7 PAA-IEC Model Extension: Introduction of the Duty Free Allowance Imports and Price Effect on Exports

7.1 Duty Free Allowance

In the initial model, industry rebatable imports, exports and domestic market of vehicles were postulated as the key determinants of domestic production potential. However, another exogenous dispensation, the Duty Free Allowance (DFA), has an effect on automotive industry imports that is almost equivalent to the PAA-IEC rebatable imports. The DFA dispensation allows domestic vehicle manufacturers to import automotive components free of duty to the value equal to 27% of their domestic wholesale value of vehicles sales. Its purpose is to reduce the duty cost related to components for which local manufacturing is not economically feasible. In essence, DFA generated imports adds to industry imports into the country on which no duties are payable. The 'non-paying' duty imports, as previously explained, have a bearing on firms' local production decisions and eventually on domestic investment.

To incorporate the effect of the DFA dispensation, two variables were introduced in the model - duty free allowance (a percentage) and the duty free imports. The value of duty free imports was then captured as a function of the DFA and domestic market for vehicles; the latter variable was already part of the model. Because of the similar effect of duty free imports and rebatable imports on the domestic production potential, the industry rebatable imports variable was replaced with *industry rebatable imports and duty free imports*. The *industry rebatable imports and duty free imports variable* was a summation of rebatable imports generated under the PAA and IEC incentive dispensations and the duty free imports generated by the DFA. Hence, the new postulate was that production potential factor was a function of the industry rebatable imports, duty free imports, exports and domestic market (Figure 34). It should be noted that model calculation of DFA imports could potentially overestimate the value of such imports as domestic sales of locally produced vehicles was a proportion of the domestic market. For the purpose of the reference mode simulation this proportion was taken to be 0.75, from the annual average local vehicle sales as a percentage of local market for the period 1995 to 2006 (NAACAM, 2006)

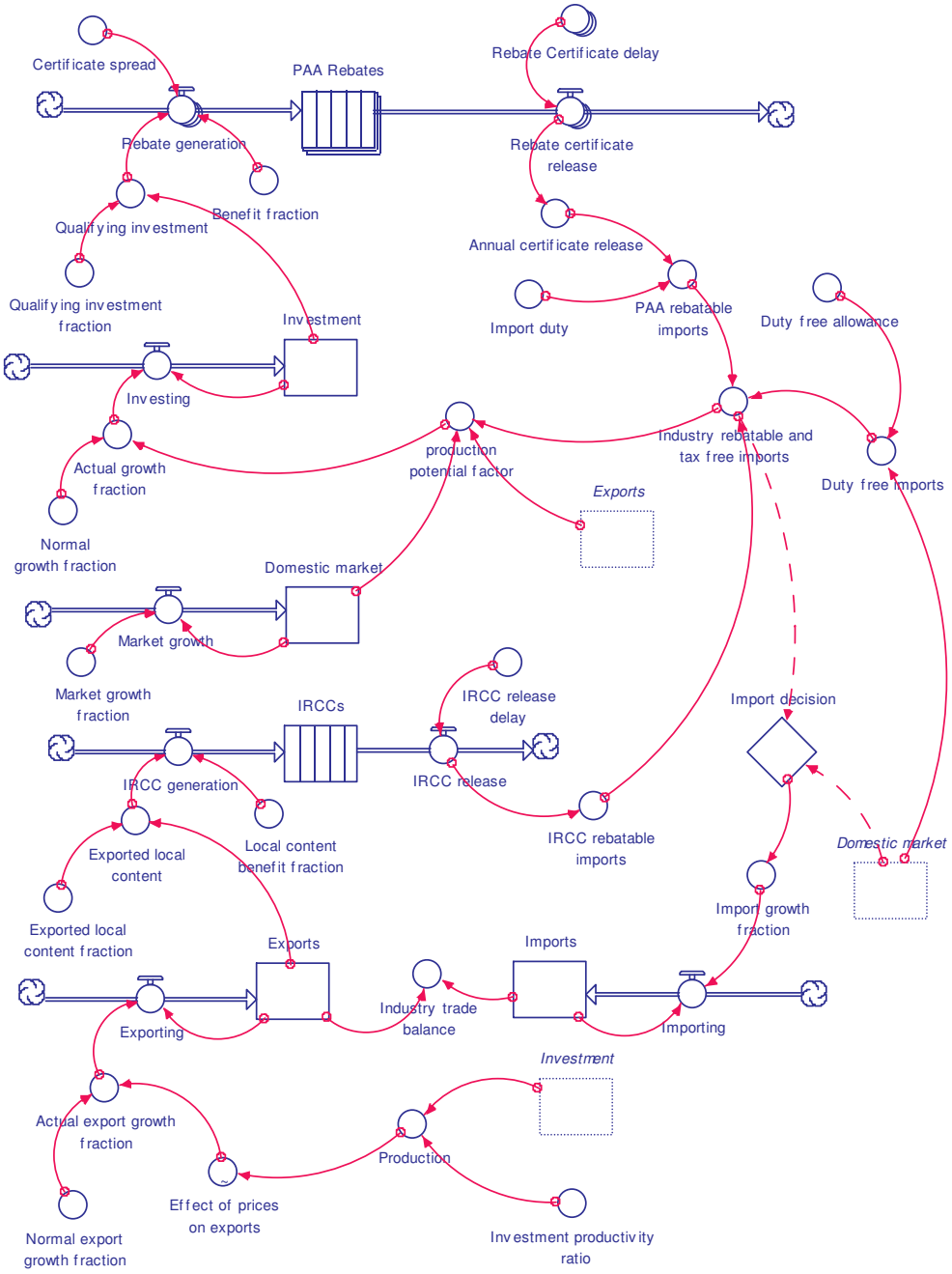

Figure 34: PAA-IEC-DFA Model Structure

7.1.1 Effect of vehicle prices on industry exports

The treatment of the IEC as an exogenous structure to the model had been motivated by initial focus to model, exclusively, the effect of the PAA on industry performance dynamics. The IEC had been introduced in the model only because the incentive augmented the stock of rebatable imports. The PAA model was underestimating the value of rebatable imports. As such, the IEC model structure was important to the research question to the extent that it contributed to the stock of rebatable imports. Again, although there was a theoretical case that increase in production volumes could lower vehicle prices, via the realisation of economies of scale, and the lower vehicle prices could in turn stimulate exports, this had been deemed unrealistic for the South African case. Export of vehicles from South Africa depended, largely, on award of export contracts to South African subsidiaries by their parent companies. Although price was an important factor in the decision to award export contracts, after the award of contract, the price elasticity of demand for exports was constrained by this parent company arrangement until the time to reconsider such contracts.

Nonetheless, the production-price-export loop was theoretically important in the endogenous integrating of the IEC with the PAA model, and in capturing the feedback effect of investment on exports. To capture the price effect on exports emanating from increased production, three variables were introduced in the model – *production*, *investment productivity ratio* and *effect of prices on exports*. Production was specified as a function of investment and investment productivity ratio. The investment productivity ratio was calculated from investment and production historical data for the period 1995 to 2006 (Appendix 6). The effect of prices on exports growth was in turn captured as a graphical function of production, with an underlying assumption that the higher the production levels, the lower was unit price and the higher was exports (Figure 34). It is important to note that the parameter "effect of prices on export growth" was not synonymous to well-known "price elasticity of demand" in this case.

7.2 Extended Models Simulations

7.2.1 Replication of the Reference mode

After the extension of the model to include the DFA and to capture the feedback effect of the PAA dispensation to the IEC model structure via the investment-production-price effect on exports, simulations were carried out to find out how the extended model results compared with the initial model. This was done with a view to establish whether there were significant differences in results to warrant a change of policy conclusions initially noted.

The first simulation was to test the extent to which the new model replicated the study reference mode. The specification that vehicle prices gradually declined with increase in production as presupposed in the economies of scale concept produced reference mode behaviour comparable to that of the initial model (Figure 35). In both cases, industry deficit peaked at some R39 billion before starting to decline. However, the rate of decline was slower in the extended model that included DFA imports. This could be understood in the context of DFA imports upward pressure on industry imports in general.

