). The multi–country, multi-sector G-Cubed model (McKibbin and Wilcoxen 1998) is another. Both of these models link nominal and real variables in the labour market, through wage growth and employment.

We depart from the standard model by making the price level (the consumer price index) endogenous. This allows us to link the nominal and real economy in the labour market through a Phillips-like curve (shown below).

$$\frac{\Delta w_t}{w_{ss}} = (Ei_t)e^{\left(\frac{0.5}{Ei_t}\right)\left(\left(\frac{0.5(L_t+L_{t-1})}{L_{ss}}\right)-1\right)} \quad (1)$$

In equation 1, $\frac{w_t}{w_{ss}}$ shows the ratio of the wage at time t, to the wage in the steady state. Expressed this way, deviations from the steady state level will be driven by changes in expected inflation (Ei_t), which are anchored at 2.5 per cent for simplicity, and departures from steady state hours worked (L_{ss}), where both current and lagged hours worked factor into the decision.

Interest rates, exchange rates and employment

Similar to standard macroeconomic models, the exchange rate is governed by forward looking interest parity (shown in equation two below).

$$\frac{e_t}{e_{t-1}} = \frac{1+0.5(R_t+R_{t-1})}{1+R_{ss}} \quad (2)$$

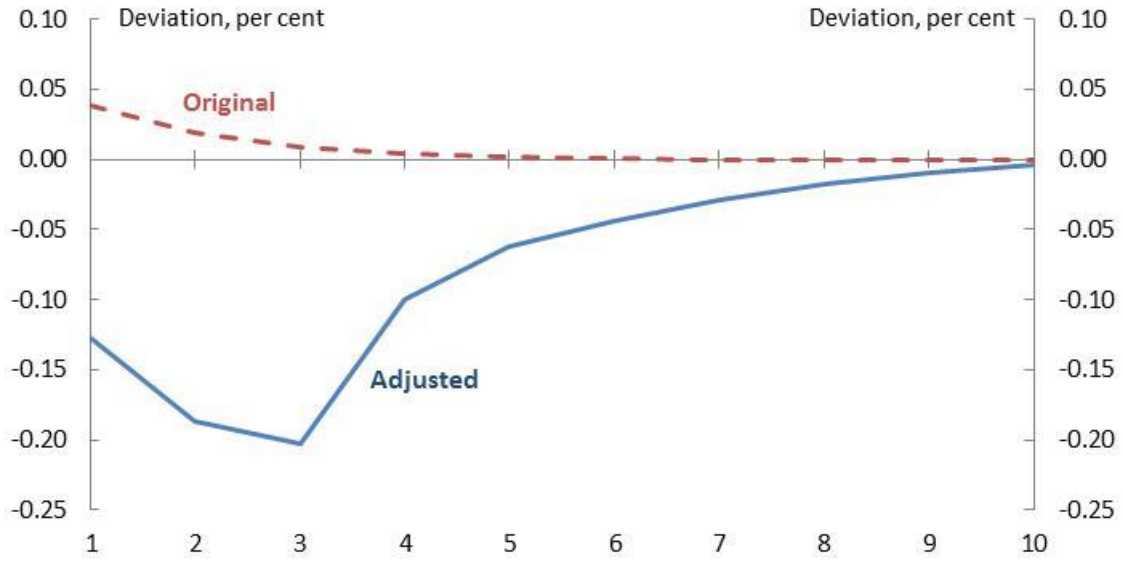
In equation two, the ratio of the current real exchange rate to its lagged value ($\frac{e_t}{e_{t-1}}$) is governed by departures of the real interest rate (and its lagged value) from the steady state level. In addition to this, we introduce a policy interest rate set via a Taylor rule which takes account of the output gap (measured via employment deviations) and price stability (measured by deviations in the CPI, shown in equation three, below).

$$R_t = 5 + 1.5(\pi_t - \pi_{ss}) + 0.5(L_t - L_{ss}) \quad (3)$$

As can be seen in equation three, the real interest rate is set by a Taylor rule in which deviations from steady state inflation and output (measured by employment) govern changes. There is a zero-lower-bound applied to this interest rate, but it is not relevant for the applications in this paper. For simplicity, we do not link this policy rate to investment or consumption equations. The only effect of the policy rate is in determining exchange rate dynamics.

