A Dynamic General Equilibrium Model for Malaysia: Macroeconomic Effects of A Reduction in Motor Vehicle Tariff

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Abstract— This paper examines the economic effects of a cut in motor vehicle tariffs in Malaysia using a dynamic computable general equilibrium (CGE) modelling approach. The macroeconomic results indicate that with the government balancing the loss in tariff revenue through increased labour taxes, there would be a small welfare gain measured by the increase in aggregate consumption. In the short run, export-oriented industries do not gain despite real devaluation, but gain in the long-run. There are only small changes in average real wages and employment. Damped labour supply effects are found in both the short and the long-run.

Keywords—Dynamic CGE model, macroeconomic effects, Malaysia, tariffs.

I. INTRODUCTION

TRADE liberalization considerably alters the policy environment of a country; for example, the labour market. Consequently, an appropriate measurement of the effects of such a policy requires a comprehensive framework to investigate the interaction between the different economic agents in the market. A dynamic computable general equilibrium (CGE) model for the Malaysian labour market, MyAGE_LM is used to analyze the effects of a reduction in motor vehicle tariffs. A dynamic CGE model provides a strong foundation for investigating the short and long run effects of trade on Malaysia's labour market. This is because CGE models have computational rigour and extensive analytical capabilities. This study contributes to existing literature by using a dynamic computable general equilibrium (CGE) framework for Malaysia with the introduction of labour supply adapted from the labour market specification of [2] to analyze the short and long run macroeconomic effects of a motor vehicle tariff reduction. To the best of my knowledge, this is the first study using a dynamic CGE model to investigate the macroeconomic effects of a motor vehicle tariff cut in Malaysia. Section II +discusses results from the tariff cut simulation for macro variables. Concluding remarks are in Section III.

II. DESCRIPTION OF TARIFF CUT POLICY SIMULATION

The policy simulation carried out in the MyAGE_LM model aims to produce a set of results that demonstrates the impact of a proposed tariff cut policy on the Malaysian economy over a period of time. Results are calculated as percentage deviations from the baseline, i.e., what otherwise would have happened had the policy not been implemented. The policy simulation is carried out as a reduction in import tariff in the motor vehicle industry in Malaysia with the introduction of a wage sensitive labour supply function. In the policy simulation, the import tariff is cut by 50 per cent in the motor vehicle industry. The 50 per cent cut in the tariff rate reduces the landed duty paid price by 5.117 per cent. In explaining the simulation results in detail, a back of the envelope (BOTE) model adopted from [2] is used. The BOTE model is a very useful tool to support the interpretation of macro results in the MyAGE_LM simulations. The BOTE calculations are important in the development, understanding and application of MyAGE_LM.

A. BOTE Equations

In the BOTE model, the Malaysian economy is assumed to produce one good (rice) and import one good (motor vehicle). The production of rice is assumed to be via a constant-return-to-scale (CRS) production function of capital and labour inputs. It is also assumed that rice and motor vehicles are both consumption and investment goods. The units of consumption and investment are formed as Cobb-Douglas production functions. In addition, it is assumed that the costs per-unit of employing capital and labour are equal to the values to the employer of their marginal products given in (1) and (2):

$$MPL\left(\frac{K}{L}\right) = W^{Real}.TL.\left(\frac{P_v}{P_r}\right)^{\alpha_{vc}}.T_c \qquad (1)$$

$$MPK\left(\frac{K}{L}\right) = R.\left(\frac{P_v}{P_r}\right)^{\alpha_{vi}}.T_i \qquad (2)$$

$$T_c = T_{rc}{}^{\alpha_{rc}}.T_{vc}{}^{\alpha_{vc}} \; ; \; T_i = T_{ri}{}^{\alpha_{ri}}.T_{vi}{}^{\alpha_{vi}} \qquad (3)$$