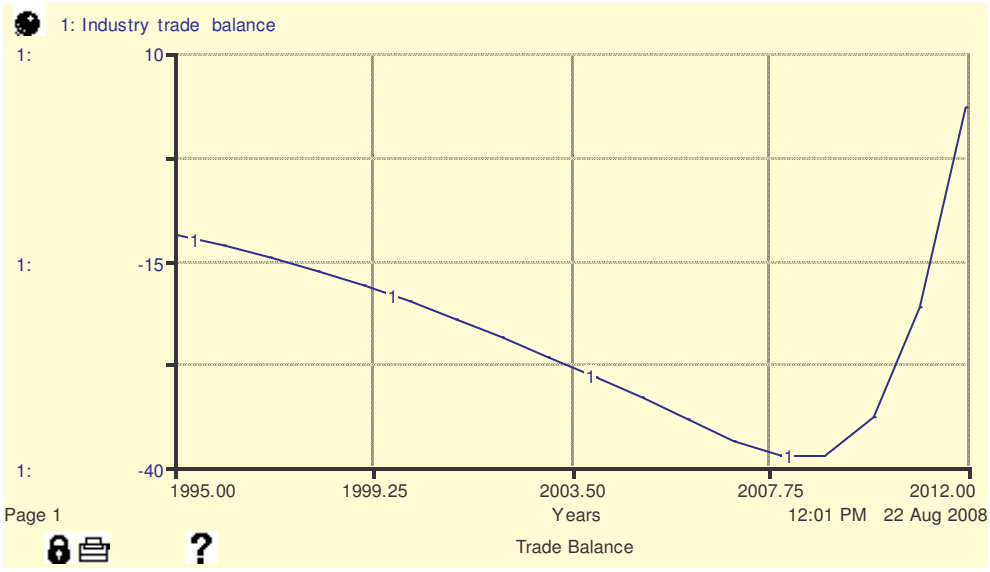

Figure 35: Extended Model Reference Mode

Simulations were then carried out to test the effect of change in the PAA benefit fraction and change in import duty rates on the trade balance trend. In both cases, simulations results showed that a change in these two PAA policy levers had minimum effect on the

industry trade balance trend (Figure 36 and Figure 37), the same conclusions as had been reached with the initial model.

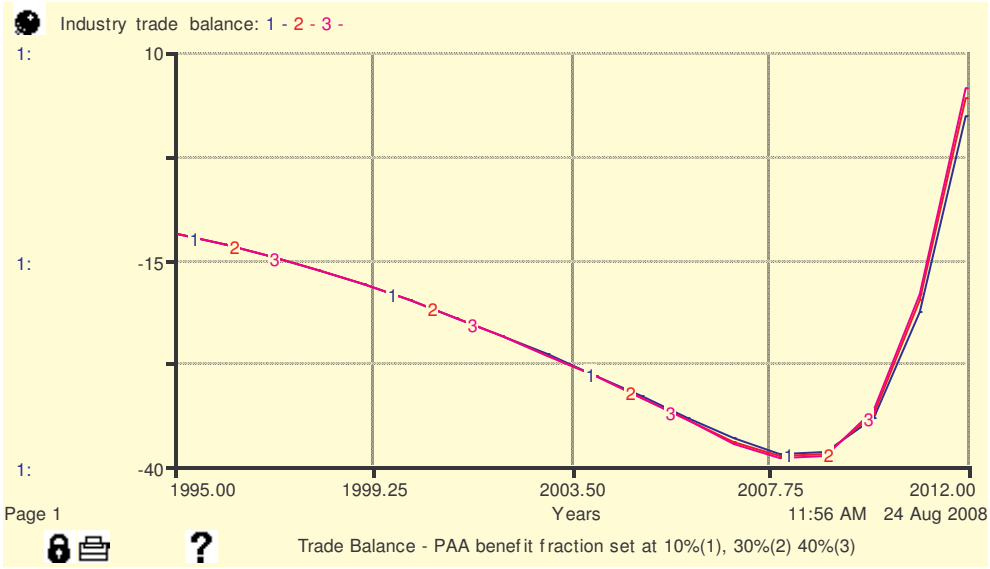

Figure 36: Effect of PAA Benefit Fraction on Industry Trade Balance

Specific to the effect of import duty rate, it was noticeable that the small effect that a reduction in import duty rate had on the industry trade balance trend had declined further after the introduction of DFA imports in the model (Figure 37).

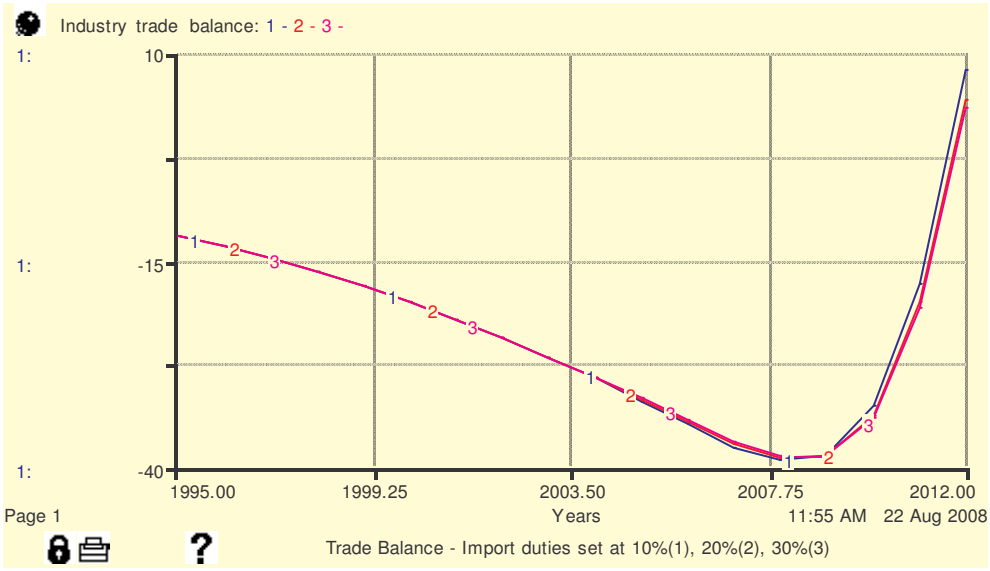

Figure 37: Effect of Import Duty Rates on Industry Trade Balance

Similarly, the effect of changes in the IEC's exported local content benefit fraction on industry trade balance in the extended model was compared to initial model results. After accounting for the increased impact of the combined rebatable imports and DFA enabled imports on the import decision, simulation results were comparable to that of the initial model. A reduction in the exported local content benefit fraction could effectively mitigate against increasing industry deficit trend (Figure 38).

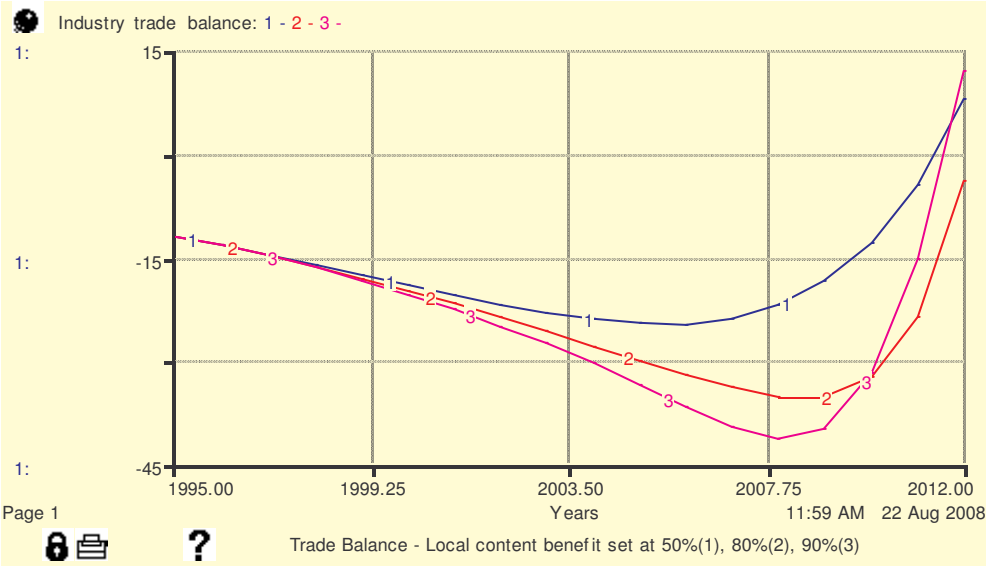

Figure 38: Effect of Exported Local Content Benefit Fraction on Industry Trade Balance

7.3 Synthesis

The effect of the DFA dispensation on the initial model performance was important to the extent that a summation of rebatable imports and duty free imports affected import growth. After accounting for the increased impact of the 'non-paying' duty imports on the local production potential, the extended model simulations results were, largely, similar to the initial model that had excluded the DFA dispensation. The introduction of production and price variables in the model, on the other hand, provided a means of capturing the economic concept of economies of scale and for capturing the feedback effect of investment on exports, linking the PAA model structure to the IEC. The assumption that increase in production results into lower vehicle prices which in turn has a bearing on

export growth rate produced coherent results in terms of replication of the study reference mode, but the responsiveness in unit prices to production increase was low.