Figure 4 compares the employment deviation from the original model and the altered model. As can be seen from this comparison, this new approach completely changes the profile of employment deviations. Rather than increasing in the first year, employment now decreases. Also interesting, the adjustment path is slower than in the original model and involves changes the speed of convergence.

Figure 4: Comparison of employment deviation



An appropriate time path for the exchange rate is calculated iteratively and shocked into the model so that interest parity and price stability are maintained while the output gap is gradually closed.

After comparison with empirical literature, we find that the framework strengthens as well as extends short run model dynamics, relative to assumptions often used in real CGE models.

Consumption

Consumption is modelled as a fixed share of income in mini USAGE, as it is in many models. This is fine when a shock is not expected to change peoples' average propensity to consume, or where changes in household consumption are unlikely to drive the end result. However, in this case, there is an issue with modelling consumption in this traditional framework. As the removal of a tariff makes imports cheaper, households, like firms, seek to take advantage of this. However, the exchange rate also depreciates in the standard model, somewhat neutralising the impact of removing tariffs. This is not the case in the adjusted model as the exchange rate is exogenous specified via interest parity. As such, without modification, the shock would lead to a large surge in consumption and a widening of the current account deficit. This is not an issue in and of itself in the short run but it would occur indefinitely if left unchecked, which is not realistic.

To fix this issue, the average propensity to consume is assumed to shift over time, in order the balance the deviation in the current account. Importantly, this does not mean that a country in the model cannot have a current account deficit but simply that shocks should not result in it permanently deviating from the steady state level it is assumed to have in the baseline. This is similar in spirit to the transversality assumption in G-Cubed that the stock of net foreign debt must equal the discounted sum of the trade balance (i.e. foreigners will only lend what a country can afford to repay via export income).

Time-varying elasticities

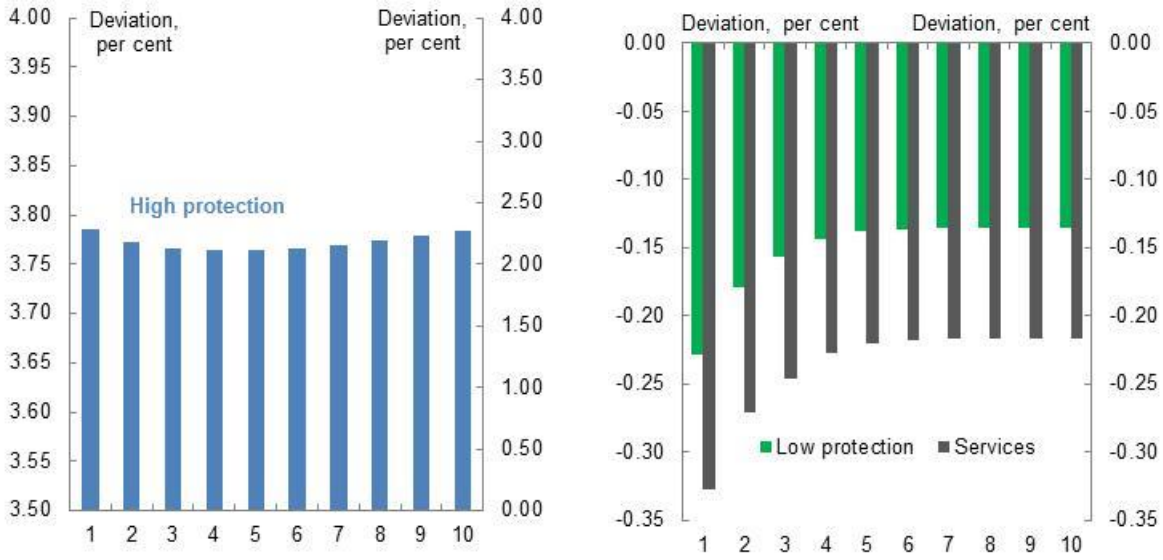
In addition to the changes listed above, we modify the model by allowing the elasticities to mimic the fact that it takes time for domestic firms to seek out export opportunities in response to any changes in the exchange rate. This will obviously have a significant impact given the expansion of exports was key drive of the output and employment response in the standard model.