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where *MPL* and *MPK* are the marginal products of labour and capital, T_c and T_i are the average powers of the taxes on consumption and investment, T_{rc}, T_{vc}, T_{ri} and T_{vi} are the powers (one plus the tax rate) of the taxes (including tariffs) that apply to consumption purchasers of rice and motor vehicles and the investment purchasers of rice and motor vehicles; Q and W^{Post} are the factor payments, where Q is the rental rate and W^{Post} is the post- tax real wage, W^{Real} is the post-tax real wage rate; *TL* is labour income tax, *R* is the rate of return on capital, which equals the rental price of capital divided by the asset price for a unit of capital, and α's are positive parameters that reflect the shares of rice and motor vehicle consumption and investment, where $\alpha_{rc} + \alpha_{vc} = 1$ and $\alpha_{ri} + \alpha_{vi} = 1$.

B. Short Run Results for 2010

Figs. 1 to 5 show the policy impacts on macroeconomic variables in Malaysia. In each case, impacts are expressed as percentage deviations from the basecase forecasts. From (1) and (2), the marginal products of capital and labour are both functions of the *K/L* ratio. *MPL* is an increasing function of K/L while MPK is a decreasing function of *K/L*. In MyAGE_LM, the government replaces the loss in tariff revenue from a cut in the motor vehicle tariff rate by increasing the labour income tax[1]. In terms of the BOTE model, this has the effect of increasing *TL* and decreasing the average power of the tax on consumption goods, T_c (which includes tariffs).

Looking at the terms of trade in (2); the export price of rice relative to the c.i.f price of motor vehicles is given by the term P_r / P_v. In the MyAGE_LM model, Malaysia is treated as a small country on the import side, that is, c.i.f. import prices in foreign currency are assumed to be exogenous.

In the short run, W^{Real} in (2) is sticky. That is, it will adjust slowly to eliminate the deviations between the policy and the basecase forecast level of employment. In the short run, W^{Real} declines by only 0.005 per cent. With little movement in W^{Real} and in the terms of trade, it can be seen that the dominant effect on the right hand side of (2) is the increase in $TL*T_c$. This increases the marginal product of labour, and consequently *K/L* will increase. Since *K* adjusts slowly, in order for *K/L* to increase in the short run, the demand for labour, *L* has to decrease. This is shown in Fig. 1, where aggregate employment moves below control in the year 2010, which is the year of the tariff cut.

1. GDP and Efficiency Triangle

Table 1 shows real GDP decreasing by 0.019 per cent. Given that employment decreases by 0.1 per cent, GDP is expected to decrease by 0.03 per cent (the labour share of GDP times the percentage in employment, 0.3*(-0.1)). Part of the additional gain in GDP (0.011 per cent) is provided by the efficiency effect, given in the following equation:

$$\text{Efficiency area} = \frac{1}{2}\left[\left(P_{MV}^I - 1\right) + \left(P_{MV}^F - 1\right)\right] * \left[M_{MV}^F - M_{MV}^I\right] \quad (4)$$

where P_{MV}^I is the initial power of tariff for motor vehicle in the basecase forecast period, P_{MV}^F is the final power of tax after the 50 per cent cut in the power, M_{MV}^I is the quantity of imports of motor vehicles in the base year, 2010, measured by the c.i.f value, and M_{MV}^F is the final quantity of imports of motor vehicles in 2010 in the policy calculated from M_{MV}^I and the percentage change motor vehicle imports. Given the prices and quantities of P_{MV}^I, P_{MV}^F, M_{MV}^I and M_{MV}^F, the right-hand-side of (4) gives RM44.52 billion, or 0.01 per cent of GDP. This value is close to the additional gain in GDP of 0.011 per cent indicated above.