In all, the model extension did not warrant a change in policy conclusions that had been drawn from the initial model. It should be emphasised that this was the case because the effect of the introduced variables was specified as being minimal to overall industry performance dynamics and the other new variable (DFA imports) only augmented an already existing variable (industry rebatable imports), the effect of which had already been captured. Otherwise simulations of the extended model may be different to that of the initial model. For example, it was noted that a high effect of price reduction on export growth emanating from increased production would lessen the deterioration of trade deficit relative to the reference mode run (Appendix 7).

8 Policy insights

This chapter presents policy insights from the PAA-IEC model simulations. Section one and two discuss insights on policy decisions relating to the PAA and the IEC dispensation respectively. In the last section, time-bound constraints and the substitutability of the PAA with the IEC is explored.

8.1 Policy decisions on the PAA

Implicit to any policy model is a policy variable or a set of variables that can be adjusted in order to influence intended outcomes. In complex systems, with more than one policy variable, system dynamics modelling provides a useful means of identifying high leverage policy variables through estimating variable effect on the situation being modelled. Under the PAA dispensation, there are only two policy variables – the PAA benefit fraction and the import duty. These are the policy variables under direct government control. The delay in the issue of the PAA could be considered as another policy tool, but over time the value of annual certificates to be issued becomes dependent on the previous investment which government cannot control after the approval. As such, policy decisions on the PAA relate fundamentally to adjusting the PAA benefit fraction and/or industry import duties in order to influence the value of rebatable imports generated per specific investment. The immediate product of the PAA and the conduit of the incentive effect to industry dynamics is the value of rebatable imports generated under the dispensation. In order to influence industry performance via the PAA, government policy makers need to have an insight into the effectiveness of each of these two policy levers in determining industry performance. The PAA-IEC model provides a useful tool in this regard. It can be used to estimate the value of the PAA certificates that would be issued in a specific period given a particular investment trend. But most importantly, it can reveal which policy variable is effective in influencing a particular behavioural aspect of the model under scrutiny. In this study, the main variables of interest were industry competitiveness and industry trade balance. However, having established in Chapter 4 that the PAA had little direct effect on industry competitiveness by way of supporting R&D and innovation, subsequent analysis was limited to understanding how the changes in PAA policy variables affect the automotive

industry trade balance. First, the model was used to answer the seemingly obvious question whether the PAA rebatable imports were sensitive to the incentive benefit fraction and import duties. Thereafter, the model was used to answer the question which of the two policy levers is more effective in influencing PAA rebatable imports and subsequently the industry trade balance.

8.1.1 Effect of PAA benefit fraction on PAA rebatable imports

A test on PAA rebatable import sensitivity to the PAA investment benefit fraction set at 20%, 30% and 40% was done. The 20% was the prescribed benefit fraction and the intention of the sensitivity tests was to find out how increasing the benefit fraction would affect the value of rebatable imports. Model simulations showed that the increase in PAA rebatable imports was proportional to the increase in investment benefit fraction (Figure 39). Given a specific value of PAA qualifying investment, one could double the value of PAA rebatable imports by simply doubling the PAA benefit fraction. The value of the rebatable imports relative to total industry rebatable imports remained insignificant even at a 40% benefit fraction. For example, the value of industry rebatable imports in 2008 was projected to stand at R49.7 billion while that of the PAA rebatable imports predicted in the same year was a mere R 3.1 billion.

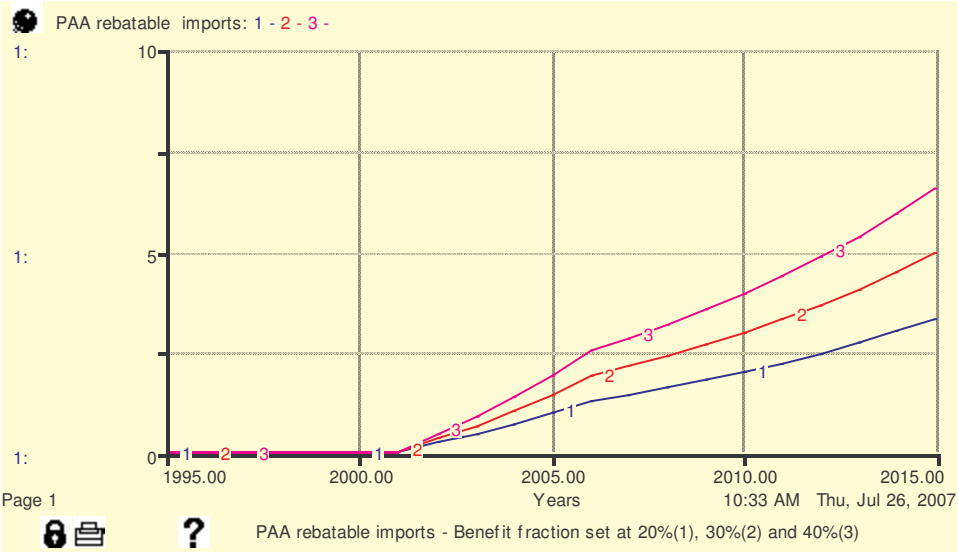

Figure 39: Effect of PAA benefit fraction on PAA rebatable imports

It was acknowledged that this form of linear relationship was uncommon in system dynamics modelling and could only apply when one was still considering the model in piece-wise, before accounting for time and feedback effects. This did not mean, however, that the simulations did not provide useful information. These simulation results provided the building blocks on which model complexity was built.

8.1.2 Effect of change of import duty on PAA rebatable imports

The expectation was that PAA rebatable imports would be highly sensitive to import duty rates. Given a particular value of PAA rebate certificates, the value of PAA rebatable imports increases with the lowering of import duties – PAA rebate certificate value being the value of duty one can offset on imports. As an example, if industry was awarded R10 million worth of PAA rebate certificates, at an import duty rate of 20%, industry would offset duty on imports to the value of R50 million, but if the import duty rate was lowered to 10%, the value of imports on which duty could be offset would increase to R100 million. Figure 40 shows the sensitivity of PAA rebatable imports to import duty rates set at 10%, 20% and 30%. The increase in the value of rebatable imports at 10% import duty rate was more than threefold compared to when import duty rate was set at 30%. The non-linearity of the duty rate effect on PAA rebatable imports emanated from the hyperbolic relationship between PAA rebatable imports and import duty on one hand, and from import duty effect on overall industry rebatable imports that in turn affected domestic investment and hence the generation of PAA rebate certificates on the other. The import duty rate, together with the new value of PAA certificates generated, would then ultimately determine the value of rebatable imports.

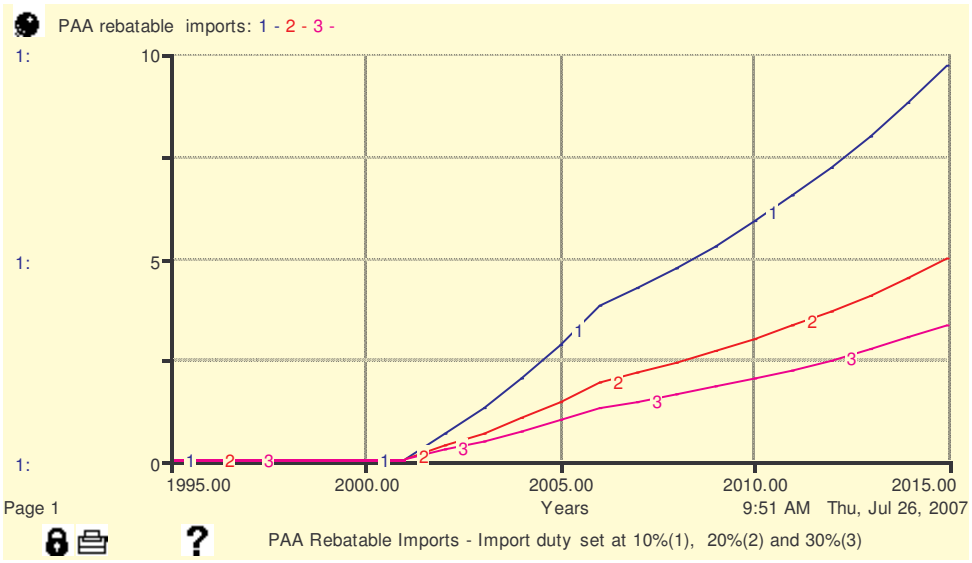

Figure 40: Effect of import duties on PAA rebatable imports

From Figures 39 and 40 it was clear that a change in import duty rate provided a more effective policy lever to influence PAA rebatable imports. Still, compared to overall total industry rebatable imports, the increase of PAA rebatable imports due to a change in import duty rates remained insignificant.