The results of all these changes are presented in the next section.

3. Results from the modified model

As can be seen from the figure 5 below, the results from the adjusted model, in terms of imports at the sectoral level, have not changed much. This is good as there was little contention with the original model's result in this regard.

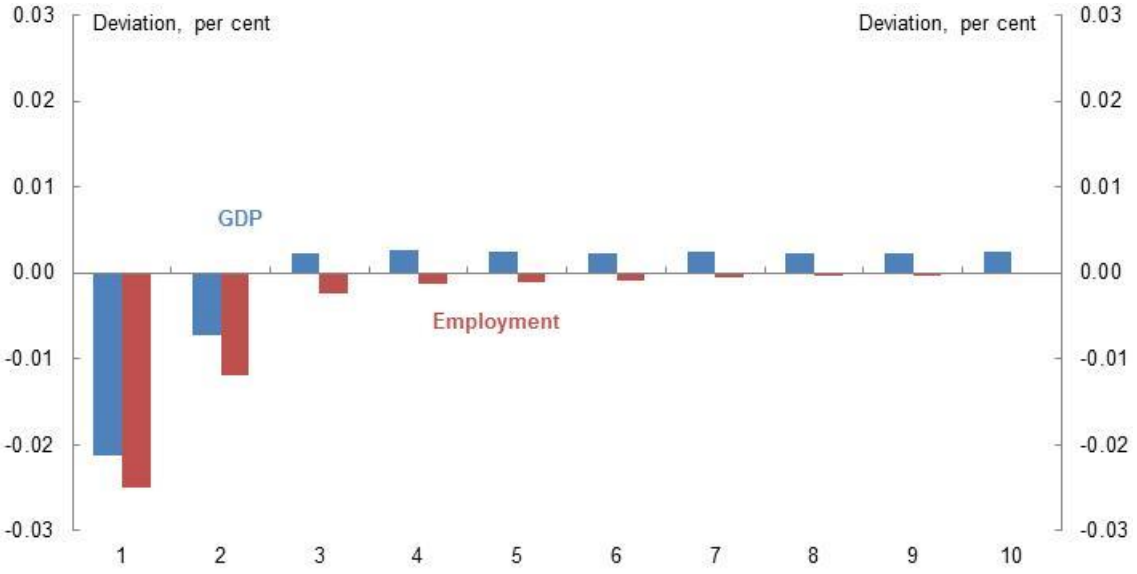
Figure 5: Change in imports – adjusted model



In the standard model, this shift in imports was accompanied by an expansion in GDP and employment. As shown in figure 6 below, this is not the case in the adjusted model.

A few things are immediately noticeable from this chart. The first is the sign of the response: the tariff cut results in output and employment losses initially. The second is the path, both GDP and employment remain lower in the second year and while GDP is permanently higher from year three onwards, employment takes some time to return to equilibrium.