2. Aggregate Investment

Investment is a function of the rate of return, *R*. An increase in the expected rate of returns on capital increases investment. In the MyAGE_LM simulation results, investment increases by 0.037 per cent in the short run. This indicates R has to increase for investment to increase. From (2) in the BOTE model, *K/L* increases in the short run because employment declines, and this decreases *MPK*. With little movement in in the terms of trade, for an increase in *R* (hence investment), the dominant effect on the right hand side of (2) is the decrease in T_i (around 90 per cent of imported motor vehicles are used in investment). In the simulation for MyAGE_LM, R increases in the short run, and as seen from Fig. 2, K edges upwards.

With little movements in W^{Real} and in the terms of trade, the dominant effect on the right hand side of (1) is the increase in $TL*T_c$. This increases the marginal product of labour, and consequently increases *K/L*. Since *K* adjusts slowly, in order for *K/L* to increase in the short run, the demand for labour, *L* has to decrease.

In addition, from Fig. 1, it can also be seen that the effect of the decrease in tariff in the motor vehicle had very little effect on total labour supply in the economy (total labour supply decreases only 0.005 per cent in the short run), where the graph shows movements in labour supply being very damped.

3. Increase in Household Consumption

From Fig.3, a positive deviation in aggregate consumption per cent) is observed, even though real GDP decreases. Aggregate consumption is tied down by household disposable

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[1] This differs to the simulation by [1], where the authors replaced the loss in tariff revenue by increasing a broad based consumption tax, whereas this policy simulation increases labour income tax.

income, which consists of GDP less tax revenue plus transfers. The equation showing the relationship between consumption and household disposable income is as follows:

$$\frac{C}{CPI} = APC * \frac{HDY}{PGDP} * \frac{PGDP}{CPI} \quad (5)$$

where C is aggregate consumption, APC is the average propensity to consume, HDY is household disposable income PGDP is the GDP price deflator, and CPI is the consumer price index. By converting into percentage form, (5) becomes:

$$(c - cpi) = apc + (hdy - pgdp) + (pgdp - cpi) \quad (6)$$

where c, cpi, apc, hdy and $pgdp$ are the percentage changes in real household consumption, consumer price index, average propensity to consume, household disposable income and GDP price index respectively. Substituting percentage change of these values into the terms on the right hand side of (6) gives the value of $c = 0.063$ per cent, which is the same as the value in the simulation results. This can be explained by the increase in the GDP price deflator, relative to the consumer price index.

4. Balance of Trade Deficit

Aggregate consumption and investment are around 46 per cent and 20 per cent of GDP respectively. As stated above, in the short run, the decrease in motor vehicle tariff increases consumption by 0.063 per cent and investment by 0.37 per cent. The contribution of increases in C and I is 0.11 per cent of GDP [(0.46*0.063) + (0.2*0.37)]. With GDP decreasing (Fig 4) and government spending fixed, the increase in $C+I$ must result in the real trade balance moving towards a deficit.

In the tariff cut simulation, aggregate imports increases by 0.12 per cent but exports decrease by 0.03. The decrease in exports increases the export price index by 0.2 per cent and causes the terms of trade to increase. Looking at Fig.5, a small positive deviation in the terms of trade (0.05 per cent) is observed. The negative deviation in aggregate exports from Fig. 4 in the short run is another unexpected result. With a positive deviation in real devaluation in the short run (0.125 per cent), a boost in exports is expected.

5. Decrease in Aggregate Exports with Real Devaluation

A possible reason for the decrease in aggregate exports is that the cut in motor vehicle tariffs increases the cost of exports, such that the benefit of a real exchange rate devaluation is outweighed by higher export cost. We calculate real depreciation based on the following equation:

$$REALDEP = \frac{P_M^* / \Phi}{P} = \frac{P_M}{P} \quad (7)$$

where $REALDEP$ is the real exchange rate, Φ is the nominal exchange rate, defined as F/RM, with RM being the