8.1.3 Effect of change of PAA benefit fraction on industry trade balance

The aim of the study was to establish whether and how MIDP incentives influenced overall industry performance trends, specifically the industry trade balance. As such, the effect of change in PAA policy variables on industry trade balance was considered next. Model simulations showed that the effect of such a change on industry trade balance was marginal. Figure 41 shows how industry trade balance trends change with a change in PAA benefit fraction from 20% to 30% and to 40%.

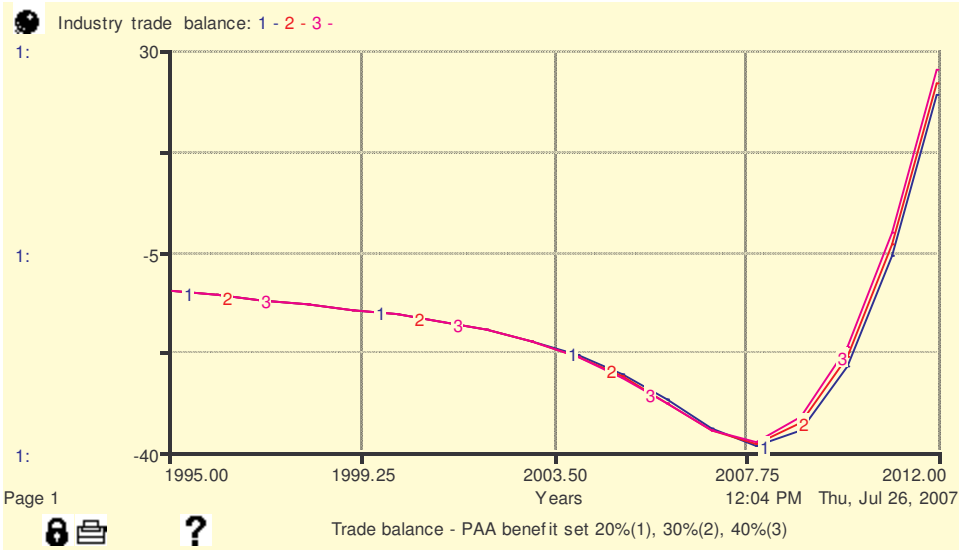

Figure 41: Effect of PAA benefit fraction on industry trade balance

Although a change in PAA benefit fraction did have a noticeable effect on PAA rebatable imports, its effect on the industry trade balance was minimal. This could be attributed to the relatively low value of PAA rebate certificates compared to the overall industry import value. As such, industry benefit from the PAA dispensation could be adjusted without affecting industry trade balance.

8.1.4 Effect of import duty on industry trade balance

Next, a test was done on the effect of change in import duty rate on industry trade balance, as the second PAA policy variable. Model simulations showed that at an import duty of 20% and 30%, the impact of import duty on industry trade was almost synonymous to that of a change in the PAA benefit fraction. The change in the industry trade balance remained minimal. However, as the import duty was lowered further, excessive increase in industry trade deficit was impeded. At import duty of 10%, it was notable that industry trade deficit did not reach levels projected when import duty was at 30%, before it started to improve (Figure 42). Hence, import duty adjustment could be used to influence industry trade balance under the PAA dispensation, but for the duty to have a visible effect, it would have to be reduced to very low rates, a situation which may be almost unrealistic and could yield other industry dynamics outside the scope of this analysis.

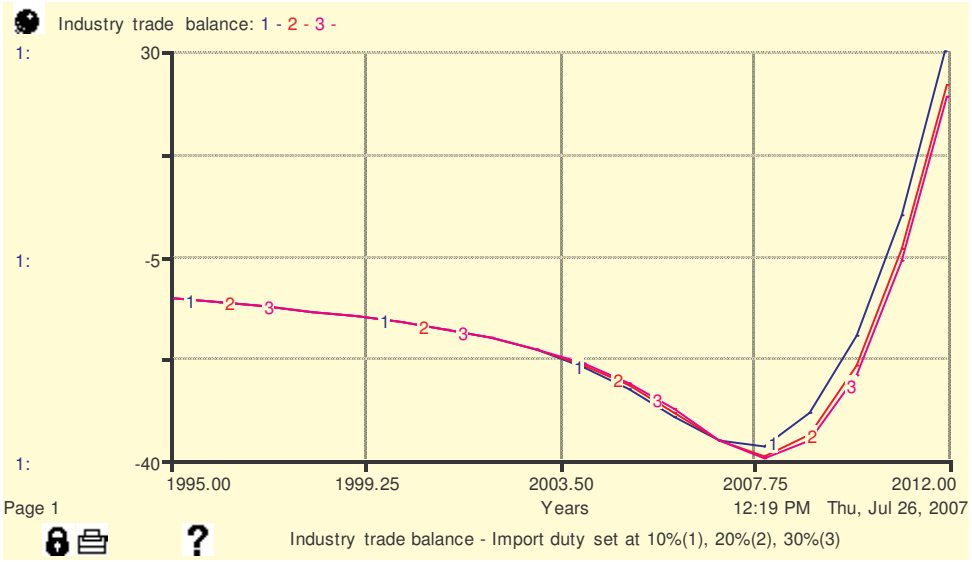

Figure 42: Effects of import duties on industry trade balance

There is another dimension to the import duty reduction that needs to be acknowledged. With the location disadvantage and relatively low production volumes of vehicles in South Africa, the country is a high-cost producer relative to its global competitors in Europe, Asia and Latin America. MIDP incentives make it profitable for local OEMs to produce domestically as long as the domestic market is still protected from cheaper foreign imports. At very low levels of import duties, local OEMs may find it profitable just to import from other low-cost production locations, given that all locally produced models are also assembled in other international locations. The resultant effect will be that the import growth fraction will be higher than the estimated 12% used in the reference mode run. If the domestic market and export growth rates were to remain unchanged, increase in industry imports will result into lower production levels being planned for domestic production and subsequently lower investment growth rates. Hypothetically, if the import duty rate threshold at which industry switches to import rather than domestic production was uniform and immediate at 18% duty level, industry trade deficit would increase to higher levels than captured in Figure 42 before it starts to improve at any import duty rate less than 18% (Figure 43).

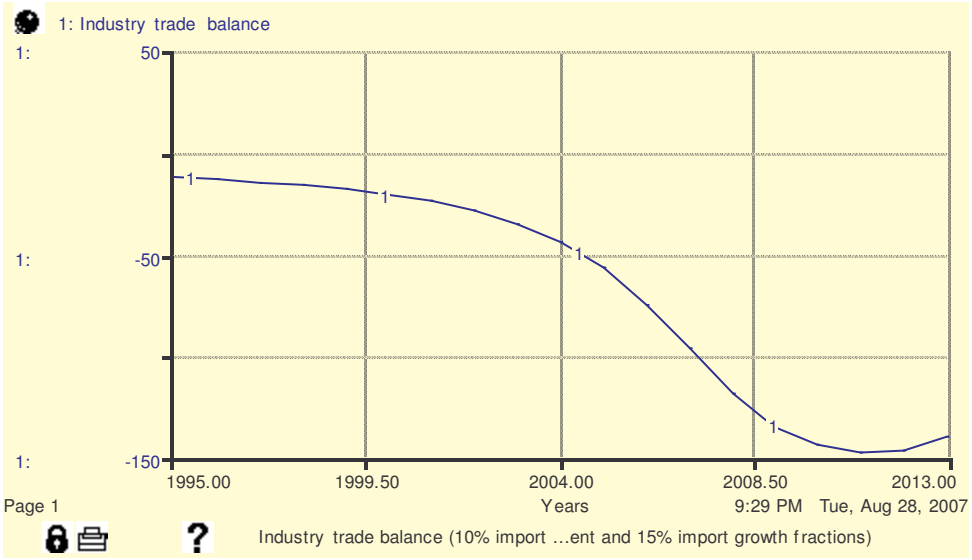

Figure 43: Industry trade balance at 10% duty rate with increased import and decreased export rates

Since the drastic deterioration of industry trade balance as simulated in Figure 43 above has not happened, it can be said with certainty that the 30% duty rate is above a threshold rate at which industry switches to import more than produce. Unfortunately, the exact 'import-switching' duty rate cannot be determined with the available information. Moreover, the rate will be influenced by a number of factors, which could differ for each business case of OEM or OE component manufacturer project. Practically, a more gradual decline in domestic production is likely as an increasing number of projects become globally uncompetitive. The most likely trend of industry balance if the import duties were to be reduced below 30% duty rate would depend on whether the import duty considered is below or above such 'switching' thresholds for projects. If the duty rate is above the threshold, trade balance trends shown in Figure 42 would be more likely, otherwise the Figure 43 trend would apply.