Figure 6: Changes in employment and GDP –adjusted model



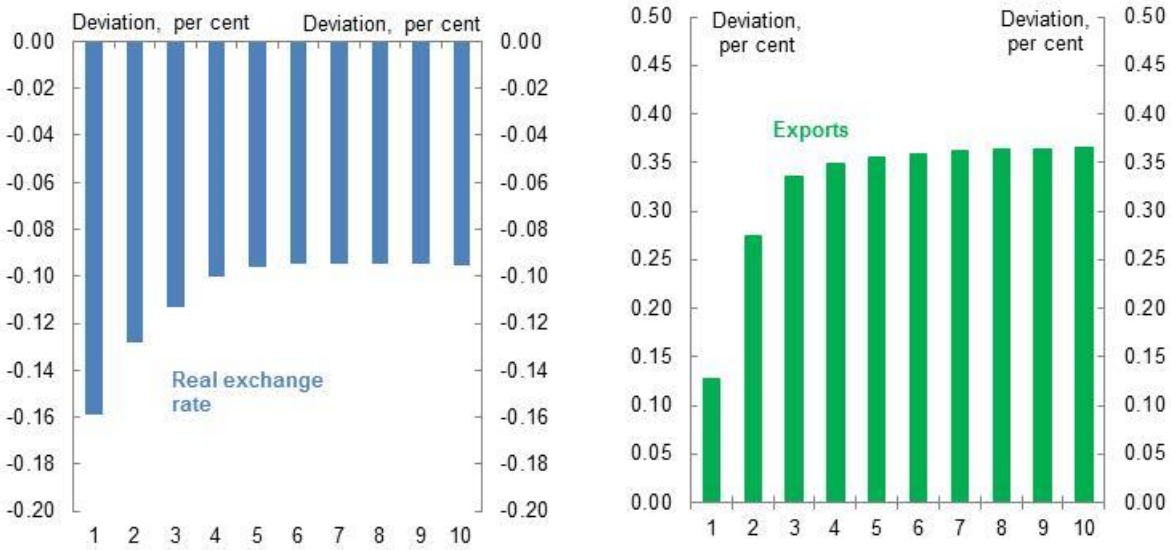
As was the case with the standard model, a driver of the GDP and employment deviations shown in the chart above is the change in the real exchange rate and exports. However, distinct from the original model, the adjustments made result in a more muted depreciation in the real exchange rate and corresponding expansion in imports. In fact, the initial depreciation in the real exchange rate seen in the adjusted model is nearly half that seen in the original model.

A back of the envelope calculation provides some insight into the fall in output. The tariff reduction reduces import prices by around 5%. The price of imports for households only falls by 2.5%, as imports of these goods require significant margin costs. Imports of highly protected goods rise by about 2%, and domestic production falls by 0.6%. Domestic production constitutes 2% of domestic production, so a 0.6% fall would imply a fall in output of 0.012%. Output falls a bit more than this rough estimate – by 0.02%. <this could do with some more work, I'm just trying to explain the magnitude of the change in output from the demand side>

The reason for the difference is that the real exchange rate is now set via forward looking interest parity. Additional to this, interest rates are set via a Taylor rule which takes account of the output gap and changes in expected inflation. A change in tariffs will naturally affect these variables but this would be of no consequence in the standard model. It is in the adjusted model.

As shown in figure 7 below, there is still depreciation in the real exchange rate and an expansion of exports. Importantly, the sign of the deviation in these two variables produced by the standard model was never in question. Rather, the magnitude seemed implausible, especially considered in the context of what was predicted by various macro-models.

Figure 3: Change in real exchange rate and exports – adjusted model



4. Conclusion

There is little contention that tariff reform has been a positive for the Australian macroeconomy. CGE modelling has been a valuable tool in elucidating this point. However, there has been and remains apprehension over the adjustment path, especially the effects on employment in the short to medium run. While macro-models have made considerable progress on this issue they are usually run at a much higher sectoral aggregation than CGE models and generally not as well suited to 'what if' type scenario analysis. With the relatively straight forward changes described here, we believe that many of the CGE models in current use could better capture the dynamic adjustment association with tariff reform as well as a host of other policy changes (such as changes in fiscal policy).

5. References

Dixon, P.B. and Rimmer, M.T., 2005, June, 'Mini-USAGE: Reducing Barriers to Entry in Dynamic CGE Modelling', *8th Annual Conference on Global Economic Analysis*, Lübeck, Germany.

McKibbin, W. J., & Wilcoxen, P. J., 1999, 'The theoretical and empirical structure of the G-Cubed model', *Economic modelling*, Vol: 16:1, pp. 123-148.

Szeto, K. L., 2002, 'A Dynamic Computable General Equilibrium (CGE) Model of the New Zealand Economy', *New Zealand Treasury Working Paper*, No. 02:07.