Malaysian currency, P_M^* and P_M are the price of imports in foreign and domestic currency respectively, and P is the domestic price level represented by the GDP deflator. Converting (7) into percentage change gives:

$$p0realdev = p0cif\_c - p0gdpexp \quad (8)$$

where $p0realdev$ is the percentage real devaluation, $p0gdpexp$ is the percentage change in the GDP deflator, and $p0cif\_c$ is the percentage change in the c.i.f import price index in RM. In equation (8), $p0cif\_c$ is a proxy for the rate of inflation in foreign countries adjusted by the exchange rate and $p0gdpexp$ is a proxy for inflation in the cost of producing exports in Malaysia. It turns out that in the MyAGE_LM simulation of a motor vehicle tariff cut, $p0gdpexp$ does not represent accurately what happens to the cost of producing exports. A cut in import tariffs is a cut in indirect taxes. The effect of a motor vehicle tariff cut on production of any commodity (apart from motor vehicles) depends on the extent to which motor vehicles are used as an input to the production of the commodity compared with the labour input. The cost of motor vehicles goes down, but the cost of labour goes up. For Malaysia, motor vehicles are a very small part of the inputs to export production. Thus, the cost of exports for Malaysia goes up relative to the cost of producing goods in general, that is, the export price index rises relative to the GDP deflator. This means that $p0realdev$ as defined in (8) overstates the competitive improvement for exporters associated with a cut in motor vehicle tariffs.

C. Long Run Results for 2021

From (2), in the long run, the rate of return on capital, R goes back to the baseline. Investors are willing to invest more in industry i in response to increases in i's expected return. However, they are cautious. In any given year, the capital supply functions limit the growth in industry i's capital stock such that disturbances in industry i's rate of return are eliminated gradually. If the expected rate of return in industry i in year t in the policy run is higher than that in the basecase, then capital growth in industry i will be higher in the policy run than in the basecase; investors will supply capital at a level above the level required to generate capital growth at the basecase rate. This will make capital stock abundant and the K/L ratio will rise with an associated decrease in MPK. In this way, expected rates of return in the policy run are forced back to their basecase path. A similar story operates in the opposite direction if the policy shock initially reduces the expected rate of return in industry i. Then the consequent slowdown in investment in industry i eventually returns the expected rate of return to its basecase path.

The next term on the right hand side of (2) is $\left(\dfrac{P_v}{P_r}\right)$. This is the reciprocal of the terms of trade. With Malaysia being a small country (high export demand elasticities and exogenous c.i.f import price), a cut in motor vehicle tariffs has little effect

on the terms of trade. Thus, with *R* unaffected in the long run by the cut in motor vehicle tariffs, and $\left(\dfrac{P_v}{P_r} \right)$ little affected, the dominant movement on the right hand side of (2) is the decrease in T_i (average power of the tax on investment). T_i falls quite sharply because imported motor vehicles are a higher proportion in investment than domestic vehicles; 89.37 per cent of imported motor vehicles are used in investment and account for 5.4 per cent of the total cost of investment. With T_i decreasing in the long run, *MPK* has to decrease. In the long run, aggregate employment, *L* returns to control facilitated by the decrease in W^{Real}. Therefore, for *MPK* to decrease, the capital stock, *K* has to increase. This is shown in Fig.2, where there is a positive deviation in *K* in the long run.

Also, in the long run, the balance of trade tends towards surplus when investment is falling. With falling investment, this weakens the real exchange rate (Fig.5), which boosts exports relative to imports (Fig.4). The balance of trade tends towards surplus. In addition, there is also a positive deviation in both GDP and aggregate consumption in the long run.

In the long run, the deviation in aggregate consumption is 0.11 per cent. The factors that contribute to the positive deviation in consumption are as follows:

(i) Efficiency Gain: The efficiency gain in the long run is re-calculated using (3) to give a gain of RM107.41 billion. This efficiency gain translates into a consumption increase of around 0.02 per cent.