In the nutshell, under the PAA dispensation, policy makers did not have high leverage policy levers to influence industry trade balance. The policy levers at their disposal were, however, effective in benefiting the industry in terms of PAA rebatable imports, particularly in respect of the import duty rate.

8.2 Policy decisions on the Import-Export Complementation

Under the IEC dispensation, policy makers have one effective policy lever under their control – exported local content benefit fraction. It was acknowledged, however, that policy makers could indirectly influence the value of exported local content by use of other policy interventions, but such undertakings lay outside the study scope. Again, the change in the value of exported local content would have essentially had the same dynamic effect on industry performance as a change in exported local content benefit fraction. Hence, only change in exported local content benefit fraction was considered in the analysis.

8.2.1 Effect of the exported local content benefit fraction on industry trade balance

Note should be taken that setting the exported local content benefit fraction at 0% was equivalent to complete neutralisation of the incentive, while setting the benefit fraction at 100%, gave maximum benefit to industry under the IEC dispensation. Since there were no indications, at the time of study, to reduce the benefit fraction below 50%, the model sensitivity to exported local content fraction was tested by setting the fraction at 50%, 80% and at 100%. Simulation results showed that the model was very sensitive to the exported local content benefit fraction. With the fraction set at 50%, there was a minimum deterioration in the industry trade balance relative to the 1995 status, before the deficit started to decline. The low local content benefit fraction led to less rebatable imports being generated under the IEC dispensation, hence mitigation against increase in trade deficit in general. It followed that increase in trade deficit, before the decline set in, was more pronounced at 100% benefit fraction compared to 80% (Figure 44).

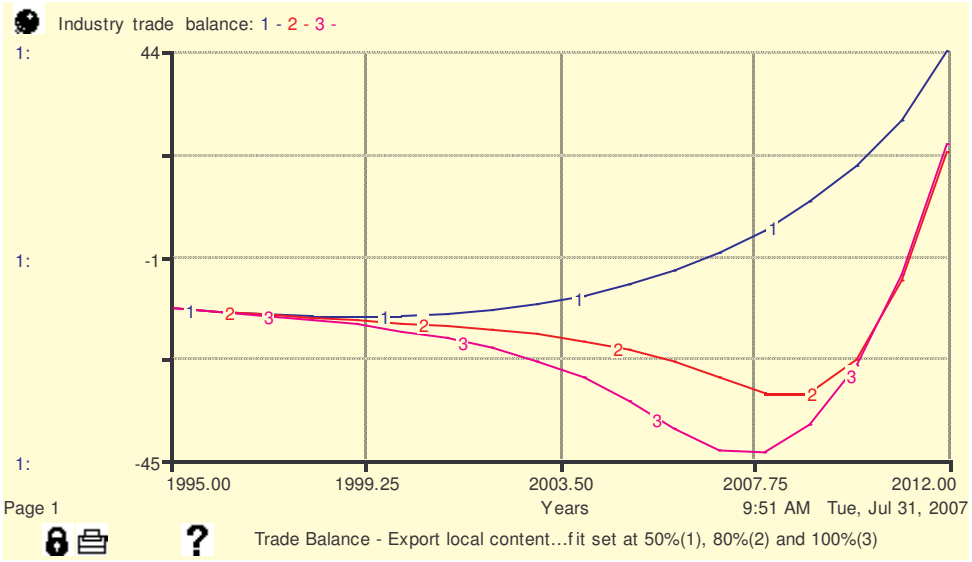

Figure 44: Effect of exported local content benefit fraction on industry trade balance

It is important to note that the analysis above is based on the effect of exported local content benefit fraction on the supply of IRCCs in value terms. An increase in exported local content benefit fraction may also have a 'demand effect' in terms of motivating the industry to export products with higher local content. In order to do so, industry has to increase its local sourcing of products. Local sourcing of products offsets potential imports, hence has a positive effect on the industry trade balance. The opposite results of the supply and demand side effects on the industry trade balance may put into question the soundness of the trade balance trend captured in Figure 44. However, given the limited capacity of the domestic component-manufacturing sector to meet OEM component supply requirements, even if there was intention to increase local sourcing, the increase would not be drastic. As such, it was felt that the effect of change in the exported local content benefit fraction was more likely to increase IRCC supply than increase in local component sourcing. Thus, the contention that Figure 44 was a fair reflection of what would happen if the exported local content benefit fraction were to be changed.

In retrospect and by implication, model simulations pointed to the fact that deteriorating industry trade balance witnessed under the MIDP period could have been minimised by adjusting IEC exported local content benefit fraction. Interpreting model simulation should be done with caution. Simulation results are informative in as far as the overall trade

balance trend is concerned, not on what happened at a specific period. In reality, delays and lags have to be taken into account.

The significance of exported local content fraction could be understood in the context of the value of rebatable imports generated under the IEC dispensation and the effect of rebatable imports on overall industry imports. As noted by Richardson and Pugh (1981, p.324):

> *"It is not enough to know that a particular policy improves model behaviour. The critical question is why. What is needed is a fundamental understanding of why a particular policy improves model behaviour"*,

It was important that the effectiveness of exported local content fraction in influencing industry trade balance be considered and understood. Although both industry and IEC rebatable imports were increasing, the latter was increasing at a faster rate. This could be attributed to the fact that the rate of increase in exports, upon which generation of rebatable imports was based, was higher than industry-import growth rate. The increase in industry rebatable imports was further exacerbated the Precious Group Metal (PGM) dispensation for the catalytic converter sector under which 40% of imported precious metal was being treated as local content when exporting catalytic converters. After 2010, the model projected the value of IEC generated rebatable imports tended to reach 50% of the total industry imports (Figure 45). This 'catch-up' process of IEC rebatable imports with total industry imports was predicted to continue. Therefore, to the extent that imports affected industry trade balance and that rebatable imports had a significant influence on industry imports, a change in exported local content benefit fraction would significantly affect the industry trade balance trend. It should be noted that imports cannot increase in perpetuity. At a particular point in time, import growth will be constrained by the size of the domestic market. This aspect was not explicitly modelled. As such the import growth trend in Figure 45 should be interpreted with caution.

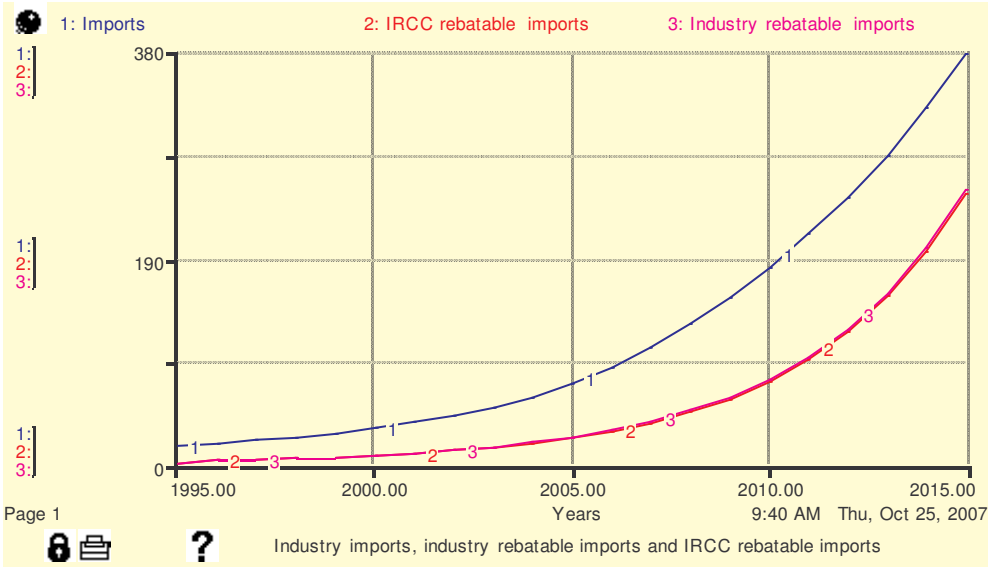

Figure 45: Industry imports, IRCC rebatable imports and industry rebatable imports