(ii) Terms of Trade Loss: In the long run, the terms of trade decreases by 0.005 per cent. In basecase data for 2021, the share of exports in GDP is 87.29 per cent and the share of imports in GDP is 78.13 per cent. A terms-of-trade decline of 0.005 per cent is equivalent to a loss in GDP of 0.041 per cent. With household consumption representing 53.2 per cent of GDP, this translates into a loss of real consumption of 0.077 per cent.

(iii) Budget effect: After the initial increase in labour taxes in the policy year; 2010, the deviation of the labour tax rate from its basecase forecast is kept at 8.656 per cent for the rest of the simulation period. In only the policy year, the increase in labour taxes balances the loss in tariff revenue from the tariff cut. With the labour tax rate kept constant throughout the simulation period, total government revenue collected from personal income tax is not enough to balance the budget deficit from the tariff revenue loss. This benefits the household and gives a little bit of a tax break from having to pay higher taxes, enabling them to increase consumption. The change in the ratio of government deficit to GDP is 0.00045. This is translated into an increase of 0.0846 per cent in consumption.

(iv) Devaluation effect: Malaysian household owns assets in foreign currency. In 2021, the baseline assets in foreign (F$)1859562.88 million and households earn 7 per cent on those assets. Also, in the long run, the cut in motor vehicle tariffs caused the exchange rate to be 0.22 per cent lower than it otherwise would have been. On the baseline assets, this increases interest in Malaysian currency by 0.22 per cent. This is worth (F$) 286.37 million, and is available for consumption. This translates into a 0.0435 per cent increase in consumption.

(v) Extra Savings: The MyAGE_LM results show that Malaysia saves an extra RM5659.1 million throughout the simulation period up to the long run. This is shown as the sum of the change in household saving from 2010 to 2021. In 2021, this earns around RM396.14 million. Translating this into a percentage change in consumption gives 0.06 per cent

Adding up the contributions of all the factors above give a total contribution to consumption of 0.0117 per cent. This value is very close to the long run value of household consumption in the MyAGE_LM simulation results. It can be seen that the main contributor to the increase in household consumption in the long run comes from the extra savings of 0.006 per cent.

Table 1 provides a summary of the short and long- run macro results of the tariff cut.

TABLE I
MACRO EFFECTS OF REMOVING MOTOR VEHICLE TARIFFS: MYAGE_LM RESULTS

| Variable	Percentage Changes	
	Short Run 50%	Long Run 50%
Employment	-0.105	0.0274
Total labour supply	-0.005	0.0015
Average post tax real wage	-0.051	0.018
Real GDP	-0.019	0.142
Real GNE	0.130	0.149
Capital stock, rental weights	-0.002	0.260
Real investment	0.371	0.300
Household consumption	0.063	0.113
Export volumes	-0.030	0.295
Import volumes	0.127	0.300
Capital rental	0.146	-0.040
Investment price index	-0.06	-0.088
Export price index	0.201	0.173
Import price index	0.196	0.22
GDP price deflator	0.070	-0.004
Government price index	0.312	0.128
Consumer price index	0	0
Real exchange rate	0.125	0.227
Trems of trade	0.005	-0.050
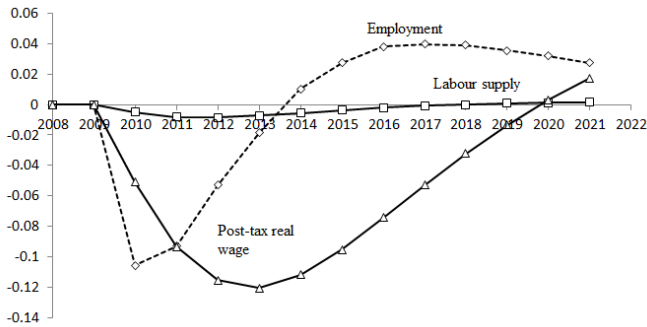
Fig. 1   Aggregate Employment, Labour Supply and Post-Tax Real Wages (% Deviation from Basecase Forecasts)
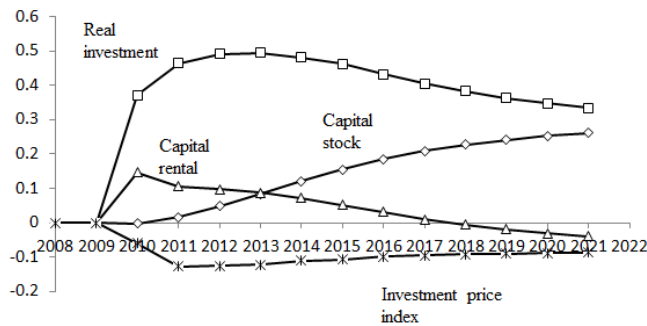