8.3 Time-bound constraints of the PAA-IEC incentive dispensation

One of the advantages of system dynamics modelling is that it can reveal time-bound constraints in a particular system. By default, MIDP incentives encouraged imports of automotive products into the country. The expectation was that the enabled exports from the country would be able to offset increase in industry imports. Domestic production would be enhanced rather than crowded out. An important policy question that was not asked was how feasible this assumption was in the medium and long term. An aspect revealed by model simulations was that the offer of incentives in the form of import rebates was not sustainable, given the general industry growth trend in the first 10 years of MIDP incentives. In particular, the domestic market for automotive products had been growing at an annual compound rate of 9% while that of exports, a major source of rebatable imports, was some 27%. Without putting a cap on the value of rebates awardable to industry, the value of rebatable imports had tended towards the value of the domestic market (Figure 46). The motivation to produce locally, for the domestic market, declines as the value of rebatable imports approach levels that can be absorbed by the local market. In the long term, domestic production is likely to stagnate, or decline as industry makes a delicate balance of how much to produce locally given the total value of import rebates received, unless a drastic increase in exports is realised.

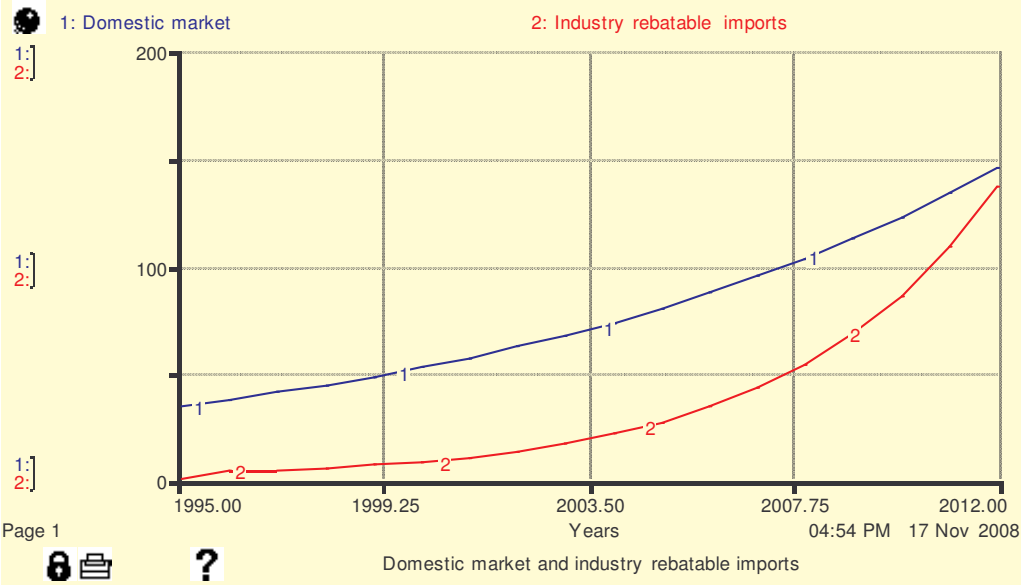

Figure 46: South Africa's domestic automotive market and industry rebatable imports

Import rebates earned over and above import levels that can be absorbed by the domestic market would have no value for industry. In such a situation, industry would be compelled to request that such benefits take a different form, like direct tax deduction on the beneficiary tax account. Model simulation pointed to the fact that the fiscal incentives for the South African automotive industry have a time span in which they could be effective and useful. Over time, however, the incentive model would become self-obliterative and self-defeating in terms of the objectives for which they were intended. Whether the pressure would came from government to limit benefit to industry in terms of the value of rebatable imports, or from industry after realising that it was holding excess rebates, the PAA-IEC model, but primarily the IEC side, would have to be modified.

8.4 Comparison IEC with the PAA incentives

As mentioned in Chapter 1, stakeholders in the industry were concerned that the IEC might be contested under WTO trade regulations. If this were to happen, it would cause serious disruption in automotive business plans in the country and negatively affect investment prospects. As a means of maintaining policy environment stability, there had been suggestions that the possibility of replacing the IEC with increased PAA benefit should be

explored, as the PAA was not contestable, being a supply side incentive. Model simulations showed that this was practically impossible. Even if the PAA benefit fraction were to be increased from the then 20% to 100%, the value of rebatable imports it would generate would be significantly lower than rebates the IEC generates under its current policy rules (Figure 47). If the intention was to give industry equal benefits, replacement of the IEC with increased PAA benefit could not realistically achieve this.

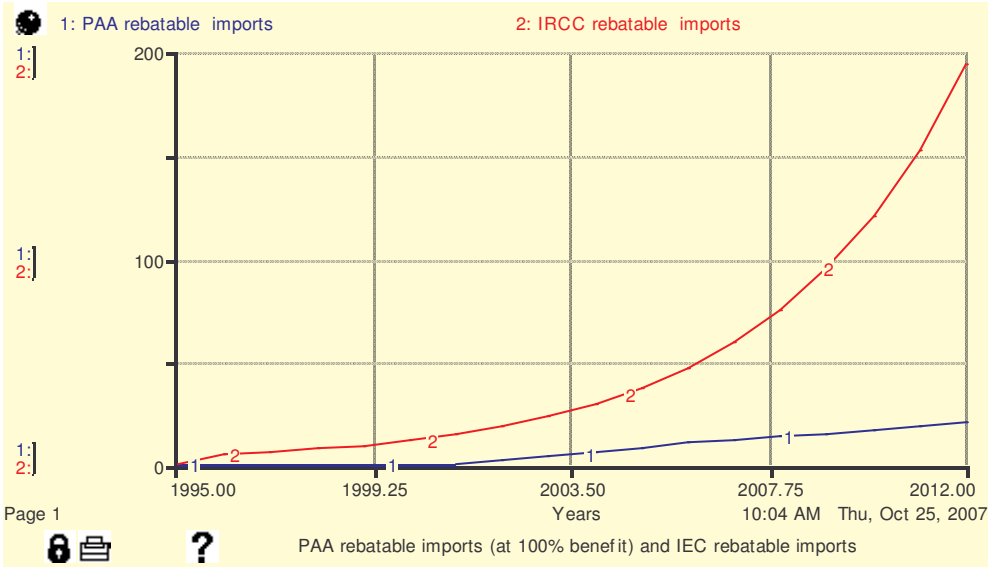

Figure 47: Comparison of PAA rebatable imports (at 100% benefit) and IEC rebatable imports

8.5 Industry performance without the IEC and PAA incentives

An important question to which the model could provide some insight was what would happen to the industry if the PAA and IEC incentives were discontinued. The model captured this situation by disabling effects of rebatable imports to the system. Investment growth faction was lowered due to the high likelihood that investment levels would be less than in situation where the incentives were being given because of the location disadvantages and low economies of scale previously highlighted. In addition, import growth fraction was adjusted upwards, while exports growth fraction was reduced. This was based on the understanding that low investment would negatively affect the country's export potential while increasing the propensity to import at the same time. Without incentives, there was high likelihood that domestic production would decrease, benefit of

economies of scale would be lost, industry competitiveness would be lost and ultimately exports based on industry competitiveness would decline. Simulation of the model under these conditions showed that trade deficit increased to higher levels compared to a situation where industry was receiving IEC and PAA incentives. Moreover, improvement of trade deficit after a while, as realised in Figures 41 and 42 did not take place in the simulation period under consideration. Figure 48 represents the likely trend in industry trade balance in a situation of no IEC-PAA incentives.