Fig. 2   Aggregate Capital, Investment, Capital Returns and AssetPrice for a Unit of Capital (% Deviation from BasecaseForecasts)
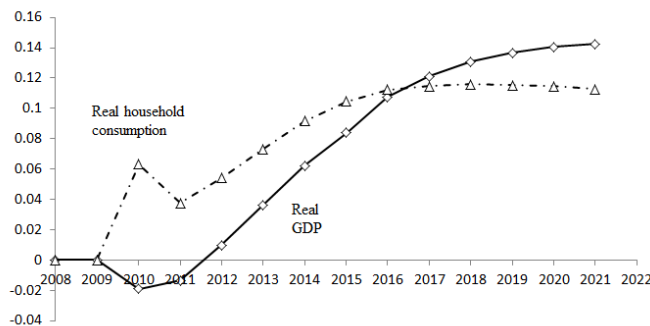

Fig. 3   Aggregate Real GDP and Real Household Consumption (% Deviation from Basecase Forecasts)
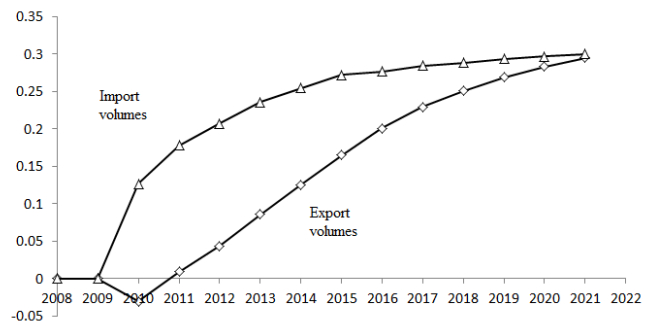

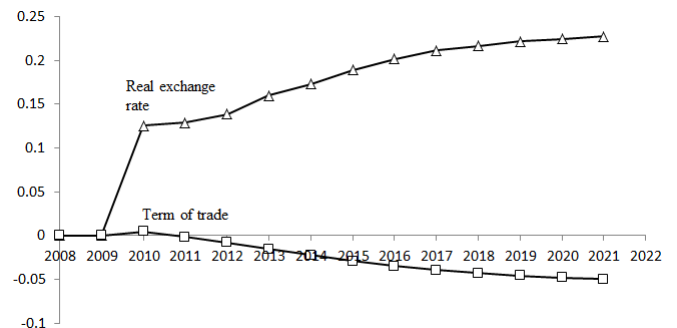Fig. 4   Aggregate Exports and Import Volume (% Deviation from Basecase Forecasts)

Fig. 5   Real Devaluation and Terms of Trade (% Deviation from Basecase Forecasts)

III.   CONCLUSION

The macroeconomic results of a 50 per cent tariff cut in Malaysia's motor vehicle industry indicate that with the government balancing the loss in tariff revenue through increased labour taxes, there would be a small welfare gain measured by the increase in aggregate consumption. In the short run, export-oriented industries do not gain despite real devaluation, but in the long run, these sectors gain. An important part of the analyis in this study is the use of a BOTE model. The BOTE model in Section II is a powerful tool used to analyze and justify the MyAGE_LM simulations results, especially at the macro level. It provides additional theoretical insights into the policy simulation.

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