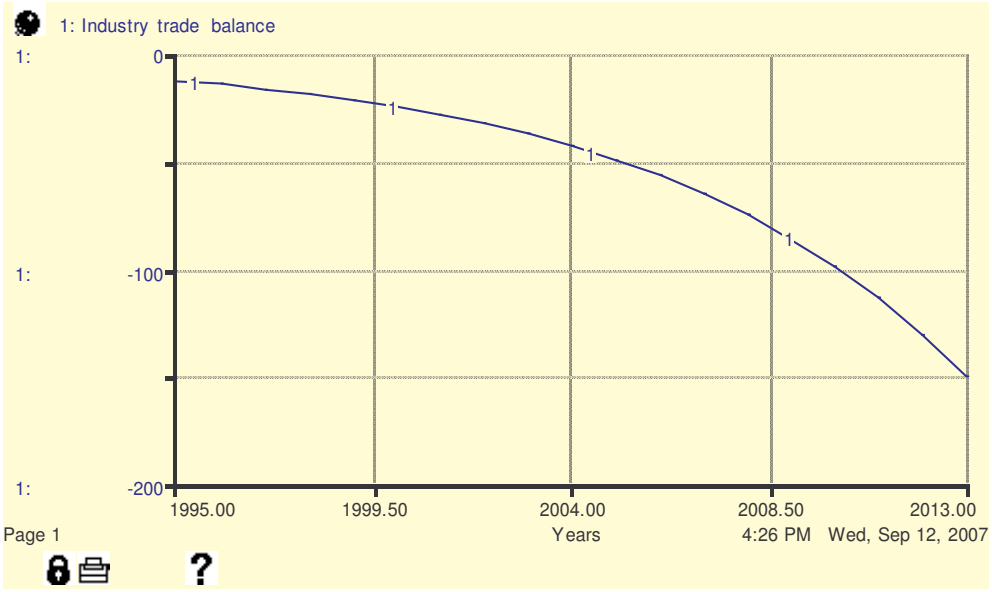

Figure 48: Industry trade balance without IEC-PAA incentives

One could not therefore argue that without the incentives, industry would be in better position as regards its trade balance account. It should be noted, however, that the trade balance trend under the no-incentive scenario was very sensitive to import growth rate fraction. Small changes in import growth rate had a significant impact on industry trade balance.

8.6 Synthesis

The IEC rather than the PAA incentive was the major contributor to the industry trade balance trend. The adjustment of PAA benefit fraction and import duty rate above a particular minimum threshold had little effect on industry trade balance. The IEC, on the

other hand, provided a high leverage policy lever to influence the industry trade balance account. The PAA-IEC model was, however, time constrained. Over time, the benefit it availed to industry tended to lose value, as the value of rebatable imports tended towards that which the domestic market could absorb. In terms of the PAA-IEC model supporting the industry competitive objective, the model had no specific policy lever that could be utilised to direct investment into R&D activities. To the extent that R&D was a prerequisite for long-term competitiveness, the PAA-IEC model in this form was a weak policy framework for supporting long-term industry competitiveness.

9 Conclusions

This chapter presents the conclusions of the study in relation to the research question, the study hypothesis, purpose and the specific objectives. A review of how the study answered the research question and met the study objectives in relation to the hypothesis is presented in section one. Study propositions and contribution to prior knowledge are presented in section two and three respectively. Methodological issues and study limitations are presented in section four. The last section looks at areas of further research.

9.1 Closure of the study

The motivation behind the study was the lack of apparent investment in R&D and the deteriorating automotive industry trade balance realised under the MIDP dispensation that put in question the ability of MIDP incentives to support industry competitiveness in the long term as initially envisaged. The study hypothesised that the PAA, as one of the MIDP incentives, was is a significant contributor to the deterioration of the automotive industry trade balance in South Africa but was potentially an effective incentive to support industry competitiveness. A change in value and structure of the incentive had a potential to reverse the deteriorating trade deficit and support competitiveness. Hence the research question for the study was how a change in the PAA structure would impact on the industry trade balance and competitiveness via increased R&D investment.

To answer the research question and meet the specific objectives of the study, an analysis of industry performance under the MIDP incentives was done. A theoretical exploration of the prospects of the PAA in supporting the industry competitiveness objective based on comparable economies to that of South Africa, with a local automotive industry, was also done. It was found that South Africa's automotive industry performance in terms of the MIDP objectives was mixed. Moreover, the success of the PAA as a competitiveness incentive was dependent on the extent to which the incentive would effectively motivate technological innovation in the country's automotive industry. Theoretical literature indicated that each case of industry offer of competitiveness incentives can only be justified on its own merit. A review of the structure and performance of the PAA indicated the incentive had no direct bearing on R&D investment as a perquisite for long term industry

competitiveness. This position was further supported by the formal model that showed that under the PAA incentive structure, there was no policy lever to direct investment in R&D and that a change in value and structure of the PAA had minimal effect on industry trade balance trend. Ultimately the modelling of the incentive structure disproved the study hypothesis. The PAA was neither a significant contributor to the deterioration of the automotive industry trade balance in South Africa nor a significant incentive to support competitiveness. Changing policy rules relating to the incentive almost had no bearing on industry competitiveness via increased R&D investment, and on industry trade deficit trend. This did not however lessen the importance of the study in respect of the study purpose. From a practical point of view, the study revealed that the trade deficit could be influenced by changing policy parameters pertaining to the IEC but both the IEC and the PAA were not effective incentives to support long term industry competitiveness. The following section presents theoretical contributions and conclusions of the study.

9.2 Theoretical conclusions

The aim of the study was to develop a formal framework for formulating and evaluating an industrial policy intervention aimed at supporting competitiveness. Given that this was an applied study and used a system dynamics model-building methodology, theoretical conclusions arose from the model building process and model simulations.

Proposition 1: Qualitative articulation of competitiveness policy does not sufficiently take into account the systemic interdependencies and feedback effects within the industry that have a bearing on intended outcomes.

The study showed a tendency to match directly intended outcomes to policy inputs without taking into account the effect of internal interdependencies and dynamics at play in the space between policy inputs and outcomes. This policy articulation gap is presented by Figure 49.

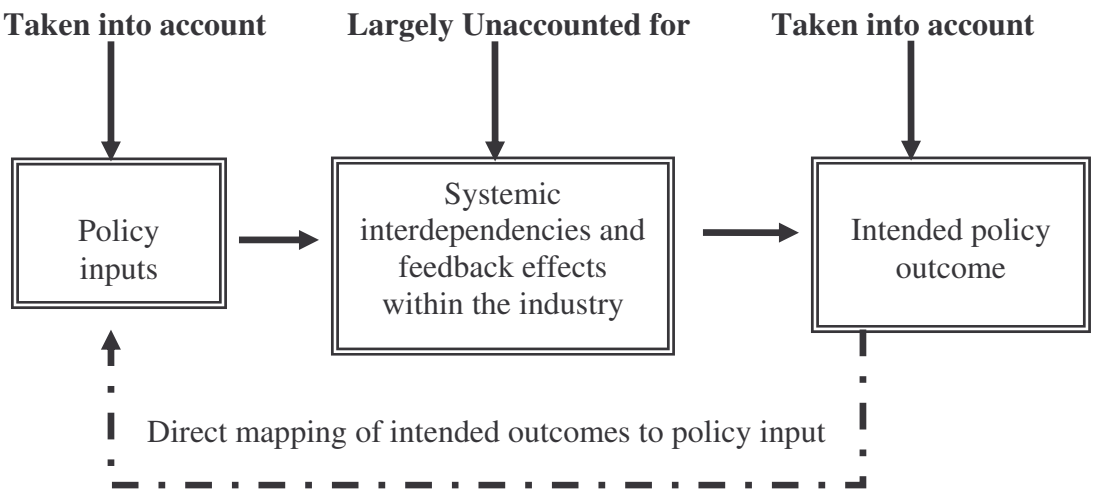

Figure 49: Competitiveness policy articulation gap

Addressing divergence between the intended and realised policy outcomes had always taken the form of revisiting policy input, in the case of MIDP industry incentives, with limited ability to interrogate how the systemic factors within the industry setup could be influencing the intervention. Because of this, some outcomes had come as a surprise to policy makers, yet these could have been anticipated. Specific to this study, the surprise outcome of policy intervention had been the deteriorating industry balance, which can be indicative of industry competitiveness loss in the long term.

There is a general lack of research on how systemic processes within policy frameworks relate to policy interventions, yet understanding systemic influences in any complex system is critical in finding out why well-intentioned policy interventions end up yielding undesired consequences or less than expected outcomes. This study contributes towards filling this knowledge gap by incorporating systemic interdependencies and feedback effects in South Africa's automotive competitiveness policy articulation.

Proposition 2: System dynamics modelling of a policy model can reveal time-bound policy constraints that are implicit to a model structure.

The capturing of feedback effects within a system is one of the fundamental elements of system dynamics modelling. Its importance in policy modelling is fairly well researched and documented. The same applies to using system dynamic modelling to identify high

leverage policy variables in a model. What is less researched and less documented is the role of system dynamics modelling in identifying time-bound constraints of policy models. This is critically important in applied policy research. Implicit to most policy model are time-bound constraints, which can be resources constraints or performance convergence to untenable positions. The study showed that in an effort to support industry competitiveness through the offer of investment and export-based rebate allowances, the value of rebatable imports becomes a bigger percentage of the domestic market size. At the extreme, the two can equate. Unless the loss of domestic market share of locally produced products to imports is compensated for by increase in exports, domestic production, for the local market, will be crowded out. The objective of making the local industry competitive as a means of supporting increased domestic production will be completely lost. Of course, this extreme situation cannot happen in practice, but the above analysis points to the fact that at a particular point in time, the PAA-IEC industry support model will have to be modified or changed because of industry convergence to an undesirable state. Not withstanding limitations of use of growth rates in some stocks extrapolations, the study contributes towards adding to the stock of knowledge on the usefulness of system dynamics modelling in terms of exploring the time span under which policy interventions may be useful and identifying internal model constraints that may make a particular policy model obsolete.

Proposition 3: A generic investment and/or export based incentive model does not provide effective policy levers to guide industry to a long-term competitiveness path. At best, it serves as an indirect motivation to invest and export.

Formalisation of existing policy frameworks, often based on intuition, into system dynamics models, as a means of getting better understanding and improving such models, is an area that has not yet received much attention in developing countries. The endogenous approach to policy modelling of system dynamics methodology points to the fact that one has to look for internal factors driving a particular behaviour. In order to influence behaviour, one must have the means to identify model variables that influence behaviour and adjust them accordingly. Existing literature has tended to assume that within a particular model, there will always be such high leverage policy variables. This study shows that there are situations in which a well-intentioned and consensus-based model may

fail to have an internal policy lever to influence its ultimate objective. At best, the model may only influence the objective by proxy. The study found sufficient evidence that R&D investment, as a prerequisite for long-term industry competitiveness, had not been taking place, despite the offer of industry incentives. Most importantly, the formal model revealed that that there was no specific policy lever to directly influence industry investment in R&D activities and innovation, hence to influence competitiveness (Lim, 1994, p.834; Wint, 1998, p.281; Frankema & Lindblad, 2006, p.316).

9.3 Contribution to prior knowledge

The main contribution of this study stems from its combination of economic theory on investment, industrial and science policy. Although offer of investment incentives is widely studied in economics as a form of market-correction intervention in case of externalities (Brewer & Young, 1997, p.177; Dupasquier & Osakwe, 2005, p.244; Bwalya, 2006, p.514), a theoretical framework that links the externality concept with competitiveness does not exist. Competitiveness is considered as a separate macro-economic concept relevant to industrial policy.

This study explores the theoretical link between investment, externalities, investment incentives and industry competitiveness. Most studies do not consider the competitiveness element in the investment-investment incentive conundrum. Notwithstanding the ambiguous relationship between investment incentives and investment as proposed by Hall & Jorgenson (1967, p.391) and Hayashi (1982, p.214), theoretical literature rationalises the offer of investment incentives as a means of correcting market imperfections created by investment externalities. In other words, the intention of investment incentives is seen as a means to remove the market distortion created by investment externalities and to ensure that potential investors do not under-invest. The basic assumption of this conventional literature, that the rationale for offer of investment incentives is the existence of investment externalities and hence the need for market correction, is not entirely true or complete. Many countries or entities offer investment incentives, not because there are externalities attributable to investment, but rather to influence the investment externality. Contrary to the proposition that investment incentives are offered, in part, to correct market failure in

investment decision-making, the incentives are often intended to influence the investment decisions to the extent that they serve particular objectives. More often than not, the intention is not to correct market imperfection but rather to make markets imperfect in the theoretical sense to meet the political-economic objectives of a country.

The study contributes to establishing a coherent conceptual framework to answer the question of how to offer investment incentives. It also brings out the dimension of incentives as a means to influence investment externalities rather than the conventional approach to such incentives as a means of compensating for investment externalities.

9.4 Methodological considerations and study limitations

Given the nature of the study, methodological considerations and study limitations were interlinked. Study limitations highlighted below had largely to do with the application of the system dynamics modelling protocol.

9.4.1 Choice of model boundary

In system dynamics modelling, the choice of model boundary can be a source of model weakness. The choice of what variables to include and what variables to exclude, depends on factors that the modeller considers important in influencing the model under study internally. This is a subjective process. System dynamics modelling does not provide a specific test or rule of the thumb to determine model boundary adequacy. The onus is on the modeller to use all information available when deciding what variables to be considered endogenous or external to a model. In this regard, the choice of the model boundary for the PAA-IEC model can, therefore, be a potential weakness of the study since it was subjectively done. It should be noted, however, that model boundary decision is a more risky area when it comes to developing hypothetical models. Since this study was on formalisation of an existing policy framework into a system dynamics model, the choice of model boundary was not so contentious. Only the choice of growth rate fractions for the exogenously assumed normal industry investment and export that can be contested, but again, these rates were based on historical data.

There was adequate documentation on how the model worked to allow identification of cause and effect relationships in the situation under study. However, since the model was extended to include feedback effects, which were not explicit in the available information potential model weakness based on boundary choice could not be ruled out completely. Model assumption on the impact of rebatable imports and domestic market on the import growth fraction being an example. Although based on a logical argument, that increase in value of rebatable imports relative to the domestic market would have a positive impact import growth fraction, the weights used could be contested.

9.4.2 Level of model aggregation

Even after establishing model boundary adequacy, the level of model aggregation can be a contentious aspect in system dynamics modelling. The fundamental question here is whether aggregation or disaggregating fundamentally affects model performance and can lead to different conclusions. Specific to this study was the question whether all investment should be taken as homogeneous in the modelling process. As stated previously, the nature of investment that qualifies for the PAA takes the form of land and buildings, plant and machinery, and capitalised research and development expenditure. The model did not disaggregate industry investment by category; as such, one can argue that by not doing so, some dynamics emanating from the different categories of investment could have been omitted. One will have to consider, then, whether the resultant complexity of model disaggregating would be worth the effort in terms of the study objective. This is one of the areas proposed for further study.

9.4.3 Study timing

The study was undertaken in the period when government was reviewing the overall performance of industry incentives**.** As could be expected, it was in the interest of the local industry that the offer of incentives would be continued. Information collected during the period could have been biased towards elevating the importance of incentives to industry performance. There was the possibility that industry stakeholders, excluding government,

could have dwelled more on external rather than internal influences in articulating what was influencing industry performance during the period of data collection. There was also a risk that some internal factors that were instrumental in understanding internal industry dynamics could have been deliberately omitted. The use of both qualitative and quantitative data could have mitigated against this, but only partly.

In summary, like any other research project, the study had limitations emanating from the methodological approach used, timing and researcher bias, but these were deemed not significant enough to fundamentally change the contribution of the study to the research problem.

9.5 Areas for further research

One area of further study recommended is the explicit introduction of the disaggregated Cobb-Douglas production function (Frank, 2000, p.296) in the PAA-IEC model. That is, defining output as dependent on capital and labour and thereafter accounting for increase in capital and labour productivity as industry investment increases. Investment could be disaggregated to reflect the different categories like plant, machinery and equipment and R&D expenditure. This will automatically bring into consideration the nature of investment taking place and the role of technology and innovation on the production function and how such effects permeate into overall industry behaviour. Explicit inclusion of labour productivity and employment dynamics will allow the new model to make pronouncements on social objectives from the intervention; a major issue of concern to government and an important determinant for the continued offer of industry incentives.

It may also be useful to explore how the return on investment concept fits into the investment-investment incentives theoretical framework used in this study. One would have assumed that the PAA would have bigger influence on overall industry dynamics via its direct and positive contribution to return on investment being undertaken in the industry. According to the study, this seems not to be the case.

Last, given the degree of importance that the industry and experts attach to the exchange rate, as an explanatory factor for changes in imports and exports, it would be useful to explore how this theoretical assumption applies to the South Africa's automotive. Exchange rate movements have a potential to influence industry exports and imports in nominal value terms, but more important can affect the demand for imports and exports. These issues were outside the scope of this study but could be useful in understanding the future trend of the industry trade balance.